IJRTS TAKSHILA FOUNDATION

An Edited Book

NEW CHALLENGES IN ENVIRONMENTAL & SUSTAINABLE ENERGY FOR GREEN FUTURE

ISBN
978-81-966175-6-1

12 September 2024

Chief Editor

Prof. Vijay Aithekar

Assistant Professor, Dept. of Science
Oriental University, Indore, MP 453555, India

Invited Manuscripts

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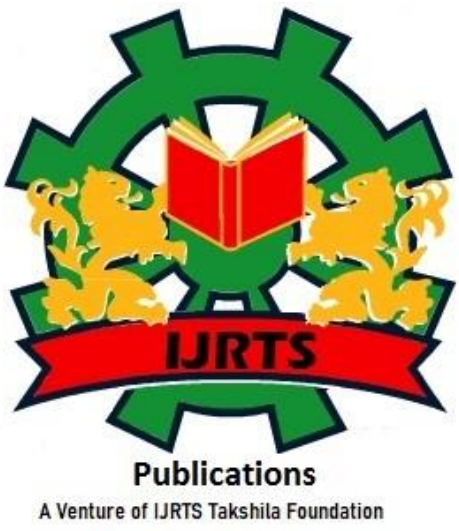

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ISBN: 978-81-966175-6-1
Price: ₹ 999

Published by Dr. Vipin Mittal for IJRTS Takshila Foundation,
71-75 Shelton Street, Covent Garden, London WC2H 9JQ ENGLAND
Printed in India
by Mittal Printers, SCF#10, Opposite DRDA, Jind-126102 INDIA
Bound in India
By Satyawaan Binders, SCF#09, Opposite DRDA, Jind-126102 INDIA

Preface

As we face growing environmental challenges, the need for sustainable energy solutions has become more urgent than ever. Climate change, resource depletion, and pollution are some of the biggest threats to our planet, and how we produce and use energy plays a central role in these issues. Transitioning to clean and sustainable energy is essential for protecting the environment and ensuring a healthier future for generations to come.

"New Challenges in Environmental & Sustainable Energy for Green Future" aims to explore the various obstacles and opportunities in the journey toward a more sustainable energy system. This book looks at the latest advancements in renewable energy, energy efficiency, and green technologies, while also addressing the barriers that still exist in adopting these solutions. From technical challenges to policy issues, this book covers the wide range of factors that must be considered to achieve a greener and more sustainable energy future.

The purpose of this edited book is to provide readers with a clear understanding of the key challenges and opportunities in the field of sustainable energy. It will discuss the importance of collaboration between governments, industries, researchers, and communities in driving the necessary changes. By highlighting both the progress we've made and the work that still needs to be done, I hope to inspire action and encourage innovative thinking to solve these critical environmental problems.

This edited book is written for anyone interested in learning more about sustainable energy, whether they are students, researchers, industry professionals, or concerned citizens. My hope is that it will help readers understand the importance of sustainable energy in shaping a better future for our planet. I owe the dedication to my mother Late. Smt. Sarla Aithekar.

As we move forward, the decisions we make about energy will have a lasting impact on the environment. This book is a call to action for all of us to work together and find solutions that support a green and sustainable future.

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Understanding Solar Cell Efficiency at Low Intensity Levels: A Qualitative Examination of Influencing Factors

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Abstract

The transition to renewable energy sources is essential for reducing the environmental impact of fossil fuels such as petroleum and diesel. Photovoltaic (PV) cells are at the forefront of this shift due to their ability to convert sunlight into electricity without harmful emissions. However, despite their benefits, PV cells often exhibit lower efficiency compared to traditional energy sources, leading to higher costs. This review explores various factors that influence the efficiency of solar cells, including installation design, solar module characteristics, and environmental conditions. Addressing these factors is crucial for improving performance, increasing energy output, and reducing costs. Environmental factors such as sunlight intensity and temperature, along with material quality and design innovations, play significant roles in optimizing PV performance. The review also highlights less obvious factors impacting efficiency and underscores the importance of a comprehensive approach to advancing solar technology. By adopting these strategies, PV cells can become more competitive and contribute to sustainable energy solutions.

1. Introduction

Solar photovoltaic (PV) technology represents a significant advancement in reducing reliance on fossil fuels and mitigating carbon emissions. PV cells harness solar energy, providing a sustainable alternative that contributes to reducing environmental damage and improving energy security. Currently, solar power accounts for about 20% of global renewable energy, with significant growth expected in the coming years. Despite their potential, PV cells face challenges related to efficiency, which is influenced by a range of factors including both environmental conditions and technological aspects.

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Solar PV efficiency is affected by several parameters, including fill factor, ideal power, and overall performance. Environmental factors such as temperature, moisture, wind speed, light quality, altitude, and atmospheric pressure have a considerable impact on PV cell efficiency. Additionally, less obvious factors like the albedo effect, parasitic resistances, and contamination from sources such as vehicle exhaust and bird droppings also affect performance. Addressing these issues is crucial for optimizing solar cell efficiency and enhancing their overall effectiveness in harnessing solar energy.

2. Impact of Parameters

2.1 Environmental Factors

2.1.1 Solar Cell Temperature: Temperature plays a critical role in the performance of PV cells. As temperatures rise, the band gap of the cell decreases, and the reverse saturation current increases, this can lead to a reduction in output efficiency. Effective cooling solutions are essential to maintain optimal performance and mitigate the adverse effects of high temperatures.

2.1.2 Dust Deposition: Dust accumulation on solar panels can significantly impair their efficiency and fill factor, reducing power output. Regular cleaning is necessary to maintain performance, and the development of low-maintenance panels is essential to address dust-related issues.

2.1.3 Wind Speed: Wind can positively impact PV panel efficiency by aiding in cooling and dust removal. While moderate wind speeds can enhance performance, extreme wind conditions may negatively affect the stability and productivity of solar installations.

2.1.4 Shading Effects: Shading from objects such as trees or buildings can reduce solar module efficiency by creating hotspots and performance issues. To minimize shading effects, proper panel placement and the use of bypass diodes are recommended.

2.1.5 Humidity: High humidity can cause water droplets to form on panels, leading to rust and a reduction in panel lifespan. This, in turn, affects the power, voltage, and current output of the PV system.

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2.1.6 Rainfall and Cloud Cover: Cloud cover and rainfall can dramatically reduce solar panel output, with reductions of up to 93% observed on cloudy or rainy days. Effective system design should account for these variability factors to optimize performance.

2.1.7 Irradiance: The intensity of sunlight directly influences PV performance. Sunny conditions enhance the efficiency of solar panels, while cloudy or rainy weather can significantly decrease output.

2.1.8 Color Wavelength Spectrum: The color of light affects solar panel performance. Studies have shown that different color filters can impact the efficiency and voltage output of PV modules, highlighting the importance of optimizing light conditions.

2.1.9 Air Pressure: Air pressure influences photon energy and electron extraction in solar cells. Higher air pressure can improve output voltage and current, thereby enhancing overall efficiency.

2.1.10 Tilt Angle: The tilt angle of solar panels is crucial for maximizing performance. A 45-degree tilt facing south is generally optimal for achieving the best power output, efficiency, and fill factor.

2.2 Solar Module Characteristics

2.2.1 Material Choice: Solar cells are classified into three generations: wafer-based silicon (first generation), thin-film silicon (second generation), and advanced technologies like nanocrystals and perovskites (third generation). Each generation presents unique efficiency levels and manufacturing complexities.

2.2.2 Dust-Free Coating: Applying dust-resistant coatings and implementing regular cleaning practices are essential for preventing dust buildup, which can reduce PV output by up to 30% on a monthly basis.

3. Solar Installation Design Factors

3.1 Maximum Power Point Tracking (MPPT): MPPT inverters optimize solar power performance by adjusting to environmental conditions and ensuring compliance with grid standards. This technology is crucial for maximizing energy harvest from PV systems.

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3.2 Tilt Angle and Orientation: The correct tilt angle and orientation of solar modules are essential for efficiency. A tilt angle of 45 degrees facing south is typically optimal for performance.

3.3 Cable Thickness: The thickness of cables connecting solar modules affects system efficiency. Thicker cables reduce voltage drops and resistive losses, which improves overall system performance.

4. Other Hidden Factors

4.1 Albedo Effect: The albedo effect, which measures light reflection from surfaces, impacts solar panel efficiency. High reflectivity can lead to energy loss, reducing the effectiveness of PV cells.

4.2 Parasitic Resistances: Series and shunt resistances in solar cells can affect efficiency. Advances in technology aim to minimize these resistances and improve cell performance.

4.3 Degradation of PV Modules: PV systems typically have a lifespan of 25 years, with performance degradation affecting efficiency over time. Maintaining rated power in the initial years is crucial for long-term performance.

4.4 Mounting: Proper mounting of solar panels, whether on rooftops or the ground, influences system efficiency and stability.

4.5 Potential-Induced Degradation (PID): PID can cause significant output loss and cell damage, especially in ungrounded systems. Addressing PID is vital for maintaining system efficiency.

4.6 Car Exhaust Smoke: Smoke from vehicle exhaust can reduce panel efficiency, highlighting the need for regular maintenance and cleaning.

4.7 Bird Droppings: Bird droppings can damage solar modules and reduce their efficiency. Regular cleaning is necessary to prevent such damage.

4.8 Reflection: Antireflection coatings and rough surfaces on silicon cells can enhance efficiency by minimizing light reflection and increasing light absorption.

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4.9 Inverter Efficiency: Inverters are crucial for converting DC to AC power in PV systems. High-efficiency inverters contribute significantly to overall system performance.

5. Impact of Low Intensity on Solar Cells

5.1 Technological Impact: Low sunlight intensity reduces energy conversion efficiency, requiring more materials to produce the same amount of energy. This increases costs and environmental impact.

5.2 Economic Impact: Reduced efficiency at low light levels raises costs per watt and extends payback periods, making solar technology less attractive economically.

5.3 Environmental Impact: Large-scale solar installations needed to compensate for low-intensity conditions can lead to significant land use, potentially disrupting local ecosystems and biodiversity.

5.4 Social Impact: Higher costs and lower returns limit access for low-income households, exacerbating energy disparities. Public perception of solar technology can be influenced by its efficiency and associated costs.

6. Conclusion

This review has examined critical factors affecting the performance of solar PV systems, including temperature, irradiance, tilt angle, and dust accumulation. Effective management of these factors, combined with technological advancements, can enhance solar cell performance. Addressing hidden factors such as the albedo effect and PID is essential for optimizing efficiency. A holistic approach to improving solar technology will make it more competitive and sustainable, contributing to a greener energy future.

Acknowledgment

I extend my sincere gratitude to the Department of Science, Oriental University Indore, and my esteemed guide, Dr. Hasina Adil Mam, for their invaluable support and resources that facilitated the completion of this review.

ISBN: 978-81-966175-6-1

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ISBN: 978-81-966175-6-1

Ethics in Publishing: Upholding Integrity in Academic Communication

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Abstract

Academic publishing serves as the cornerstone of knowledge dissemination, influencing education, policy, and research across diverse fields. The integrity of this communication process is vital to ensure the reliability and credibility of published work. This paper explores the importance of ethics in academic publishing, highlighting key challenges such as plagiarism, data manipulation, authorship disputes, and conflicts of interest. Additionally, it emphasizes the roles of editors, peer reviewers, and institutions in maintaining ethical standards. The paper concludes by suggesting measures for strengthening ethical practices in scholarly communication, reinforcing the importance of transparency, accountability, and integrity.

Introduction

Academic publishing is the foundation of knowledge dissemination, contributing significantly to the advancement of science, technology, and various fields of study. The ethical responsibilities associated with this process cannot be overstated, as they ensure the integrity and credibility of published research. Unethical practices, such as plagiarism, falsification of data, and conflicts of interest, can tarnish the reputation of both the academic community and the broader scientific enterprise. As the volume of published work continues to grow, so does the need for vigilance in maintaining ethical standards.

This paper discusses the core principles of ethics in publishing, the challenges encountered in upholding these standards, and the key stakeholders responsible for ensuring ethical compliance. It also explores the importance of transparency and accountability in fostering trust within the academic community and the broader public.

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Ethical Principles in Academic Publishing

The fundamental principles of ethical academic publishing revolve around honesty, transparency, accountability, and fairness. These principles are essential for preserving the integrity of the scholarly record and ensuring that published work contributes meaningfully to the advancement of knowledge.

1. Honesty and Accuracy

Researchers are expected to present their findings truthfully and accurately, without manipulation or fabrication of data. Misleading or falsified data undermines the credibility of the research and can have serious consequences, such as misinforming future research, policy decisions, or medical practices.

2. Transparency and Disclosure

Transparency is crucial in the publication process. Researchers should disclose any conflicts of interest, funding sources, and affiliations that may influence the study's outcome or interpretation. Similarly, transparency extends to data sharing, where researchers should make their data accessible for verification and replication by other scholars.

3. Fairness in Authorship

The issue of authorship can be a source of ethical tension in academic publishing. Proper credit should be given to individuals who have made significant contributions to the research. Ethical guidelines require that authorship is accurately assigned, and all contributors are fairly acknowledged. Ghostwriting, honorary authorship, and exclusion of deserving contributors violate ethical standards.

4. Peer Review Integrity

The peer review process is central to maintaining the quality and credibility of academic publications. Peer reviewers play a crucial role in evaluating the validity, significance, and originality of research. To ensure ethical integrity, reviewers must maintain confidentiality, provide unbiased feedback, and avoid conflicts of interest that could compromise their objectivity.

Challenges in Upholding Publishing Ethics

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While the principles of ethical publishing are well-established, various challenges threaten their consistent application in academic communication. These challenges include plagiarism, data manipulation, conflicts of interest, and the proliferation of predatory journals.

1. Plagiarism and Self-Plagiarism

Plagiarism, or the presentation of another's work as one's own, is a severe violation of ethical publishing standards. It undermines the originality of research and damages the trust that readers place in the scholarly record. Self-plagiarism, where authors republish their own previously published work without proper attribution, is another concern, as it inflates the academic output without contributing new knowledge.

2. Data Fabrication and Manipulation

One of the most serious breaches of ethics in research publishing is the fabrication or manipulation of data. This practice involves altering research results to support desired outcomes, which can mislead readers and researchers who rely on published data. Such actions can cause a ripple effect, with future research building on falsified findings, leading to a cycle of misinformation.

3. Authorship Disputes

Authorship disputes often arise when there is a lack of clarity about the contributions of each individual involved in the research. Unethical practices such as "guest authorship" (granting authorship to individuals who made no significant contribution) or "ghost authorship" (excluding deserving contributors) are common issues that need to be addressed to maintain fairness in the publishing process.

4. Conflicts of Interest

Conflicts of interest occur when personal, financial, or professional relationships could potentially influence the objectivity of the research. Authors, reviewers, and editors must disclose any conflicts of interest to avoid bias in the publication process. When undisclosed conflicts of interest come to light, they can severely damage the credibility of both the research and the journal.

5. Predatory Journals

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The rise of predatory journals—publications that prioritize profit over rigorous peer review and ethical standards—poses a significant challenge to academic publishing. These journals often publish low-quality or even fraudulent research, bypassing the safeguards that reputable journals have in place. Researchers, especially those early in their careers, may fall prey to predatory journals due to their aggressive marketing tactics and promises of rapid publication.

The Role of Stakeholders in Maintaining Ethical Standards

The responsibility for maintaining ethical standards in academic publishing does not fall on authors alone. Editors, peer reviewers, academic institutions, and funding bodies all play crucial roles in ensuring the integrity of the scholarly communication process.

1. Editors and Journal Publishers

Editors are gatekeepers of the academic publishing process. They are responsible for ensuring that submitted manuscripts meet ethical standards and are free from plagiarism, data manipulation, and conflicts of interest. Journal publishers must also enforce rigorous peer review procedures and provide clear guidelines on ethical practices for authors, reviewers, and editors.

2. Peer Reviewers

As part of the peer review process, reviewers must evaluate submissions impartially and provide constructive feedback. They should be vigilant in identifying potential ethical issues, such as plagiarism or conflicts of interest, and report any concerns to the journal editor. Reviewers also have an ethical responsibility to maintain confidentiality and avoid any biases that could influence their assessments.

3. Academic Institutions

Universities and research institutions are pivotal in promoting ethical research and publishing practices. They should provide training on research ethics, plagiarism prevention, and proper authorship attribution. Institutions must also have mechanisms in place to investigate allegations of misconduct and take appropriate disciplinary actions when necessary.

4. Funding Bodies

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Funding agencies play a key role in shaping the research landscape. By requiring transparency and ethical compliance in grant applications and funded projects, they can ensure that research integrity is upheld. These agencies can also contribute to ethical publishing by mandating data sharing and disclosure of conflicts of interest.

Recommendations for Enhancing Ethical Practices

To strengthen ethical standards in academic publishing, several measures can be implemented:

1. **Clear Ethical Guidelines:** Journals should provide clear and detailed ethical guidelines for authors, reviewers, and editors. These guidelines should outline expectations for transparency, authorship, data sharing, and disclosure of conflicts of interest.

2. **Plagiarism Detection Tools:** Publishers and academic institutions should invest in advanced plagiarism detection tools to identify potential instances of plagiarism before publication.

3. **Education and Training:** Researchers should receive ongoing training in ethical publishing practices, including proper citation, authorship attribution, and data management.

4. **Strengthening Peer Review:** Enhancing the rigor of the peer review process through double-blind reviews and transparent criteria for evaluating manuscripts can help maintain the quality and integrity of published research.

5. **Addressing Predatory Journals:** Academic institutions and funding agencies should raise awareness about predatory journals and provide researchers with resources to identify legitimate outlets for publication.

Conclusion

The ethical challenges in academic publishing are multifaceted and demand a collective effort from authors, editors, reviewers, institutions, and funding bodies. Upholding integrity in scholarly communication is essential for the credibility of the academic community and the advancement of knowledge. By adhering to ethical principles, such as transparency, honesty,

ISBN: 978-81-966175-6-1

and accountability, and by addressing the challenges posed by unethical practices, the academic publishing system can continue to serve as a trusted source of information and innovation. The ongoing commitment to these standards is crucial for fostering trust in research and ensuring that the scientific record remains reliable and robust.

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IJRTS Takshila Foundation

Reg. No. U80902HR2022NPL104244

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