Review Report

Manuscript Title: The impact of setback regulations on PV deployment strategies in Gyeonggi province, South Korea
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Summary of the report

This study examines the impact of safety distance regulations on photovoltaic (PV) deployment in Gyeonggi Province, South Korea. Using GIS-based spatial analysis, suitable sites for PV were identified and analyzed under two scenarios: one assuming no safety distance restrictions, the other considering the safety distance. Logically, when there are no installation constraints, the installation area of PV increases, which has a positive impact on electricity production. The authors tried to answer some important questions such as: i) How do setback regulations affect the deployment potential and economic feasibility of photovoltaic systems in regions with low land constraints? ii) What are the trade-offs between maximizing the installation area and maintaining deployment efficiency? iii) What are the optimal deployment strategies under different regulatory scenarios?

We note that the study primarily focuses on a multi-criteria optimization problem with associated constraints. The criteria considered include economic, social, and environmental aspects. However, the study does not address a fourth criterion—technical or technological considerations—in detail. This is particularly important given that applications in the residential, industrial, or agro-photovoltaic sectors suggest the need for various photovoltaic technologies, as well as differing requirements for production and storage capacity. The study proposes three deployment strategies: one economic plan based on cost, and two others focused on quantity. The first strategy aims for complete deployment, while the second takes a more quantitative approach. The work is generally interesting and demonstrates some originality; however, several parts of the manuscript require review and improvement.

1. **Presentation part**:

This part deserves the authors to look into more seriously and improve and correct the following:

1.1. The conclusion is excessively lengthy; I have never encountered such a long conclusion in a scientific article. A good conclusion should succinctly highlight the most compelling results of the study. In its current form, this conclusion needs to be revised and should not exceed one-fifth of the length presented in the manuscript.
1.2. In the introduction, the authors reference scenarios A and B without explaining their meanings.
1.3. In section 2.3, the LCOE is given in Won/kWh, it should be expressed according to international standards in $/kWh.
1.4. The explanations for the figures and tables are lengthy; it is advised to streamline them while keeping the essential information so that readers can easily engage with the study.
1.5. The discussion on the limitations of this study should be included as a section in the text, and therefore remove it from the conclusion by mentioning it in a brief manner.
1.6. The bibliography is generally well-compiled; however, the authors should consider including additional references that address crucial aspects of their study. This is particularly important when discussing the various types of photovoltaic (PV) technology used in agro-photovoltaics, residential applications, storage solutions, and climatic conditions. These factors significantly impact the electrical output of PV systems, their lifespan in different climates, the annual conversion efficiency of PVs in the Gyeonggi Province region, sensitivity analysis, and multi-criteria optimization methods such as MDCA. Consequently, it will be necessary to use and add the following references to the bibliography:

   a) Comparative analysis of photovoltaic configurations for agrivoltaic systems in Europe. https://doi.org/10.1002/pip.3727.
   b) Photovoltaic Panel System with Optical Dispersion of Solar Light for Greenhouse Agricultural Applications. https://doi.org/10.3390/agriengineering7040125.

c) A multidisciplinary view on agrivoltaics: Future of energy and agriculture. https://doi.org/10.1016/j.rser.2024.114515.
d) Evaluation of solar energy potential for residential buildings in urban environments based on a parametric approach. https://doi.org/10.1016/j.scs.2024.105350;
e) Prediction of building-scale solar energy potential in urban environment based on parametric modelling and machine learning algorithms; https://doi.org/10.1016/j.scs.2024.106057;
f) Modeling multi-criteria decision analysis in residential PV adoption. https://doi.org/10.1016/j.esr.2021.100789.
g) Optimal site selection for floating photovoltaic systems based on Geographic Information Systems (GIS) and Multi-Criteria Decision Analysis (MCDA): a case study. https://doi.org/10.1080/14786451.2023.2167999.
h) Modeling and simulation of the thermal behavior and electrical performance of PV modules under different environment and operating conditions. https://doi.org/10.1016/j.renene.2023.119420.
i) Detailed modeling and numerical analysis of thermo mechanical stresses in the crystalline silicon and thin film PV modules under varying climatic conditions. https://doi.org/10.1016/j.tsep.2024.102625.
j) Energy assessment and economic sensitivity analysis of a grid-connected photovoltaic system. https://doi.org/10.1016/j.renene.2019.12.127.

2. **Methodology and modeling section**:

2.1. Equations 1, 2, and 3 proposed by the authors of the article assume that a specific solar technology produces energy based on the annual amount of solar radiation received on a horizontal plane. They consider a total of 8,760 hours of solar irradiation per year. However, these formulas do not account for the climatic variations that occur at the site throughout the year. The most effective sizing method is one that incorporates actual measurements taken on-site for each day and hour over the year. This approach also considers the optimal tilt angle for the photovoltaic (PV) solar collector, which is generally set to match the latitude of the installation location.
2.2. The summary of this report highlights that a multi-criteria modeling approach is needed to evaluate the various scenarios based on five selected criteria: economic, technical, financial, social, and environmental. This approach will help us determine which scenario, by integrating all these criteria, is the most optimal and suitable.
2.3. A comprehensive study of photovoltaic (PV) technologies, including monocrystalline silicon and thin films, is essential for evaluating their electrical efficiency and thermomechanical behavior under various climatic conditions over an extended period. This rigorous analysis is crucial for accurate life cycle assessment (LCA). Additionally, this technical study should be integrated with a multi-criteria decision-making algorithm, such as TOPSIS-AHP, to optimally classify the available options.
2.4. For any multi-criteria optimization task, conducting a sensitivity analysis is crucial to understand how the chosen weight values affect the final classification of the proposed solutions. The authors rightly identify this as a limitation of their work.

3. **3. Results and discussions**:

3.1. The discussion of the study results is very long, whereas it would have been necessary to propose comparisons between the different scenarios with numbers in tables. Tables summarizing the entire study would have made it possible to highlight the essential results without having to delve into very long paragraphs and then lose the thread of ideas.
3.2. This study lacks generalizability as it focuses on a very specific case study, making its practical application to different climatic conditions limited. It is crucial to ensure that the results have broad interest and practical significance. In this context, proposing a calculation algorithm that combines modeling of photovoltaic (PV) systems under variable climatic conditions—such as ambient temperature, wind speed, and solar irradiation—with a multi-criteria optimization approach would be highly valuable.