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A GIS-based analysis of Solar Power Plant Investment potentials in Indonesia: A decarbonised electrical supply vision to 2040

A)Introduction

The aim of this study is to analyze potential solar plant investments in Indonesia in line with its national energy transition. The study has three main research questions namely:

1. **What is the projected electricity demand for Indonesia by 2040, and how much solar capacity will be provided by new solar power plants?**
2. **What is the solar energy development strategies?**
3. **What is the economic viability of the solar investments**

Indonesia has set forward ambitious targets in terms of its renewable energy futures. President Prabowo Subianto famously declared plans for Indonesia to achieve net zero emissions by 2050, 10 years ahead of schedule. Traditionally steeped in coal use, this energy transition aims to phase out fossil fuels and expand renewables capacity. According to (Yutsika, M., 2024), upto 146 billion USD investments may be required for Indonesia to meet its 2030 targets.

The objective of this study is to perform a holistic analysis from demand projection, to site suitability analysis for solar PV plant installation and ultimately financial assessment of the projects viability. The end goal is to develop a strategy for solar development that the Indonesian government can use as a road map for its energy transition.

B) Literature review

Several studies have attempted GIS based approaches to determining optimal locations for Solar PV installations. The process typically involves a multi-criteria decision making (MCDM) analysis by establishing the suitability indices for the different criteria which are then combined to form a single suitability index using the Analytic hierarchical process (AHP) as developed by Saaty and Vargas.

According to (Ruiz et al., 2020), the AHP process is somewhat subjective and depends on the objectives of the research. The study mentions that while all the relevant criteria data from online public domains forms the base framework for any GIS-AHP MCDA model regardless of the location, only locally available data from relevant stakeholders would provide the implications of choosing one MCDM-AHP approach over another.

The factors determining optimal sites can be categorized as climatic, topographic and proximity factors. The most obvious and important is the climatic factor of solar surface radiation downwards (SSRD) also known as global horizontal irradiance. According to (Yang, et al., 2019); (Doorga, J.R et al., 2019, SSRD is the most important criteria in determining site suitability for solar PV sites especially when an entire country is being analyzed. Another important climatic factor affecting site suitability is temperature. (Doorga, J.R et al., 2019) state, the efficiency of state-of-the-art PV systems increases for temperatures lower than 25 ◦C, but at higher temperatures, every 1 ◦C rise leads to a decrease in the power output of 0.4%-0.5%.

Of the topographical factors, elevation and slope have been found to be the most crucial factors. (Ruiz et al., 2020) found to mitigate expenditure from construction of solar PV sites in high elevated and steep slope areas, the most the most suitable regions are below 90 m in elevation, with flat or mild slopes (< 9%) – this study was specific to the West Kalimantan province of Indonesia.

Some studies emphasize other factors. For example, (Sánchez-Lozano, et al., 2013) found a higher weighting attribution for grid proximity in Cartagena-Spain. Larger distances from a solar PV site to the existing grid infrastructure result in increased investments in associated infrastructure (transmission lines), transportation costs and right of way compensations (Majumdar, D., et al., 2019). The same applies to large distances to d

Further, proximity to roads is crucial in assessing suitability of a site as it determines logistics constraints such as accessibility. However, as determined by (Ruiz et al., 2020), the location of the grid and transmission lines often collides with road infrastructure which can then lose relevance as a criterion.

The last criteria having analyzed the three broad categories is the land use constraint factor. Not all land is available for utilization in solar PV development and care must be taken not to infringe on protected zones, agricultural lands, forested areas, wildlife habitats or regions of cultural significance.

C) Methodology and Data

Methodology outline

The analysis is carried out in the following steps:

1) A country snapshot is obtained to establish the capacity of existing, in construction, and planned renewable projects in Indonesia.
2) From the literature, a projection is made of Indonesia's national electricity demand in 2040.
3) From the projected electricity demand, the capacity of new solar plants required is determined based on assumptions of capacity factors of different energy sources and national energy generation targets of the Indonesian government.
4) A site suitability analysis is carried out including:
    a. Visualizating spatial distribution of the individual criteria.
    b. Multicriteria decision making utilizing analytic hierarchical process (AHP)
    c. Identification the number of solar sites required to meet the installed capacity required, their optimal locations and length of transmission lines required for grid connections
5) Finally, a financial analysis is carried out to establish the economic viability.

Country snapshot

A current snapshot of Indonesia's renewable power plants is seen in Fig. 1. It can be noted that majority of existing renewable power plants in Indonesia are on the island of Java.

The other major island in the archipelago - Sumatra has fewer existing renewable plants however there are two solar plants in construction (Musi Green Hybrid and Tangjun Enim).

The island of Borneo has no existing renewable power plants however, the largest planned renewable power plant – the proposed Kayan 9 GW hydropower plant has been planned for construction on the island.

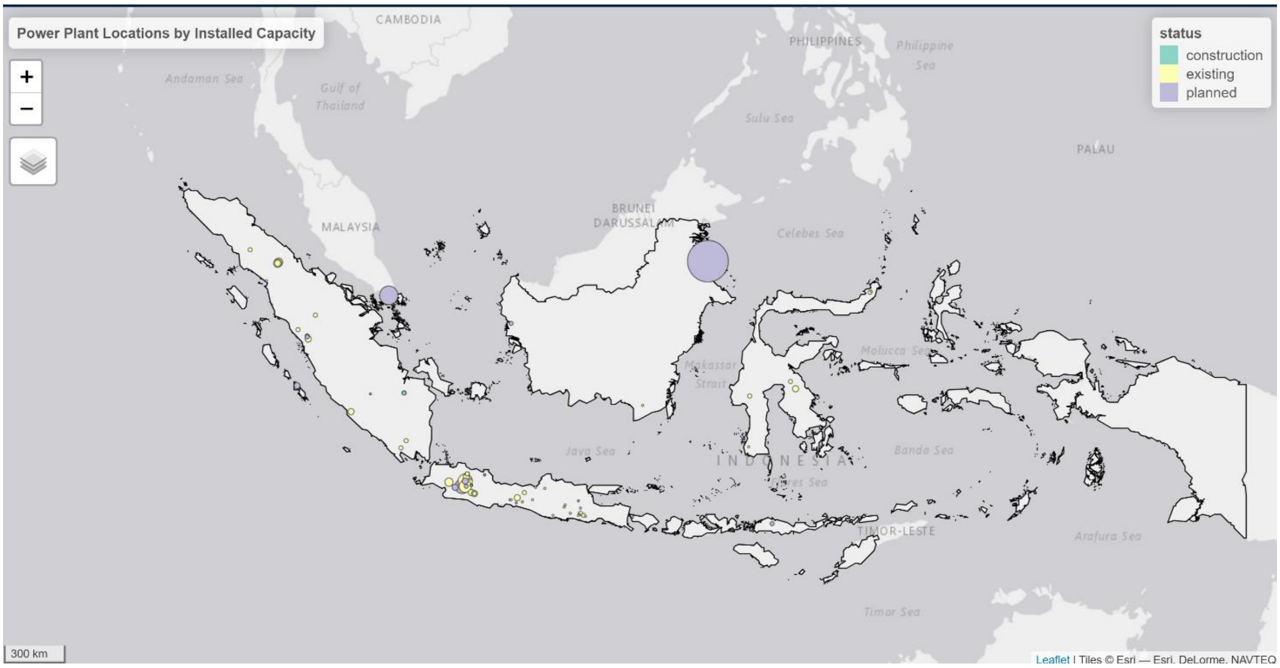

Figure 1: Locations of existing, in construction and planned renewable plants

Demand projection

According to (Setyawati, D. et al., 2024) the electricity demand in Indonesia is expected to grow to approximately **806 TWh** by 2040, which corresponds to an annual demand increase rate of **4.7%** as stipulated by the Indonesian state owned national electricity company (PLN) in their strategic planning document – the **RUPTL (2021-2030**).

Also, according to (De Vivero, G. et al.,2023), Indonesia's electricity demand is expected to increase by a factor of 3.2 by 2040 compared to 2022 levels. Using this finding and the total final consumption of electricity in Indonesia in 2022 as reported by the international energy agency ~ 1,277,852 TJ = 355 TWh, we get the projected electricity demand in Indonesia as 3.2 *355 = **1136 TWh.**

Finally, according to (Ishida, H. et al., 2024), if electricity demand continues to increase at the same rate, the electricity demand in 2040 will approximately be 80GW or **700.8 TWh** for the year.

Combining the findings from the three sources we get an average projected electricity demand in Indonesia in 2040:

$$Total\ Electricity\ demand\ (\ in\ 2040) = \frac{(806 + 1136 + 700.8)}{3} \sim \mathbf{880}\ TWh$$

New Solar plants Capacity

Converting the projected energy demand to actual capacity.

$$Actual\ Capacity = \frac{880 * 10^3 Gwh}{365 * 24} \sim \boldsymbol{100GW}$$

Next, the total installed capacity is calculated. The study makes the following assumptions:

- **38%** of the total installed capacity in Indonesia in 2040 will comprise renewable sources.
- The capacity factors for renewable and non-renewable sources are **0.24** and **0.45** respectively

$$0.38C * 0.24 + 0.62C * 0.45 = 100GW$$
$$Installed\ capacity, C = 270\ GW$$
$$Installed\ renewable\ capacity = 0.38 * 270 = 103\ GW$$

The installed capacity of solar in 2040 is obtained by subtracting the capacity of existing, in construction and planned renewable power plants from the total installed renewable capacity in 2040. A table summarizing the capacity of existing and planned renewable projects in Indonesia is prepared from literature– see Table A in the appendix. From this table, the total capacity of existing, in construction and planned renewable projects is **18GW.** Hence, the capacity required for newly installed solar plants in 2040 is:

$$Installed\ solar\ capacity = 103 - 18 = \mathbf{85\ GW}$$

Data Sources

Table 1: List of Data sources

Table 1 shows a list of data sources used in the analysis

Table 1: Data Sources

Name	Data Source	Year	Notes
Global power plants	Global power plants	2024	An updated list of all global power plants including their locations, fuel types and installed capacites
Protected regions	Protected planet	2018	A shape file with the protected zones including nature and wildlife reserves, national and game parks as defined by Indonesia Ministry of Forestry(MoF) Ministry of Marine Affairs & Fisheries (MMAF)
Indonesia Country boundary	Global administrative boundaries	2022	A shape file with the national administrative boundaries of Indonesia
Surface Solar Radiation Downwards (SSRD)	European Center for Medium Weather forecasts	2024	A grib file containing average monthly values of SSRD per square meter in Indonesia for the year 2024
Temperature	European Center for Medium Weather forecasts	2024	A grib file containing average monthly values of temperature @2m height in Indonesia for the year 2024
Elevation	Natural earth	2024	Greyscale downsampled elevation data from STRM-plus satellite.
Electricity Grid	Open street map	2018	A shape file showing transmission lines in Indonesia
Population	World population hub	2018	A shape file containing population of major cities in Indonesia
Roads	Open street map	2018	A shape file showing roads in Indonesia

D) Site suitability analysis

Individual criteria Analysis

As described in the literature review, the site suitability analysis for solar PV is broadly dependent on climatic, topographic and proximity factors. This study focuses on Surface solar radiation downwards (SSRD) and temperature as the climatic factors, elevation as the topographic factor, and proximity to the grid, demand centres and roads, as the proximity factors.

Solar

Figure 2 shows average monthly SSRD data is imported from ECMWF Climate Data Store.

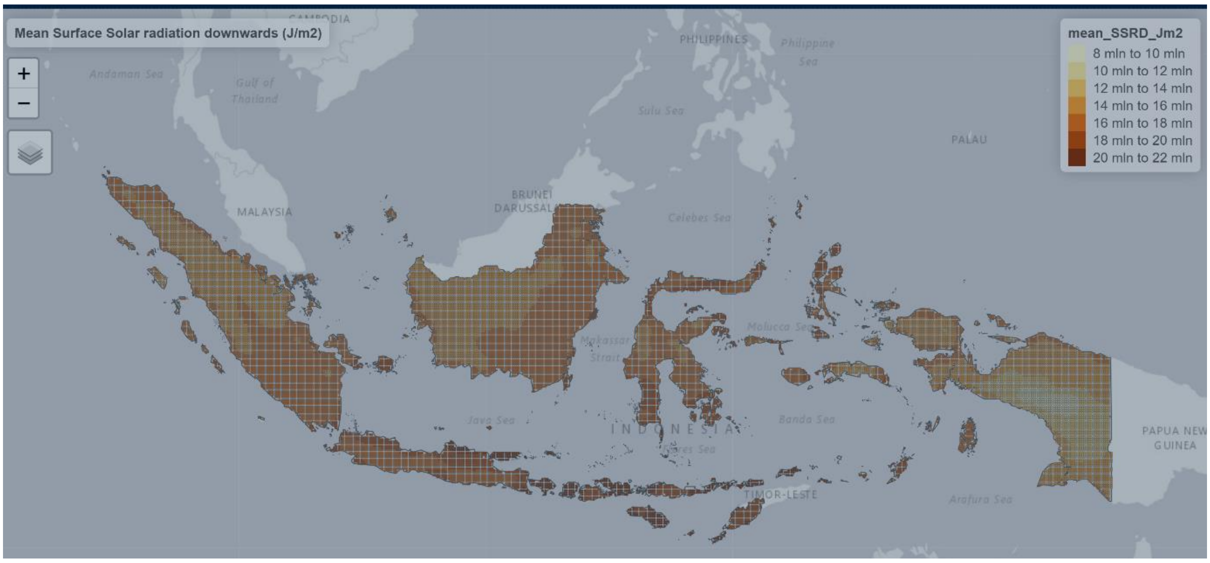

Figure 2: SSRD samples from ERA data

Using the point data from ECMWF on SSRD, **Inverse distance weighting** is used as the spatial interpolation tool to obtain a continuous map of SSRD. The choice of this interpolation method is because it is simple to interpret and does not rely on strong assumptions. It is less computationally intensive than other interpolation algorithms e.g. Kriging, and it also applies Tobler's first rule of geography - everything is related to everything, but closer phenomena are more correlated than further away phenomena.

Root mean square error (RMSE) and K-fold cross validation is used to determine which distance decay power results in the highest interpolation accuracy. The result of this analysis is shown in Fig. 3.

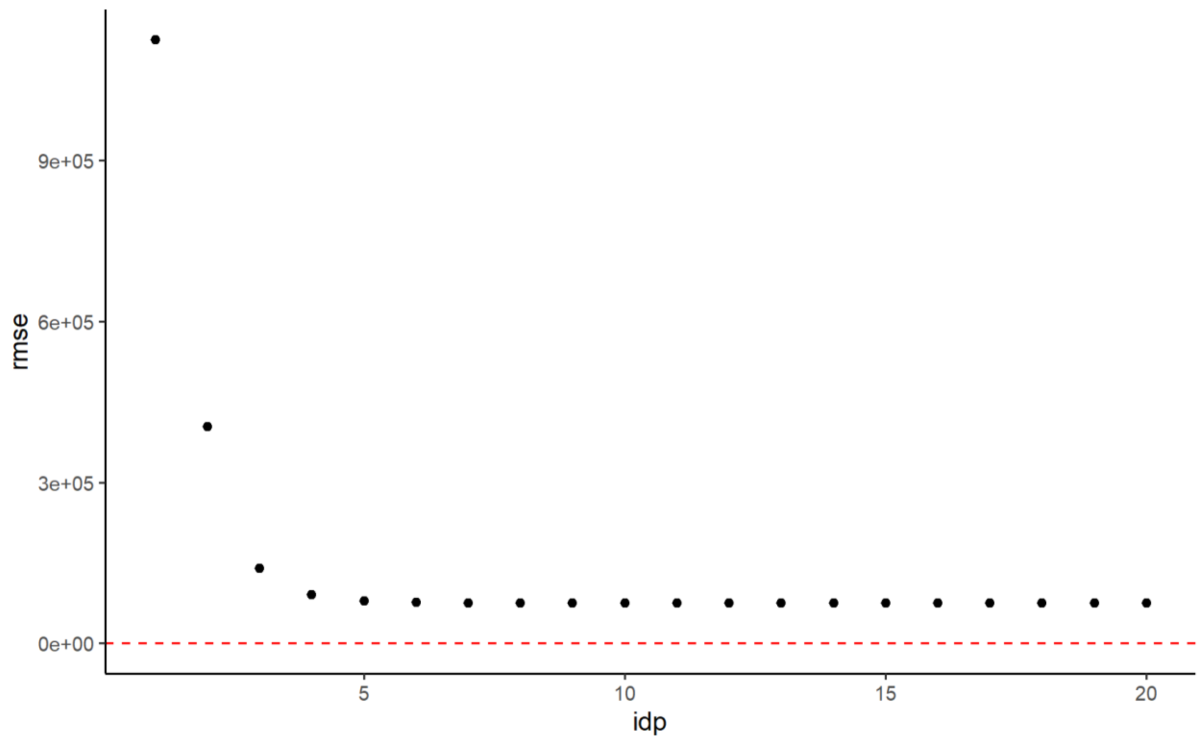

Figure 3: Choosing the IDW power

With IDP = 7, this results in the lowest RMSE. However, it is to be noted that while this offers better accuracy using IDP values greater than 2 becomes exponentially more intensive computationally and encounters difficulty in rendering the interpolated plot so a value of IDP = 2 is chosen.

To create a raster template for the interpolation, the solar plant size constraint is implemented i.e. no solar plant should be more than $12km^2$ in area. This translates to square grid cells each of size 3.464km or 0.0312 degrees.

This resolution is maintained throughout the analysis of all other factors. Fig. 4 shows the interpolated plot.

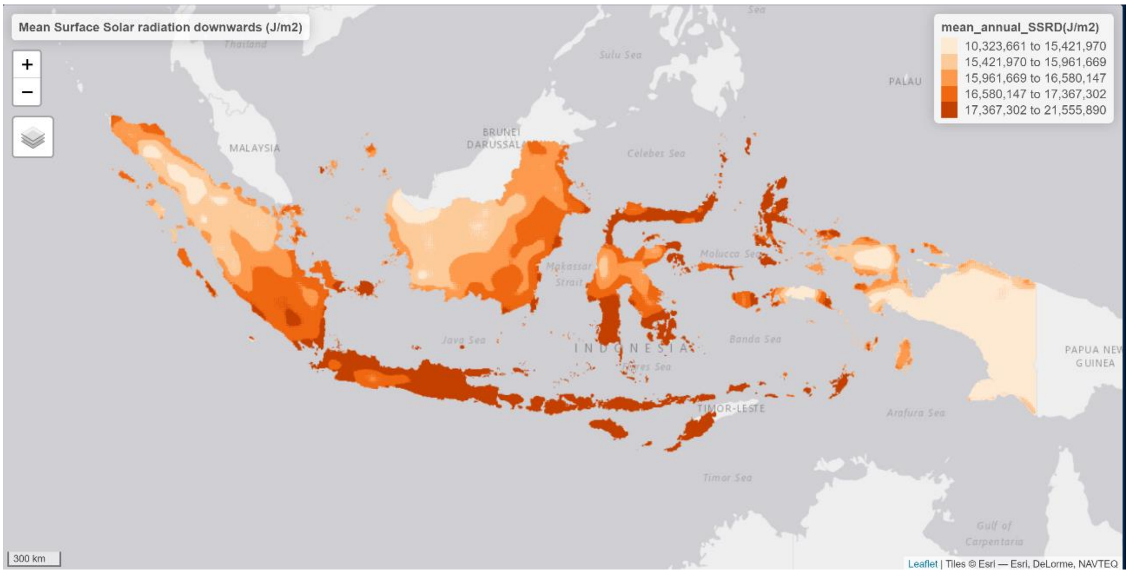

Figure 4: Interpolated SSRD plot

SSRD to Power

Having interpolated the mean SSRD for each grid cell in the raster file, the annual Generation potential is then obtained. Since the area of each cell is 12km2 (raster resolution) as stipulated by the constraint, in the power conversion formula this value is used as the area constant. The power generated in each cell is given by:

Power[kWh] = G * A * r * p * (hours/3600);

Where, **G** is the SSRD value in J/m^2 , **A** is the area in m^2 , **r** is the panel efficiency and **p** is the performance ratio of the whole system. The power generation plot is shown in Fig. 5

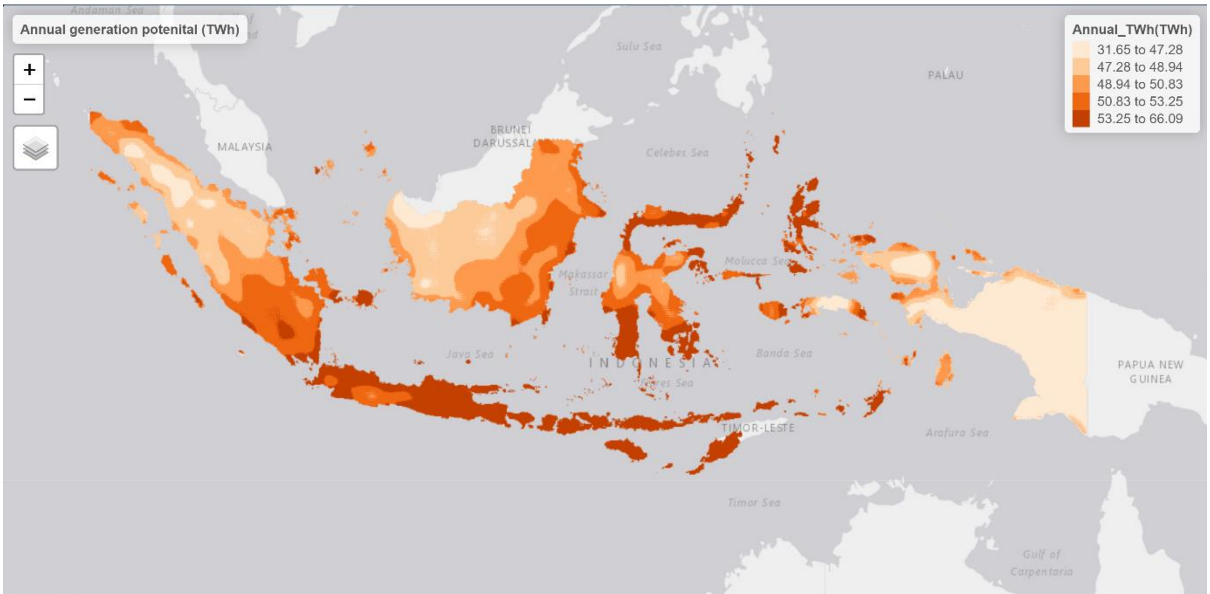

Figure 5: Annual generation potential

SSRD suitability index

The raster data is reclassified based on SSRD and assigned a suitability index ranging from 1 to 7 from low to high SSRD. Since the goal is to show the absolute generation potential of each region as opposed to relative generation potential the reclassification utilizes equal-interval classes as opposed to equal-number classes (quantiles). This classification method is maintained in developing suitability indices for all subsequent variables. Fig. 6 shows the SSRD suitability index plot.

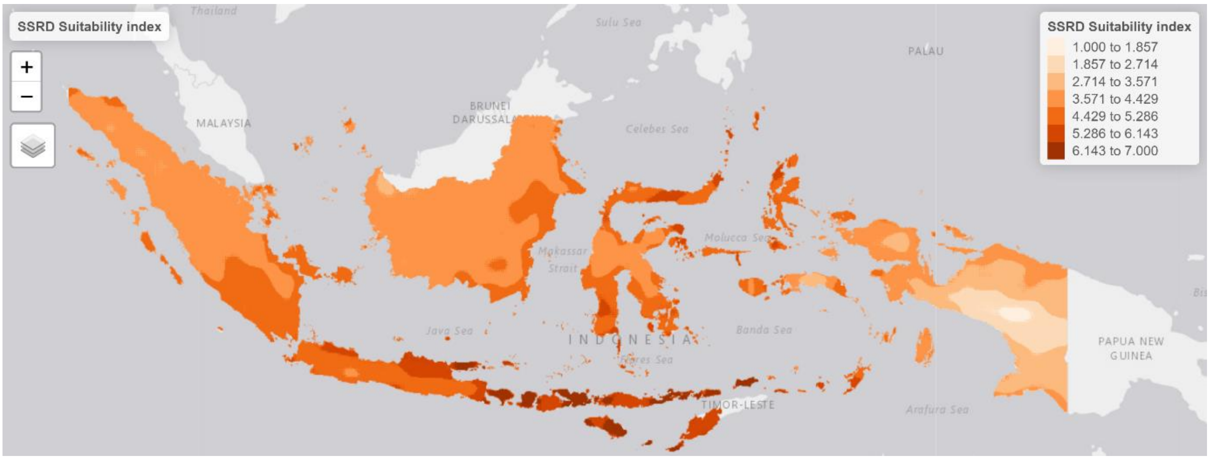

Figure 6: SSRD Suitability Index

Temperature

Temperature data is inertpolated in the same way as SSRD data. Like the SSRD raster data, the temperature data is then reclassified into 7 quantiles based on temperature except this time the relationship is inverse i.e. the lower the temperature the higher the suitability index for the region. Fig. 7 and Fig. 8 show the plots for mean absolute temperature and temperature suitability index plots respectively.

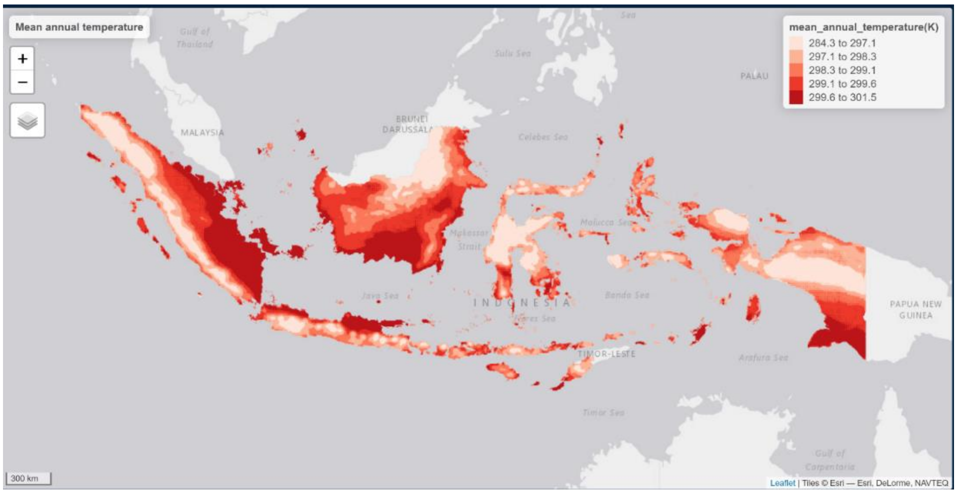

Figure 7: Mean annual temperature

Figure 8: Temperature suitability index

Elevation

Elevation data is plotted and suitability index applied as 1-7 from low to high elevation. Low hill-shade values from the grayscale data correspond to high altitude areas. Fig. 9 and Fig. 10 show the elevation and elevation suitability index plots respectively.

Figure 9: Elevation

Figure 10: Topography suitability index

Grid proximity

Fig. 11 and Fig. 12 show the plots for grid proximity and its suitability index respectively.

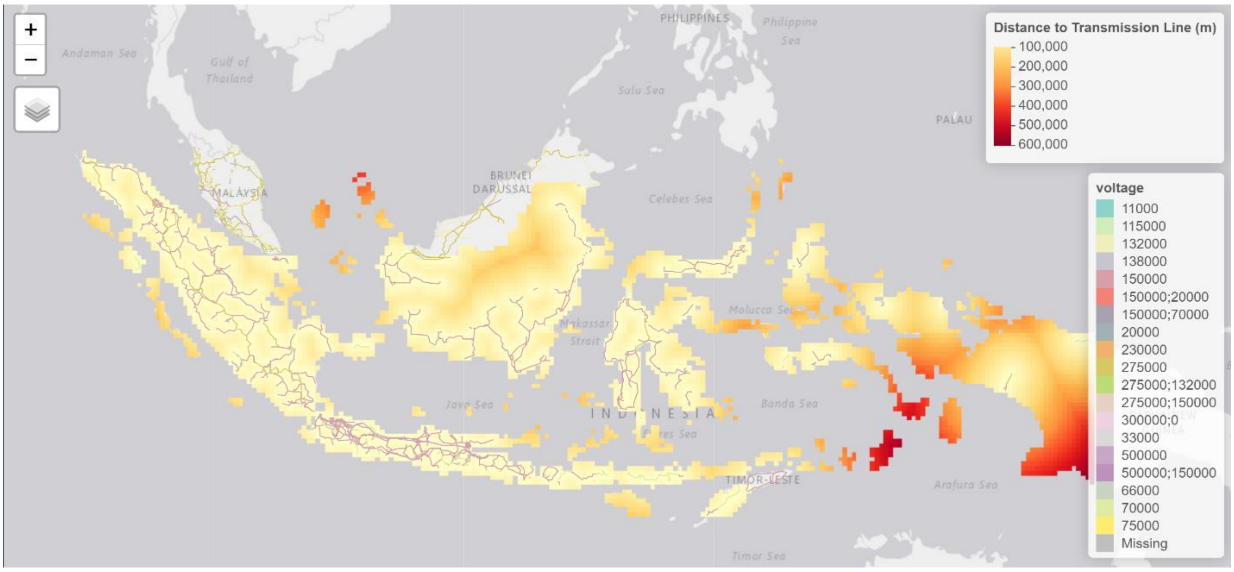

Figure 11: Grid proximity

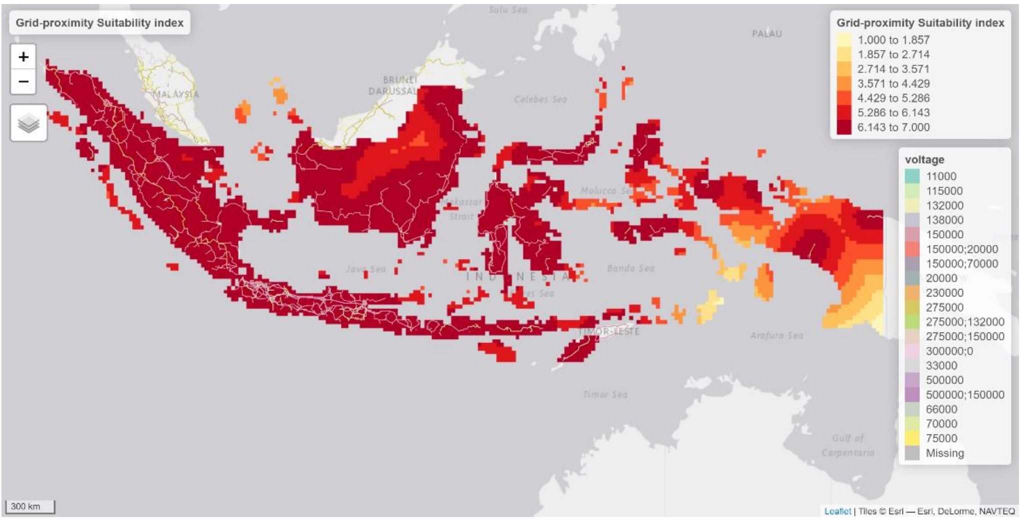

Figure 12: Grid proximity suitability index

Demand centers

Fig. 13 and Fig. 14 show the plots for demand proximity and its suitability index respectively.

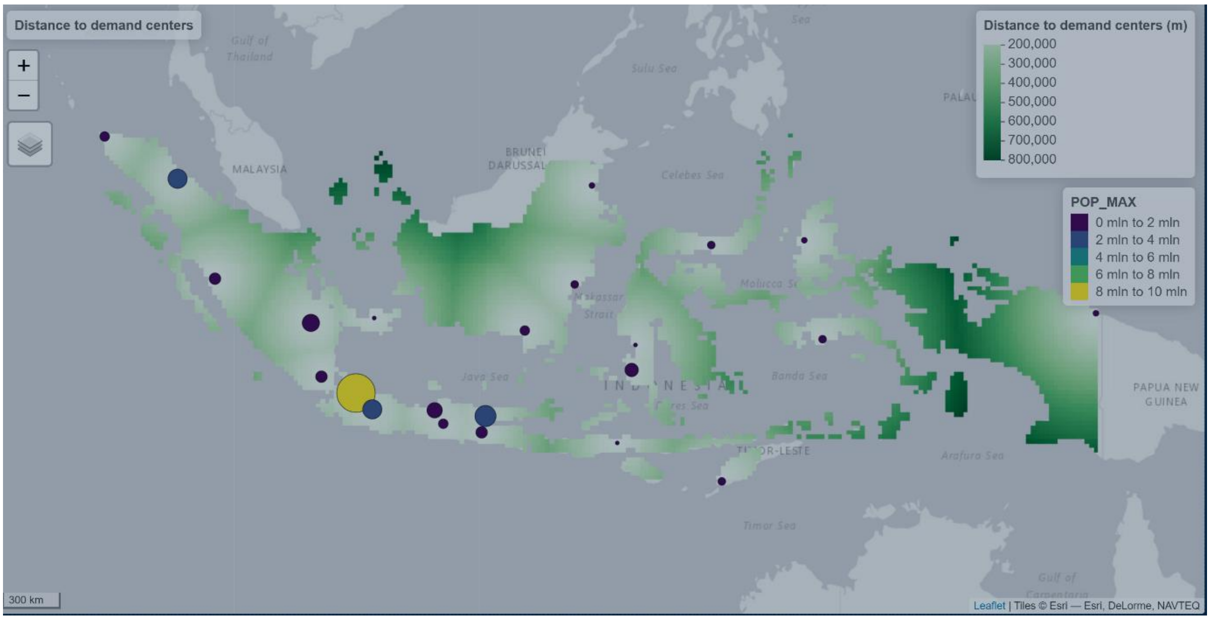

Figure 13: Demand proximity

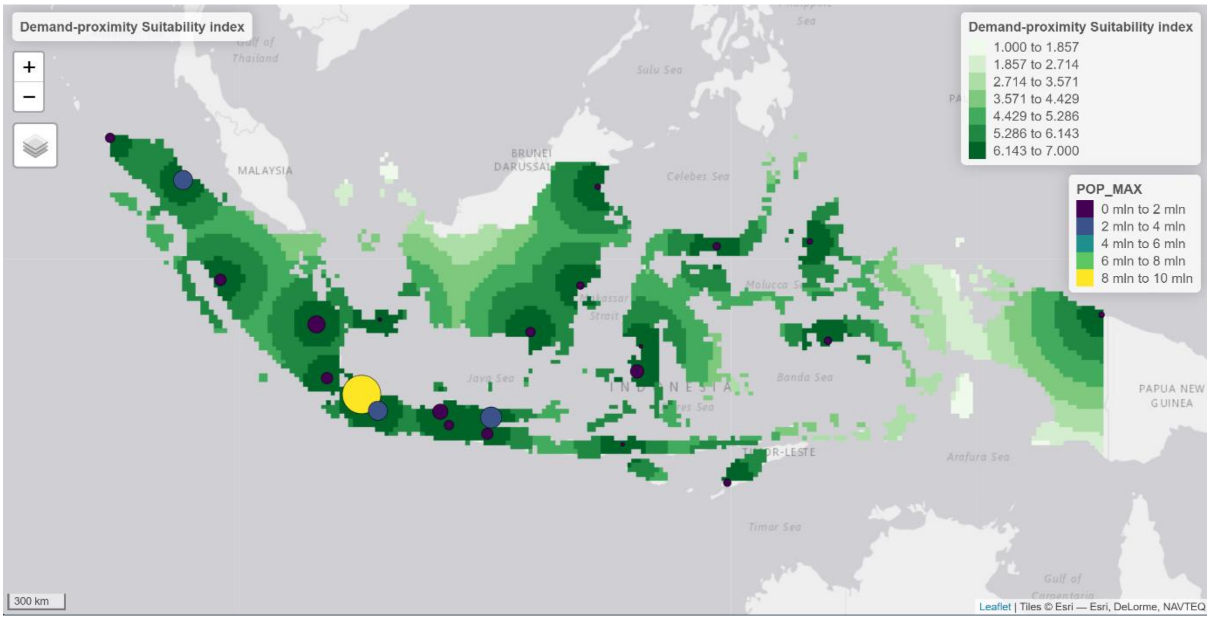

Figure 14: Demand proximity suitability index

Road Proximity

Fig. 15 and Fig. 16 show the plots for road proximity and its suitability index respectively.

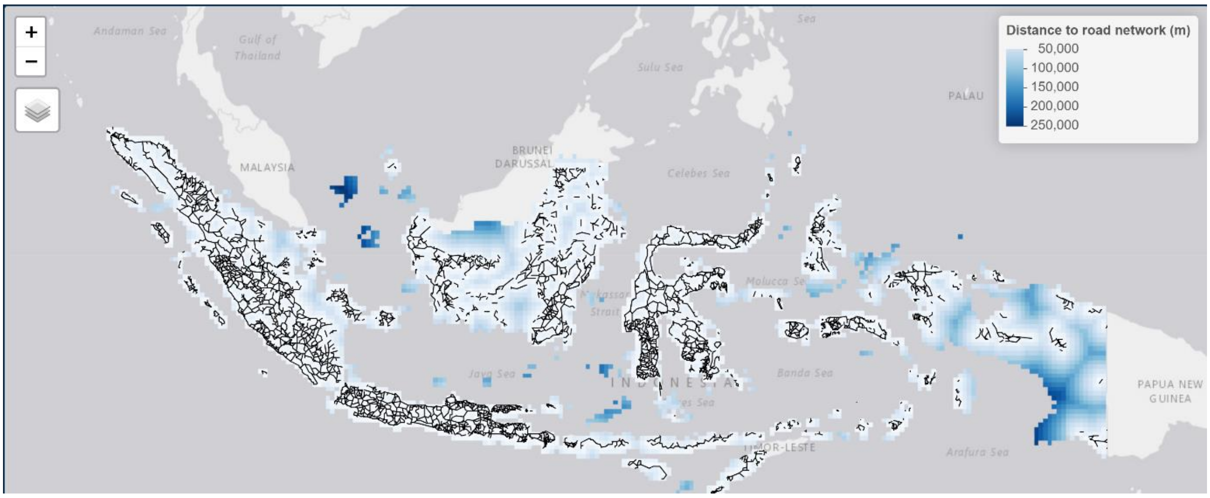

Figure 15: Road proximity

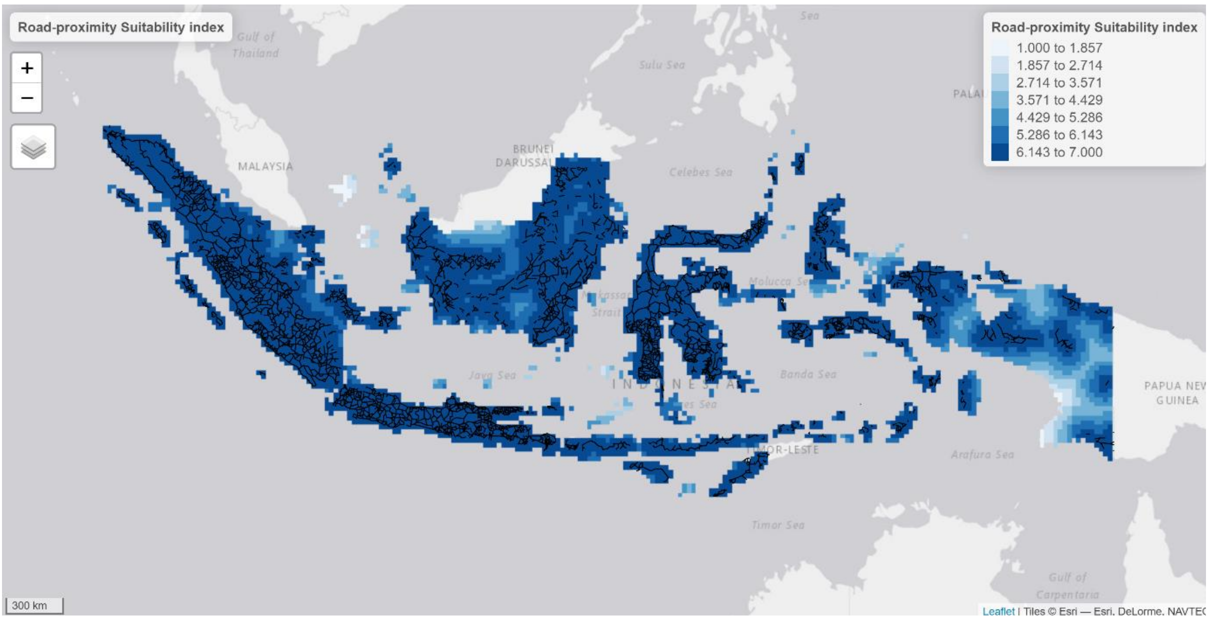

Figure 16: Road proximity suitability index

Multi-criteria decision making

Having analyzed each criteria individually, they are aggregated to form a combined suitability index through the analytic hierarchy process (AHP). In this study, a pair wise comparison matrix is developed for each criterion using the scale 1-9 where 1 signifies equal importance of both criteria and 9 signifies one criterion is much more important than the other.

The determination of the relative pairwise importance is influenced by the context and spatial distribution of the criterion – regions that are homogenous with little spatial variation of the phenomenon result in lower importance of the criterion. The result of the pairwise comparison are illustrated in Table 2 and Table 3 shows the final derived weightings for each factor:

Table 2: Pairwise comparison Matrix

	SSRD	Temperature	Elevation	Grid proximity	Demand proximity	Road proximity
SSRD	1	6/1	4/1	2/1	3/1	4/1
Temperature	1/6	1	1/3	1/6	1/5	1/4
Elevation	1/4	3/1	1	1/2	1/2	1/1
Grid proximity	1/2	6/1	3/1	1	2/1	1/1
Demand proximity	1/3	5/1	2/1	1/2	1	3/1
Road proximity	1/4	4/1	1/1	1/1	1/3	1
	2.50	25.00	11.33	5.17	7.03	10.25

Table 3: Normalized values and weights

	SSRD	Temperature	Elevation	Grid proximity	Demand proximity	Road proximity	Weights
SSRD	0.40	0.24	0.35	0.39	0.43	0.39	**0.37**
Temperature	0.07	0.04	0.03	0.03	0.03	0.02	**0.04**
Elevation	0.10	0.12	0.09	0.10	0.07	0.10	**0.10**
Grid proximity	0.20	0.24	0.26	0.19	0.28	0.10	**0.21**
Demand proximity	0.13	0.20	0.18	0.10	0.14	0.29	**0.17**
Road proximity	0.10	0.16	0.09	0.19	0.05	0.10	**0.11**
	2.50	25.00	11.33	5.17	7.03	10.25	

As mentioned in the literature, SSRD is the most important factor in determining site suitability compared to the other criteria as it is directly proportional to the yield of solar generation

According to (Arán-Carrión J, et al., 2008), advancements in development of photovoltaic systems including cheaper components means that the component of climate no longer feels so important. This is to mean that future solar PV systems will be more robust to high temperatures hence, temperature is far less important than other factors.

Scenarios of equal importance also arise in the pairwise comparison. As earlier mentioned, existing grid network tend to coincide with roads, hence when compared to each other they are of equal importance (1/1). The road proximity suitability index shows uniform distribution of roads across Indonesia hence this criterion is of reduced relevance when compared to others.

The grid proximity and demand proximity together occupy second rank below SSRD due to their association with operational costs in form of transmission losses. Elevation ranks below them as it is associated with a one-off capital investment in construction costs.

The calculated weights result in a **consistency ratio (CR)** of **0.059** indicating consistent decision making in the pair-wise comparisons.

The penultimate criteria before plotting the combined suitability index is to mask out regions in Indonseia that are not exploitable for solar PV installation including forested areas and protected zones. The layer of protected zones is used as a mask for suitable regions is shown in Fig. 17

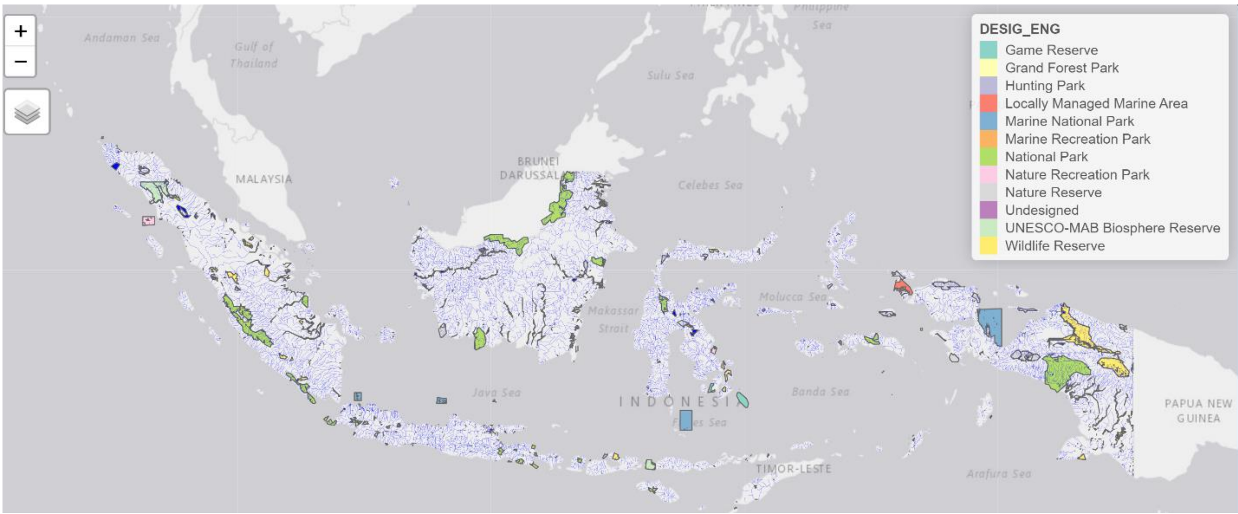

Figure 17: Protected regions in Indonesia

E) Results

Number of Solar PV plants required

The required installed capacity of new solar power plants by 2040 has been established in the literature as 85GW. Using a capacity factor of 0.24 for solar this translates to an annual generation of:

$$Annual\ generation = 0.24 * 85GW * 365 * 24 = 178.7\ TWh$$

Having calculated the annual solar generation potential of Indonesia, it is now possible to establish the theoretical number of solar power stations required. From Fig 18., inspecting the combined dataframe of each 12km^2 grid cell shows the cells with the highest generation potential are around **65** TWh. Hence 3 such cells, would suffice to meet the target solar generation i.e. it is proposed to construct **three solar PV power plants each of size 12km^2** to meet the solar generation target.

x	y	SSRDIndex	TempIndex	TopoIndex	grid_prox_Index	demand_prox_Index	road_prox_Index	combined_index	annual_generation
116.5104	-8.3048	7	3	7	7	5	7	6.50	66.09036
116.4168	-8.3048	7	3	7	7	5	7	6.50	65.89611
122.7192	-8.6168	7	1	4	7	6	7	6.29	65.67529

Figure 18: Combined dataframe of each 12km cell - generation in TWh

Suitable sites

Fig. 19 shows the combined suitability index. It is proposed to construct the three solar PV plants across the island of Java that hosts the capital Jakarta. Specifically, the provinces of Jawa Barat, Jawa Tengah and Jawa Timur.

Transmission line length

The total length from proposed sites to nearest transmission lines is calculated as **21.96km**

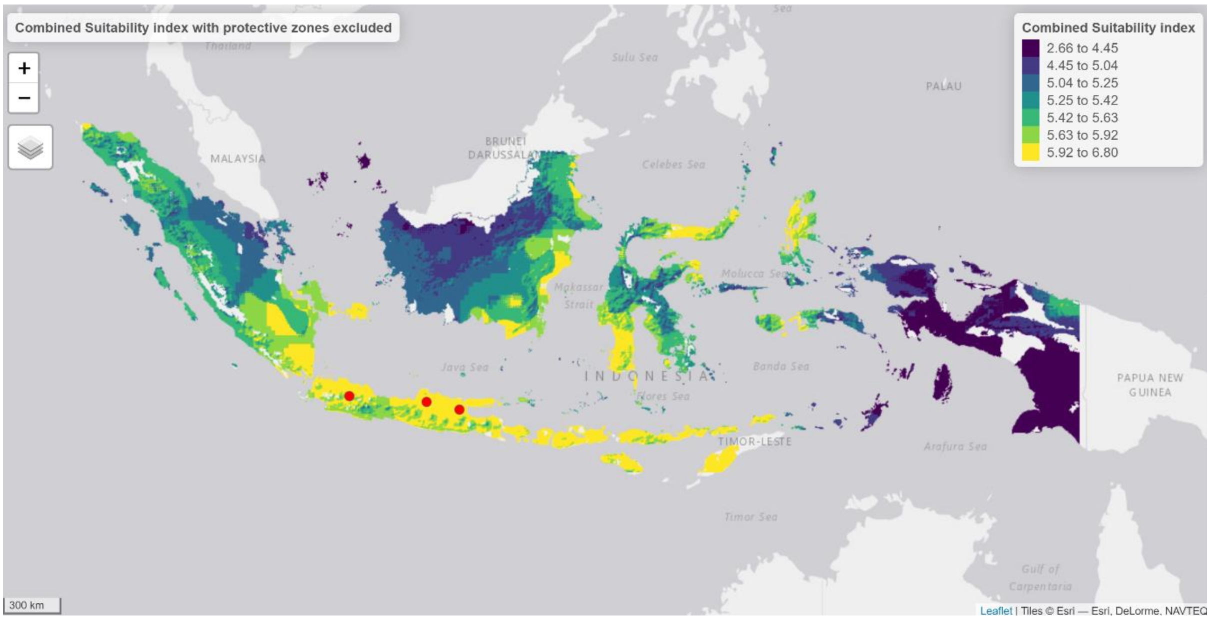

Figure 19: Combined suitability index with proposed locations

Economic viability analysis

Capital expenditure

Using the assumed capital investment rates of **1.16M** USD/MW and **590 USD**/MW.Km

$$Capex = 85000MW * 1.16M + 590\ \frac{\textbf{USD}}{\text{MW}}.\text{Km} * 21.96km \sim 100\ B\ USD$$

Net present value (NPV)

Programmatic implementation of the calculation of NPV yielded a positive value *implying* that the project should be **supported**.

Levelized cost of electricity (LCOE)

The LCOE over the 25 year lifetime of the project is programmatically calculated as **0.03** USD/KWh

F) Discussion and Conclusions

The study began by assessing the current stock of renewable projects alongside planned and in construction projects. After making a demand projection for the year 2040, the amount of solar capacity required based on set targets was established. Next, a site suitability assessment was carried out using GIS tools with multiple criteria. The spatial distribution of each criterion was analyzed individually before being amalgamated by MCDM/AHP. The main criteria include climatic factors – SSRD, temperature; topographic factors – elevation and slope; proximity factors – Grid, road and demand proximity factors and finally land use constraints i.e. exclusion of forest land cover and protected zones.

The final map showed that on the Indonesian archipelago, the island of Java is the most suitable for solar PV development, due to the high levels of SSRD on the island, its well connectedness in terms of electricity grid and roads and its hosting of the largest demand center – Jakarta, the capital. From the calculation of generation potential and required proportion of renewables in 2040 it was found that three 12km^2 solar PV plants would suffice to meet the target.

Financial assessment further revealed that proposed plan is economically viable. A positive NPV and LCOE of $0.03 compared to wholesale electricity price of £ 0.076 ~ $0.09 indicates that the project yields a profit over its lifetime.

The upfront capital investment of 100 billion dollars required represents about 7% of Indonesia’s GDP of 1.3 trillion dollars indicating that the project is feasible and financeable internally without incurring debts/concessions.

It is proposed that Indonesia employ the proposed solar PV roadmap to achieve her renewable energy targets.

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H) Appendix

Table A – Existing, in construction and planned renewable power plants in Indonesia

plant	capacity_mw	Capacity_GW	status	longitude	latitude	type	links
Musi Green Hybrid	10.5	0.0105	construction	103.2758	-3.04149	solar	https://assets.bbhub.io/professional/sites/24/BNEF-IESR-Scaling-Up-Solar-in-Indonesia_FINAL.pdf
Cirata Floating PV	145	0.145	planned	107.3372	-6.69249	solar	https://assets.bbhub.io/professional/sites/24/BNEF-IESR-Scaling-Up-Solar-in-Indonesia_FINAL.pdf
West Kalimantan	100	0.1	planned	109.354	-0.0596	solar	https://assets.bbhub.io/professional/sites/24/BNEF-IESR-Scaling-Up-Solar-in-Indonesia_FINAL.pdf
Lampung PV + storage	100	0.1	planned	104.7308	-2.9708	solar	https://assets.bbhub.io/professional/sites/24/BNEF-IESR-Scaling-Up-Solar-in-Indonesia_FINAL.pdf
Singkarak	90	0.09	planned	100.5568	-0.61163	solar	https://assets.bbhub.io/professional/sites/24/BNEF-IESR-Scaling-Up-Solar-in-Indonesia_FINAL.pdf
Bangka	10	0.01	planned	105.2204	-2.04238	solar	https://assets.bbhub.io/professional/sites/24/BNEF-IESR-Scaling-Up-Solar-in-Indonesia_FINAL.pdf
Bali 2 x 25MW	50	0.05	planned	114.5473	-8.2134	solar	https://assets.bbhub.io/professional/sites/24/BNEF-IESR-Scaling-Up-Solar-in-Indonesia_FINAL.pdf
Saguling	60	0.06	planned	107.3887	-6.91761	solar	https://assets.bbhub.io/professional/sites/24/BNEF-IESR-Scaling-Up-Solar-in-Indonesia_FINAL.pdf
Ombilin	100	0.1	construction	100.5524	-0.55077	solar	https://assets.bbhub.io/professional/sites/24/BNEF-IESR-Scaling-Up-Solar-in-Indonesia_FINAL.pdf
Tanjung Enim	100	0.1	construction	104.7308	-2.9708	solar	https://assets.bbhub.io/professional/sites/24/BNEF-IESR-Scaling-Up-Solar-in-Indonesia_FINAL.pdf
Batam	1692	1.692	planned	104.0631	1.1329	solar	https://assets.bbhub.io/professional/sites/24/BNEF-IESR-Scaling-Up-Solar-in-Indonesia_FINAL.pdf
Labuan Bajo	70	0.07	planned	120.5982	-8.5101	solar	https://assets.bbhub.io/professional/sites/24/BNEF-IESR-Scaling-Up-Solar-in-Indonesia_FINAL.pdf
West Java	50	0.05	planned	108.1781	-6.4511	solar	https://assets.bbhub.io/professional/sites/24/BNEF-IESR-Scaling-Up-Solar-in-Indonesia_FINAL.pdf
Central Java	50	0.05	planned	109.5734	-7.6333	solar	https://assets.bbhub.io/professional/sites/24/BNEF-IESR-Scaling-Up-Solar-in-Indonesia_FINAL.pdf
East Java	50	0.05	planned	112.238	-7.5389	solar	https://assets.bbhub.io/professional/sites/24/BNEF-IESR-Scaling-Up-Solar-in-Indonesia_FINAL.pdf
Tambora	10	0.01	planned	117.7437	-8.19037	solar	https://assets.bbhub.io/professional/sites/24/BNEF-IESR-Scaling-Up-Solar-in-Indonesia_FINAL.pdf
West Java	5	0.005	planned	108.1781	-6.4511	solar	https://assets.bbhub.io/professional/sites/24/BNEF-IESR-Scaling-Up-Solar-in-Indonesia_FINAL.pdf
Kayan	9000	9	planned	117.8146	2.6048	hydro	https://www.power-technology.com/marketdata/kayan-hydro-power-plant-indonesia/
Cisokan	1040	1.04	planned	107.2173	-6.9458	hydro	https://en.wikipedia.org/wiki/Upper_Cisokan_Pumped_Storage_Power_Plant
Asahan III	174	0.174	planned	100.0985	-2.6767	hydro	https://www.idnfinancials.com/news/43203/asahan-hydropower-plant-optimistic-operate
Sukabumi	150	0.15	planned	106.9177	-6.9701	wind	https://www.thejakartapost.com/opinion/2022/12/26/renewable-energy-bill-an-ambitious-attempt-at-energy-transition.html
Asahan I	180	0.18	existing	99.259	2.5113	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Bakaru	126	0.126	existing	119.6042	-3.1141	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Balambano	130	0.13	existing	121.357	-2.5213	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Bengkok+Dago/saguling	3.85	0.00385	existing	107.5564	-6.6247	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Besai - Way Kanan	92.8	0.0928	existing	104.8051	-4.9822	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Bili bili	20.1	0.0201	existing	119.5817	-5.2779	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Cikalong/saguling	19.2	0.0192	existing	107.6186	-6.9039	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Ciratal & II	1008	1.008	existing	107.3671	-6.7004	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Darajat 1	55	0.055	existing	107.7394	-7.2173	Geotherma	https://datasets.wri.org/dataset/globalpowerplantdatabase
Darajat 2 3	215	0.215	existing	107.7394	-7.2173	Geotherma	https://datasets.wri.org/dataset/globalpowerplantdatabase
Dieng	60	0.06	existing	109.9119	-7.2061	Geotherma	https://datasets.wri.org/dataset/globalpowerplantdatabase
Giringan - Pamekasan	3.2	0.0032	existing	111.6715	-7.7201	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Golang - Pamekasan	2.7	0.0027	existing	111.1317	-8.1408	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Gunung Salak	375	0.375	existing	106.648	-6.7416	Geotherma	https://datasets.wri.org/dataset/globalpowerplantdatabase
Jatiluhur	186	0.186	existing	107.389	-6.523	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Kamojang 1 2 3	140	0.14	existing	107.4553	-6.4239	Geotherma	https://datasets.wri.org/dataset/globalpowerplantdatabase
Kamojang 4	60	0.06	existing	107.4553	-6.4239	Geotherma	https://datasets.wri.org/dataset/globalpowerplantdatabase
Ketenger / mrica	8.04	0.00804	existing	109.2778	-7.5097	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Klambu/Mrica	1.117	0.001117	existing	110.7964	-7.0069	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Koto Panjang Kampar	114	0.114	existing	100.8814	0.2905	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Kracak/saguling	18.9	0.0189	existing	107.6186	-6.9039	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Lahendong (Binary Cycle)	20	0.02	existing	124.8392	1.3346	Geotherma	https://datasets.wri.org/dataset/globalpowerplantdatabase
Lahendong IV	80	0.08	existing	124.8225	1.2542	Geotherma	https://datasets.wri.org/dataset/globalpowerplantdatabase
Lamajan/saguling	19.56	0.01956	existing	107.6186	-6.9039	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Larona	165	0.165	existing	121.5783	-2.8194	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Lau Renun	82	0.082	existing	98.065	3.0824	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Lodoyo - Brantas	4.5	0.0045	existing	112.2173	-8.1613	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Maninjau III	123	0.123	existing	100.152	-0.2923	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Mendalan - Brantas	23	0.023	existing	112.3316	-7.854	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Musi	215.475	0.215475	existing	102.435	-3.766	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Ngebel - Pamekasan	2.2	0.0022	existing	111.6167	-7.7891	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
PB. Sudirman/Mrica	180.9	0.1809	existing	109.6054	-7.3927	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Pejengkolan/Mrica	1.4	0.0014	existing	109.8006	-7.5694	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Plengan/Saguling	6.87	0.00687	existing	107.6186	-6.9039	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Riam Kanan/pangeran Muhamad Nur	30	0.03	existing	115.0074	-3.5156	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Saguling	700.72	0.70072	existing	107.3663	-6.9126	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Sempor/Mrica	1	0.001	existing	109.3331	-7.4733	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Sengguruh - Brantas	29	0.029	existing	112.551	-8.1764	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Sidorejo/Mrica	1.4	0.0014	existing	110.2622	-7.4764	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Sigura gura (asahan II)	286	0.286	existing	99.2793	2.5196	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Singkarak	175	0.175	existing	100.6034	-0.6909	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Sipansihaporas	50	0.05	existing	98.7792	1.7427	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Sutami / Karangkates - Brantas	105	0.105	existing	112.4443	-8.1606	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Tangga (asahan II)	317	0.317	existing	99.3028	2.5479	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Timo / Mrica	12	0.012	existing	110.4069	-6.9485	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Tulungagung - Brantas	36	0.036	existing	111.9025	-8.0657	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Ubrug/saguling	18.36	0.01836	existing	107.6186	-6.9039	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Ulubelu 1 & 2	110	0.11	existing	104.5733	-5.3096	Geotherma	https://datasets.wri.org/dataset/globalpowerplantdatabase
Wayang Windu	227	0.227	existing	107.6258	-7.1966	Geotherma	https://datasets.wri.org/dataset/globalpowerplantdatabase
Wlingi - Brantas	54	0.054	existing	112.3311	-8.0776	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
Wonorejo - Pamekasan	6.3	0.0063	existing	112.2869	-8.1136	Hydro	https://datasets.wri.org/dataset/globalpowerplantdatabase
TOTALS	**18958.092**	**18.958092**					

I) Code Link

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