Assginment brief\_Solar Power Plant Investment in Indonesia: A decarbonised electrical supply vision to 2030

Assignment brief

* Format: You will deliver a 3,000 individual report outlining your findings and recommendations. A code link needs to be added in the end of the report. (It is acceptable to be 10% above this word limit)

1.Assignment brief

Would increasing the planned share of renewable electrical power in Indonesia’s 2030 electricity capacity be a profitable investment (earn money) or require a subsidy (loss-making)? You will deliver a 3000-word individual report outlining your findings and recommendations.

You will assume to be a consultant informing the government of Indonesia of how they can extract more energy from their renewable potential. This will involve identifying the current Indonesia renewable installed power but as well, the potential of different supply-side renewable sources. The analysis should focus on the spatial implications of meeting future demand through renewables, considering the spatial distribution of a technology’s potential as well as its proximity to demand e.g., transmission costs. As this involves development, you should estimate the amount of investment needed to make Indonesia a low-carbon power producer and to support which strategy.

A map of the world

Description automatically generated

Indonesia

You will also need to consider other factors such as land use and protected areas – since some changes e.g., deforestation is not in the Indonesian vision, infrastructure location (i.e., electrical grid), other power plants, landscape (e.g., a big mountain) and population distribution. Considering these aspects will allow you to determine a realistic renewable development plan for Indonesia’s ambitions to decarbonise. We will provide you with a series of assumptions that you will be expected to review. If these do not align with your knowledge/research, you are welcome to challenge them (please see Appendix I). If you chose to do so, any changes and deviations should be highlighted in a table to be included in the methodology section of the report.

2.Key research questions

The work will require you to present relevant data and analysis regarding the current state of Indonesia energy profile, policy framework and decarbonisation ambitions. As well, you will need to process and present spatial datasets to add value to your analysis, set of recommendations and final report. At the end of the report, you should be able to provide a solar power plants development strategies for the Indonesia government. In particular, you will answer the following key questions.

Key research questions

* **What is the projected electricity demand for Indonesia by 2030, and how much solar capacity will be provided by new solar power plants?**  
  Step 1: estimate the total electricity demand in 2030 in Indonesia  
  Step 2: the total electricity produced by solar power (using the assumption that ‘38% of total electricity generation capacity from renewable sources’)  
  Step 3: calculate the shortfall to be made up by new solar power plants Shortfall = (Projection \* 38% ) – (existing + planned + under-construction)
* **What is the solar energy development strategies?**  
  -How many solar power plants are needed?  
  -Where will you suggest building these solar power plants?
* **Would increasing the planned share of renewable electrical power by solar power plants in Indonesia’s 2030 electricity capacity be a profitable investment (making money) or require a subsidy (losing money)? Would you recommend such a strategy even if it requires a subsidy?**

3.Report content

The sections below are suggestions for what content needs to be covered and are not a required structure for the report. Refer to the mark scheme for the required report elements.

1) Country snapshot

To understand the renewable infrastructure needed for Indonesia, first, the consultant needs to report what is the status of the country in regard to its population, land usage, energy demand and energy mix. This allows having the current snapshot of the country with its different needs and challenges. As well, the consultant needs to find out what renewable power plants are already in operation, under construction or planned since these will be already covering part of the electrical demand (e.g., you can use your power plant vector layer for this). A map with the **location and installed power of the existing, under construction and planned renewable plants**, is required in the report.

After the snapshot, the consultant should **project Indonesia’s electrical energy demand and planned electrical installed capacity for the year 2030**. This can come in the form of a reference or assumption taken by the consultant (e.g., *electric energy consumption per capita and then multiply by the population size*). The data or assumption used needs to be the most up to date available (check the IEA or IRENA websites, or Indonesia’s reports cited in this document).

2) Potential new solar powerplants electricity production by 2030

It will bring forward suitable places where future solar power plants may be installed to cover **38% of the projected electrical installed capacity by 2030** (i.e., considering the existing, planned and under construction renewable power plants in 2023). You will assess the solar power potential of different sites which can bring the installed power needed to comply with Indonesia’s 2030 objective (i.e., 38% of the projected electrical installed capacity by 2030). Having clarified the total demand projection and the production by existing, under construction planned renewable power plants, the consultant will need to find **the actual electrical capacity or power production of the new solar power plants.**

Theoretically, the consultant will need to use data representing different seasons and different time-interval (e.g., the four hours in the day for the average summer and winter months: 8AM, 12PM, 2PM and 4PM, see in Fig. 1). Considering that this is a preliminary suitability analysis, the consultant may select data on surface solar radiation downwards at a representative time The government will provide you with the solar resource hourly layers from which you should obtain representative availability for each hour studied. As you are aware, the issue with these layers is that they have missing data in the study area. To address this, you will need to **infill these values through your spatial analysis knowledge, taking into consideration the level of uncertainty introduced in the analysis.**

For each of the solar power plants, there is a limit of a maximum of 12 km2 per site. You will be provided in an R script with a value of power generation capacity per area unit (e.g. kWh/m2) and a set of assumptions made to obtain these values: Generation unit models and specifications (i.e. irradiance vs power output for PV), along with sizing and costs. These assumptions will have an impact on the efficiency of the sites chosen and as such you will be welcome to review/change them if you find alternative models better suited to the sites identified. The rationale for the plants’ locations and a short explanation of the changes on assumptions -if any- need to be presented in the report. As well, the table of assumptions with the values used (see **Appendix I**) has to be added to the report as an appendix.

Consider for your selection where the grid is located, near populations and landscape (i.e. elevation) to name a few. In particular to Indonesia, one of their main priorities is to stop or **minimise its rapid pace of deforestation and peatland conversion**. This was Indonesia’s strategy to comply with their Nationally Determined Contributions (NDCs) which aimed for a 26% greenhouse gases (GHG) reduction by 2030. This set of preferences set high importance on land usage especially when land is classified as forest, jungle or peatland. You need to report in your **calculations/decisions the distance from the renewable site to the electrical grid.**

Having identified the factors that influence the site selection decision, how would you specifically conduct a spatial analysis and what are the results of these. There will be multiple factors influencing the site selection decision and what methods you will use to bring all these factors together.

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3) Investment analysis/Financial analysis (Economic viability)

After selecting suitable locations and renewable power plant sizes, the consultant will deliver a simple investment analysis for the government of Indonesia. For this section, you will be provided with *a basic R script* that will contain the main costing equations and relevant assumptions for you to make a quick assessment of the investment needed. As inputs, you will need to provide **the renewable type’s total installed capacity and distances to the grid.** The script will include assumptions on CAPEX, OPEX, discount rates and payback periods to provide as outputs the **Net Present Value (NPV) project cost and the levelized cost of energy (LCOE)**. You are expected to review the assumptions made and comment on the reasons for either agreeing to them or if disputed, changing them.

You will need to report the **final cost of your recommendation and contrast the investment required against Indonesia’s GDP**.

Use a value of **7.67p/kWh (£0.0767/kWh)** as the price at which the government can sell the energy to the electricity suppliers in 2030 to compare against the LCOE obtained. If you think a different value should be used for comparison, please use it and explain the reason.

With this information at hand, you should be able to recommend the government if they should proceed with the renewable roadmap.

4) Discussion & Conclusion

Summarise the method and key findings of this report. And provide a critical discussion about the methods used in this report.