Best Practices Handbook for the Collection and Use of Solar Resource Data for Solar Energy Applications: Fourth Edition

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Executive Summary

The "Best Practices Handbook for the Collection and Use of Solar Resource Data for Solar Energy Applications, Fourth Edition" is an updated and comprehensive reference for professionals in the solar energy industry, providing guidelines on solar resource data collection and usage. This edition, published in collaboration between NREL and IEA PVPS Task 16 experts, incorporates the latest advancements in solar energy assessment and forecasting.

The handbook is organized into multiple chapters, each addressing specific aspects of solar resource data collection, assessment, and application:

1. Importance of Solar Resource Information: The handbook starts by underscoring the crucial role of reliable solar resource data in solar power projects, especially large-scale systems such as photovoltaic (PV) and concentrating solar power (CSP). Developers need accurate data to ensure that a project's financial and operational viability is supported by solid solar radiation information, reducing risks related to resource variability.
2. Solar Radiation Resource Concepts: This chapter outlines key concepts, including global horizontal irradiance (GHI) and direct normal irradiance (DNI), which are critical for selecting appropriate solar technologies and evaluating system performance. The Earth's orbit, atmosphere, and surface features all influence solar radiation availability, and understanding these factors is essential for accurate resource assessment.
3. Measuring Solar Radiation: A significant focus is placed on best practices for measuring solar radiation, ensuring that data collected is of high quality and reliability. Different measurement instruments, such as pyranometers and pyrheliometers, are discussed, and guidance is provided on station design and operations for optimal data acquisition.
4. Data Quality Assessment and Control: This chapter covers the assessment of solar radiation data, emphasizing the importance of identifying errors caused by factors like soiling or misalignment. Automated tests, daily inspections, and long-term data analysis are discussed, helping operators maintain high data quality.
5. Additional Meteorological Variables: Besides solar radiation, variables such as wind speed, ambient air temperature, aerosols, and surface albedo also play crucial roles in assessing the performance of solar energy systems. These variables are essential for improving the accuracy of solar energy production estimates and system reliability.

6. Solar Resource Variability: Given that solar radiation is inherently variable due to atmospheric conditions, this chapter addresses the temporal and spatial variability of solar resources. Understanding these variations is vital for balancing energy production with grid demand, ensuring efficient system operation.
7. Modeling Solar Radiation: The handbook also discusses the modeling techniques used to estimate solar radiation, including satellite-based models and numerical weather prediction. Such models are key to estimating radiation at different orientations and locations, enhancing the ability to predict solar energy production accurately.
8. Solar Resource Models and Data: The various sources of solar resource data are described in this chapter. From ground-based measurements to satellite-derived data, the chapter provides a repository of information for practitioners needing accurate solar datasets for analysis and project planning.
9. Forecasting Solar Radiation and Photovoltaic Power: Solar forecasts are critical for managing grid operations, especially with the increasing penetration of solar power. This chapter explores short-term and long-term forecasting methods, from minute-by-minute predictions to day-ahead forecasts, which are essential for operational planning and reserve management.
10. Uncertainty in Solar Resource Data: No measurement or model is perfect, and this chapter focuses on estimating uncertainty in both measured and modeled data. Accurate estimation of uncertainty is important for risk mitigation and project decision-making.
11. Applying Solar Resource Data to Projects: This practical chapter provides insights into using solar resource data at different stages of a project, from prefeasibility to operational phases. It also touches on yield estimation methodologies, data bankability, and power output variability, ensuring that solar energy projects are grounded in reliable, accurate data.
12. Future Directions: Looking ahead, the handbook discusses upcoming trends and technologies, such as the increasing role of machine learning in solar energy applications and the impact of climate change on solar resource availability. These insights provide a forward-looking perspective on solar energy's evolution and the continuous improvement of resource data collection and application.

In conclusion, this fourth edition of the handbook serves as a vital resource for industry professionals, researchers, and policymakers involved in solar energy projects. It offers an extensive overview of solar resource data practices, ensuring that solar energy systems are designed, assessed, and operated based on the best available information.

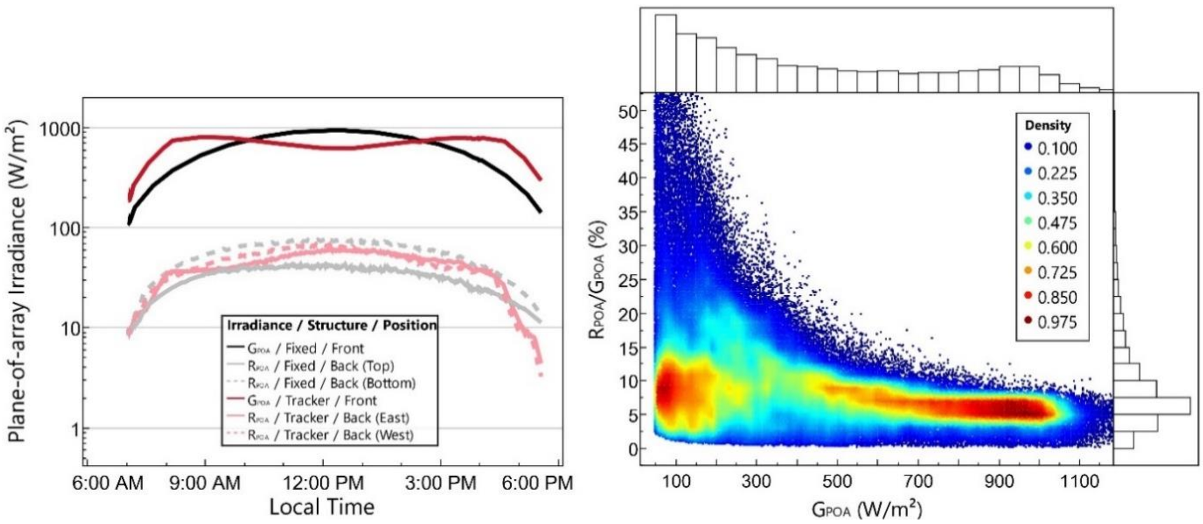

Figure 3-241. Diurnal plot of GTI (labeled as GPOA) and RPOA for fixed-tilt and single-axis tracker systems (left). Rear-to-front-side irradiance ratio versus POA from 1 year of measurements on a fixed-tilt bifacial system (right). Figures by Nicholas Riedel-Lyngskær