

# Considerations for Assessing the Technical Potential of Floating Solar Photovoltaics: A Systematic Review

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## Abstract

Floating photovoltaic solar energy (FPV) are solar photovoltaic systems that float on bodies of water. They are a rapidly expanding renewable energy source emerging as an alternative to land-intensive ground-mounted solar arrays. The applications of this technology are commonly explored through technical potential assessments; a vital step in the development of renewable energy resources that allow for the identification of feasible installation sites and provide an estimation of costs, power generation, and capacity (Lee and Roberts 2018). These assessments are carried out to aid planners, policymakers, and other decision-makers in predicting and achieving goals related to the development of renewable energy; however, some considerations may be overlooked. Assessing the technical potential of solar energy without a standardized methodological framework for site selection may lead to an inconsistent range of generation outcomes, adding to the confusion and lack of confidence that has been a significant barrier to the growth of renewable energy in recent years (Seetharaman 2019). This study systematically reviewed criteria in the published literature emphasizing assessment of FPV technical potential and related siting studies, especially those using geographic technologies. The systematic review was performed in alignment with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. Preliminary findings of this systematic review suggest that FPV site selection criteria can be categorized into economic, social, environmental, and technical considerations. We aim to elucidate which criteria within each classification are important to include in an FPV siting study based on the current literature. Results from this analysis will inform the standardization of a site-selection framework used in future technical potential studies, which may, in turn, improve the accuracy of generation estimates and offer a meaningful and realistic idea of how FPV installations could transform the direction of renewable energy science and development.

## Introduction

Floating photovoltaic solar energy (FPV) are photovoltaic solar energy systems that float on bodies of water (see Fig. 1). They are a rapidly expanding source of renewable energy and alternative to ground mounted solar arrays. The geographic potential of this technology is commonly evaluated through technical potential assessments (Lee and Roberts. 2018). Such assessments can play a vital role in the development of renewable energy infrastructure by identifying feasible installation sites and providing an estimation power generation (Fig. 2). Variations in the methodological framework for site selection, including differences in inclusion criteria, may lead to inconsistencies in generation outcomes and issues related to environmental justice (Seetharaman et al. 2019).

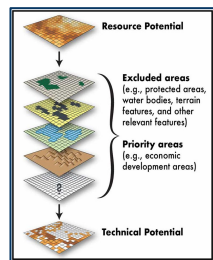


Fig. 2: Technical potential assessments use spatial criteria to determine where a renewable energy source is technically feasible (Source: REE 2021)

## Research Questions

1. What inclusion and exclusion criteria are used for determining areas suitable for FPVs in technical potential assessments?
2. To what extent are social and environmental criteria overlooked?



Fig. 1: A floating solar photovoltaic array installed upon a small body of water in Orlando, FL (Source: Emma Forester)

## Methods

To answer our research questions, we systematically reviewed the literature using the PSALSAR framework) in conjunction with the PRISMA statement. The PSALSAR, or Protocol, Search, Appraisal, Synthesis, Analysis, and Report framework is a procedure that clearly defines search scope and integrates with the PRISMA methodology (Mengist et al. 2020). The PRISMA statement, or the Preferred Reporting Items for Systematic Reviews and Meta-Analyses is a methodology for producing transparent, accurate, and replicable systematic literature reviews (Page et al. 2021).

## Data Collection

The scope of searches were limited to technical potential assessments (because they must have a site selection element to develop an exclusion layer) as well as related siting studies. Google Scholar, SCOPUS, and ScienceDirect Databases were used to collect articles for review (Fig. 3). The full workflow for the article appraisal process can be seen in Fig. 4. At the end of this process, there were 185 full texts to review for data extraction. We are currently extracting variables of interest from each site selection process and categorizing them as technical, environmental, and/or social criteria.

Database / Search Engine / Top-Level Source	Date Range	Search String	Limits / Refinements / Filters / Number of Options Used	Number of Results
Google Scholar	1994-2021	"floating solar photovoltaic" OR "floating pv" OR "floating photovoltaic" AND "gis" OR "siting" OR "technical potential"	unchecked "include citations" and "include patents"	381
SCOPUS	2013-2021	TITLE-ABS-KEY ("floating AND solar AND photovoltaic" OR "floating AND pv OR typ OR floatovoltaic AND pv OR siting OR technical AND potential")	Only search title-abstract keywords	11
Science Direct	1985-2021	("floating solar photovoltaic" OR "floating pv" OR "floating photovoltaic") AND ("gis" OR "siting" OR "technical potential")	no limits on search	358
				n=199

Fig. 3: The search strategy for each database varied, owing to the unique Boolean logic each website accepted for search strings.

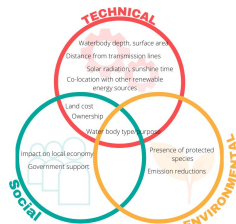


Fig. 4: Example of site selection criteria categorized as technical, social, and environmental consideration.

## Results/Discussion

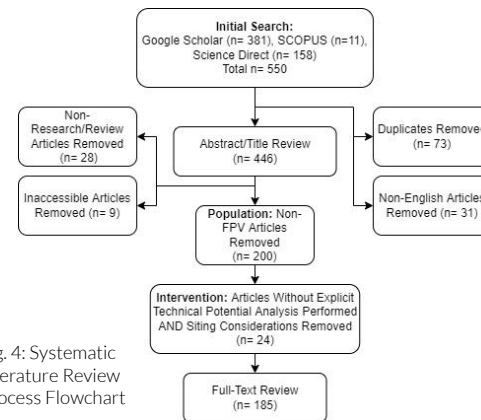


Fig. 4: Systematic Literature Review Process Flowchart

Since the literature review is still in the Synthesis stage, the few emerging trends seen are not yet conclusive.

1. Techno-economic considerations appear the most frequently and consistently across FPV technical potential assessments and site selection studies
2. Environmental considerations appear less often
3. Social considerations appear inconsistently as site selection criteria
4. There have been an increasing number of site selection studies specific to offshore FPV, which require a different set of site selection criteria than those placed on inland water bodies

## Conclusion

We have observed that there is no standard site selection procedure for floating solar photovoltaics. With this review, we hope to systematically identify the trends and gaps in the body of literature related to FPV siting to inform a standardized taxonomy of criteria for future technical potential analyses.

## Acknowledgements

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