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Covid-19 Pandemic and Supply Chain Disruption in the Solar Energy Sector of India

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Abstract

The renewable solar and power sector, as well as supply chains and businesses, has been significantly impacted by the COVID-19 pandemic, posing challenges to the ongoing sustainable energy transition. This research delves into the repercussions of the pandemic on power demand, the financial health of power distribution companies, electricity generation, the growing role of renewable energy sources, and the solar industry in India. The study focuses on both under-construction and operational solar projects, examining the issues and challenges faced by the Indian renewable power and solar sector. The paper analyses various policies and regulations introduced by the Ministry of New and Renewable Energy (MNRE) to provide relief to renewable energy developers. These support measures, announced in recent months, are detailed to highlight the efforts aimed at mitigating the adverse effects of the pandemic on the renewable energy sector in India. Finally, the paper offers insights into post-Covid era strategies for the Indian renewable energy sector. It analyses the existing policies aimed at realising this objective and addresses the challenges linked to solar electricity generation. India has taken place to achieve net - zero by 2070 and Panchamrit by 2030 here solar sector will be a major contribution to the energy basket in general and renewable energy in particular. Although there was slow progress in the solar sector during covid 19 period yet in the post-COVID period this sector is destined to flourish taking into consideration present energy generation and investment in the solar sector. Lastly, the paper provides a concise overview of the current state and evolution of the Indian RoofTop PV system market, highlighting key public and private corporations contributing to the development of solar RoofTop PV systems in the country.

Keywords: *Covid-19 pandemic, Roof Top PV system, Solar Energy, Renewable Energy, Supply Chain disruption.*

1. Introduction

The unequal distribution of the world's natural resources, including mines of coal and natural gas, as well as deposits of uranium and lithium, poses a longstanding problem. The rapid growth of India, with its population of 1.4 billion, and the subsequent increase in energy demand, further exacerbate this concern. Compounding the issue, the world has recently witnessed a surge in energy prices, driven by the scarcity of natural resources failing to meet the demands of energy consumers. Consequently, there is a growing emphasis on accessing renewable energy supplies such as solar energy, hydro electricity, nuclear energy, and more.Like other industries, the renewable energy sector faces new challenges, particularly in the wake of the Covid-19 pandemic. On April 5, 2020, global lockdown measures peaked, affecting over 4.2 billion people, more than half of the global population—through complete or partial lockdowns. Social-distancing guidelines, restrictions on business activities, travel bans, and border closures led to supply chain disruptions, project construction delays, and macroeconomic challenges. While many countries, including India, consider the energy sector essential, lockdown measures do not guarantee uninterrupted construction activity on energy projects, including renewables.

The resulting delays, stemming from disruptions in the supply chain and the closure of construction sites, have an evident impact on short-term capacity additions, with repercussions likely to be felt in 2020. It is reasonable to anticipate that numerous projects missing incentive deadlines may face further delays or cancellations. In response to these challenges, countries, akin to India, have introduced policy changes to achieve sustainability in their energy sectors.It has succeeded in increasing electricity access for more of its citizens, enhancing energy efficiency and renewables, and implementing measures to reduce air pollution. Historically, developed economies have consistently shown higher greenhouse gas emissions compared to their developing counterparts. However, recent studies indicate a reversal of this trend. Projections from the International Energy Agency foresee a surge in India's overall energy consumption by 2050, driven primarily by demographic expansion, positioning the country as the world's most populous. Greenpeace's research underscores influential factors like population growth and GDP development, predicting a more than 200 percent increase in energy demand in India by 2040–50. In response to challenges such as energy poverty and the environmental impacts of conventional sources, a transformative shift towards non-conventional sources, including Hydropower, Bioenergy, Nuclear, Wind, and Solar energy, has emerged. Solar advancements, in particular, showcase both nuanced and revolutionary progress, from nanowire-adorned solar panels to windows seamlessly converting light into electricity. Thin and flexible solar panels, solar farms on water, and solar paint have evolved from concepts to tangible inventions, propelling us toward a future where virtually anything holds the potential to generate clean energy.

2. Objectives of the Study

The primary objective of this study is to examine the impact of the COVID-19 pandemic on the solar energy sector in India, with a particular focus on supply chain disruptions. It aims to assess how restrictions on international trade, factory shutdowns, and transportation delays affected the availability of critical solar components such as photovoltaic modules, inverters, and raw materials. The study also seeks to analyze the resulting delays in project implementation and their economic implications for developers and investors. Additionally, it intends to explore the adaptive measures taken by the government and industry stakeholders to restore supply chain resilience, promote local manufacturing, and reduce dependency on imports. Through this, the study aspires to provide strategic recommendations for strengthening the solar sector's preparedness against future global disruptions.

3. Research Questions

This research aims to enquire a following questions:

- What were the key supply chain bottlenecks faced by India's solar energy sector during the COVID-19 pandemic? How did the disruption in the global supply of solar components impact the progress and cost of solar energy projects in India?

- What strategies were adopted by stakeholders to mitigate supply chain risks and enhance resilience in the post-pandemic solar sector?

4. Theoretical Framework

This study is grounded in the Supply Chain Disruption Theory and the Resource Dependence Theory (RDT) to explore the impact of the COVID-19 pandemic on India's solar energy sector. The Supply Chain Disruption Theory provides a lens to understand how unexpected global shocks, such as pandemics, can interrupt the normal flow of goods, services, and capital across interconnected systems. It emphasizes the vulnerabilities of global supply networks, particularly in industries that rely heavily on imports for critical components such as solar modules, inverters, and raw materials in India's solar sector.

Complementing this, the Resource Dependence Theory explains the challenges faced by organizations that rely on external sources for essential resources. India's heavy dependence on imported solar components, especially from countries like China, created significant constraints during the pandemic due to border closures, shipping delays, and factory shutdowns. This theoretical approach helps highlight the strategic risks of over-dependence and the importance of diversification, localization, and policy intervention.

Together, these theories frame the study's analysis of how the pandemic disrupted solar energy supply chains in India, the response strategies adopted by stakeholders, and the emerging push towards domestic manufacturing and resilient infrastructure in the post-COVID era.

5. Literature Review

This study systematically examines the various links between solar energy and supply chain disruption, encompassing aspects such as covid-19 pandemic, deconcentration of solar energy. It critically analyzes the widely accepted notion that sustainable development goals have the potential to incite solar energy. Additionally, the research explores how supply chain disruption in the solar energy sector of India poses security challenges and assesses strategies for both mitigation and adaptation. By addressing these interconnected dimensions, the study highlights the broader implications of solar energy on global stability and security frameworks **(M. Mukherjee, 2014)**.

The book gives us a good understanding of the concept of solar energy and sustainable development goals from a theoretical perspective. India is concerned about energy security. The country's deconcentration of solar energy's contribution reserves will be adequate only for a decade and growing power consumption would need to be addressed through SDG **(S Narayan & Sreeradha Datta, 2020)**.

The Solar Home Systems (SHS) program was launched in January 2003 under the leadership of the Infrastructure Development Company Limited (IDCOL), a state-owned entity established in 1997 to support infrastructure and renewable energy initiatives in India. The primary objective of the SHS program was to provide basic electricity access to rural communities not connected to the national grid. Shortly after its inception, the program gained momentum with the support of international partners, including the World Bank and the International Development Association (IDA). These organizations contributed to the initiative through the Rural Electrification and Renewable Energy Development (RERED) Project. The World Bank's initial funding was subsequently renewed multiple times, enabling the continued expansion of off-grid solar energy solutions across India **(*The Public Impact Fundamentals Helping Governments Progress from Idea to Impact*, 2016)**.

A truly equitable and inclusive global energy transition cannot be achieved without ensuring universal access to electricity. According to the International Energy Agency (IEA), if current trends continue, approximately 660 million people across the Global South will remain without electricity by 2030, the target year for meeting the Sustainable Development Goals (SDGs). While centralized power grids continue to expand, decentralized renewable energy (DRE) systems are increasingly bridging the energy access gap. These systems serve as both alternatives and complements to centralized networks. In 2021 alone, DRE solutions provided electricity to 179 million people, a significant increase from just 35 million in 2012. DRE technologies offer a quicker and more cost-effective path to electrify rural and sparsely populated regions. Furthermore, leveraging renewable energy to meet the growing power

needs of developing nations enables a double leapfrog advancing both energy access and clean energy adoption. Therefore, integrating DRE into national strategies is vital for achieving a people-centered global energy transformation (***The Public Impact Fundamentals Helping Governments Progress from Idea to Impact,* 2016**).

After conducting the literature review the researcher found that most of the researchers have studied only a few aspects or a single aspect of Solar energy and sustainable development goals in India. In this context, it is to be noted that their approach is holistic. In this study, the researcher has studied the role of covid-19 pandemic and supply chain disruption in the solar energy sector of India to have a comprehensive understanding of the problems of sustainable development goals which was absent in the previous studies.

6. Methods of Study

The researcher has followed the case study, content analysis as a qualitative method to the study on Covid-19 pandemic and supply chain disruption in the solar energy sector of India. Simultaneously, the researcher used various tools of qualitative method such as questionnaire, interview, observation, participant observations etc. for the collection data. Also, the researcher followed books, book chapters, journals, periodical articles, websites, etc. as secondary sources for the study. Case Study Approach examines key covid-19 pandemic and supply chain disruption in solar energy projects, regional energy connectivity agreements, and policy frameworks implemented for search sustainable environment in India, special reference to solar energy.

7. Nature and Scope of the Study

The nature of this study is analytical and exploratory, aiming to investigate the multifaceted impact of the COVID-19 pandemic on the solar energy sector in India, with a specific focus on supply chain disruptions. It seeks to understand how the global health crisis affected the flow of solar components, delayed project execution, and altered the dynamics of renewable energy development in the country. By analyzing data from industry reports, stakeholder interviews, and policy documents, the study explores both the short-term disruptions and long-term implications for the sector.

The scope of the study encompasses the period from the onset of the pandemic in early 2020 through its peak impact and into the early recovery phase. It covers key aspects such as import dependency, logistical bottlenecks, project financing challenges, labor shortages, and the response strategies adopted by the government and private players. Furthermore, the study also examines emerging trends such as the push for domestic manufacturing, diversification of supply sources, and policy shifts aimed at building a more resilient and self-reliant solar energy ecosystem in India. Through this, the research contributes to a broader understanding of how global crises can influence national renewable energy goals and infrastructure planning.

8. Result & Discussion

8.1 Status of Solar Energy Project

As a renewable, CO2-free power source, the environmental impact of solar power is significantly smaller than that of other power generation methods. The solar power industry has been experiencing steady growth in recent years. In the United States, for example, 2019 witnessed the addition of 7 gigawatts (GW) of solar capacity, bringing the total to over 76 GW, a 23% increase from the previous year. Similar growth trends are evident worldwide, with China leading the charge, boasting over 205 GW of installed solar capacity as of 2023, accounting for more than 30% of the world's total solar capacity. India set an ambitious target of installing 175 GW of renewable energy capacity by the year 2022, including 100 GW from solar, 60 GW from wind, 10 GW from bio-power, and 5 GW from small hydro-power. However, as of December 31, 2022, the country has installed a renewable energy capacity of 120.90 GW, about 69% of the overall target, according to a report from the Standing Committee on Energy. Also at COP26, India committed to an ambitious goal of achieving 500 GW of non-fossil fuel-based energy by 2030, marking a significant enhancement. This commitment is a pivotal aspect of the 'Panchamrit' initiative and represents the world's most extensive plan for expanding renewable energy.

A rooftop solar power system, also referred to as a rooftop PV system, is a photovoltaic (PV) arrangement designed to generate electricity using solar panels installed on the rooftops of residential or commercial buildings or structures. The majority of rooftop PV stations operate as

grid-connected photovoltaic power systems. Residential rooftop PV systems typically have capacities ranging from about 5 to 20 kilowatts (kW), while those installed on commercial buildings often range from 100 kilowatts to 1 megawatt (MW). Particularly large roofs have the potential to accommodate industrial-scale PV systems within the range of 1 to 10 megawatts. The urban environment offers extensive vacant rooftop spaces, inherently sidestepping potential land use and environmental concerns. However, this is not relatable for India, as a parliamentary committee has attributed a report, stating that Considering that the installed capacity of renewable energy has grown by over 236% since 2014, this marks a significant and commendable milestone. Nonetheless, it is important to acknowledge that the gap in meeting the overall target primarily stems from slower progress in the deployment of solar rooftop systems and wind energy projects.

8.2 Government Initiative for solar energy project

The Government of India has launched several targeted initiatives to accelerate the adoption and expansion of solar energy across the country. One such initiative is the Solar Park Scheme, which envisions the development of large-scale solar parks, each with a capacity of around 500 MW, across various states to create centralized hubs for solar power generation. Complementing this is the Rooftop Solar Scheme, which seeks to utilize residential and commercial rooftops for solar panel installation, thereby promoting decentralized energy production. In rural and underserved areas, the Atal Jyoti Yojana (AJAY), introduced in September 2016, aims to improve lighting infrastructure by installing solar street lighting systems in regions where less than 50% of households are connected to the power grid, as per the 2011 Census.

Table1: Government Initiatives for Solar Energy Projects in India

Initiative	Objective	Key Features	Year Launched
Solar Park Scheme	Establish large-scale solar parks across states	Each park has ~500 MW capacity; promotes centralized solar power generation	2014
Rooftop Solar Scheme	Utilize rooftops of homes and buildings for solar energy	Provides financial incentives and subsidies for residential, commercial, and industrial installations	Ongoing
Atal Jyoti Yojana (AJAY)	Improve lighting in underserved areas using solar power	Installs solar street lights in villages with low grid connectivity (below 50% households)	2016
National Solar Mission	Drive solar development and ensure energy security	Targets 100 GW solar capacity by promoting sustainable growth and investment	2010
SRISTI Scheme	Promote rooftop solar in urban and semi-urban areas	Aims to scale up decentralized solar projects through financial support and awareness	2018
International Solar Alliance	Promote global cooperation in solar deployment	Joint initiative with France to address climate change via solar energy expansion	2015

Source: (Sathish Kumar M et al., 2024)

At a broader level, the National Solar Mission serves as a cornerstone of India's renewable energy policy, focusing on environmentally sustainable growth while simultaneously enhancing energy security. To further promote rooftop solar adoption, the SRISTI (Sustainable Rooftop Implementation of Solar Transfiguration of India) scheme was launched, encouraging widespread participation in decentralized solar power generation. On the global front, India has also taken a leadership role through the establishment of the International Solar Alliance (ISA), in collaboration with France, to foster international cooperation and collective action against climate change through the expansion of solar energy technologies. As of June 2022, Rajasthan and Gujarat emerged as the leading states in large-scale solar installations, contributing 53% and 14% respectively, with Maharashtra accounting for an additional 9%. These efforts align with India's ambitious climate goals, including a pledge to reduce projected carbon emissions by 1 billion tonnes by 2030 and achieve net-zero emissions by 2070.

8.3. Research & Development Funding for Solar energy project in India

Q3 2023 India Solar MHere are the top five funding deals in the solar sector in India during 2023, according to Mercom's market Update report:

Adani New Industries, a wholly-owned subsidiary of Adani Enterprise, secured a trade finance facility amounting to $394 million (₹32.3 billion) from Barclays PLC and Deutsche Bank AG. The financial support is intended to meet the working capital requirements of its integrated solar module manufacturing facility.

Clean Max, a Mumbai-based renewable energy company, concluded an equity fund raise of approximately $360 million (₹29.57 billion) from Brookfield Renewable through the Brookfield Global Transition Fund. This investment is aimed at supporting Clean Max's growth plans of installing 5 GW of renewables within three to four years.

Tata Power Renewable Energy (TPREL), a subsidiary of Tata Power, received a capital infusion of $20 billion (₹260 million) in the final round from UK-based Green Forest New Energies. This funding will support various businesses under Tata Power, including utility-scale solar, wind, and hybrid generation assets, solar cell and module manufacturing, EPC contracting, rooftop solar infrastructure, solar pumps, etc.

Amp Energy India, an integrated renewable energy power producer, secured up to $250 million (₹20.44 billion) in funding from Sumitomo Mitsui Banking Corporation of Japan, the Intermediate Capital Group, and the Asian Infrastructure Investment Bank. The funding is intended to enable Amp Energy India to expand its operations, accelerate its growth strategy, and meet the rising demand for renewable energy solutions in India.

Juniper Green Energy, an independent power producer in solar, wind, and hybrid projects, raised $150 million in investment from AT Capital Group and VITOL to drive capacity expansion. The firm aims to triple its capacity to 2.5 GW by 2026, building on its over-3 GW development pipeline

Broader Market Context is India & Global are overall solar-sector funding in India Q3 2023 amounted to $1.57 billion, down 22% YoY from $2.02 billion in Q3 2022. Delays in utility-scale projects and declining module prices were cited as key factors behind the slowdown. National corporate solar funding (VC + public markets + debt) reached a decade-high $34.3 billion worldwide in 2023, with India participating through major equity, debt, and public-market inflows. In the first half of 2023, global VC funding stood at $3.8 billion (33 deals), and solar debt financing in India and globally was robust—$8 billion in 33 Indian deals and $20 billion globally, marking strong appetite for project finance and securitization deals.

9. Challenges in solar Power Project monitoring

First, acquiring land with clear title can be a complex process, and several hurdles may be encountered during this endeavour. Some common challenges and hurdles in the acquisition of land with clear title include, Land Ownership Disputes, Encumbrances and Liens,Incomplete Land Records, Government Regulations and Approvals, Political and Social Issues. Second, A "mismatch" in the time taken to set up a project and the infrastructure to route the power produced to the grid refers to a discrepancy or

misalignment in the timelines between establishing a power generation project and developing the necessary infrastructure to connect and transmit the produced electricity to the electrical grid. This mismatch can lead to several challenges and consequences: Operational Delays, Financial Implications, Grid Congestion. Third, The COVID-19 pandemic had profound impacts on global economic activity, and it also had both positive and negative effects on environmental issues. Here are some key aspects to consider: it reduced Emissions and Air Pollution, Energy Consumption Decline apart from Increased Medical Waste, Shifts in Environmental Priorities, Impact on Conservation Efforts etc.

It's important to note that while there were short-term positive environmental impacts during the lockdowns, the long-term effects will depend on how societies and governments approach post-pandemic recovery. There is an opportunity to build back in a more sustainable and environmentally conscious way, emphasising green technologies, renewable energy, and resilient environmental policies. Balancing economic recovery with sustainable practices will be crucial for addressing both environmental and economic challenges in the aftermath of the pandemic.

10. Limitations of the Study

While this study offers valuable insights into the effects of the COVID-19 pandemic on the solar energy supply chain in India, it is subject to certain limitations. Firstly, the rapidly evolving nature of the pandemic means that data may become outdated quickly, limiting the ability to capture ongoing developments or long-term impacts accurately. Secondly, much of the available information is based on secondary sources such as industry reports, government publications, and news articles, which may carry inherent biases or lack uniformity in reporting standards.

Additionally, access to primary data from manufacturers, developers, and policymakers was restricted due to social distancing measures and institutional limitations during the pandemic. This may have constrained a deeper, first-hand understanding of the challenges faced on the ground. The study also focuses primarily on the solar sector, which means the broader implications for other renewable energy segments are not extensively analyzed. Lastly, the financial and operational impact across different states and project sizes may vary significantly, making generalizations difficult.

Despite these limitations, the study provides a foundational analysis to understand vulnerabilities in the solar energy supply chain and offers direction for future research and policy formulation.

11. Relevance of the Study

This study holds significant relevance in the context of India's growing commitment to clean energy and its ambitious solar targets. The COVID-19 pandemic exposed critical vulnerabilities in global supply chains, particularly in sectors heavily dependent on imports, such as solar energy. India's reliance on external sources for photovoltaic modules, inverters, and raw materials led to delays in project execution and cost escalations during the crisis. By examining these disruptions, the study contributes to a deeper understanding of the structural weaknesses within the solar supply chain and the urgent need for diversification and resilience-building.

The findings are particularly valuable for policymakers, industry stakeholders, and researchers seeking to develop strategies for future crisis management and long-term energy security. As India strives to meet its climate commitments and expand its renewable capacity, insights from this study can inform policies aimed at strengthening domestic manufacturing, encouraging innovation, and reducing external dependencies. Furthermore, it adds to the broader discourse on sustainable development and preparedness in the face of global uncertainties, making it highly relevant for the ongoing energy transition in India and similar emerging economies.

12. Recommendations of the Study

12.1. Strengthen Domestic Manufacturing Capabilities

To reduce dependency on imports, especially from a single country, India should invest more in building an integrated domestic supply chain for solar components such as modules, cells, wafers, and inverters. Incentives under schemes like the Production Linked Incentive (PLI) must be expanded and effectively

implemented.

12.2. Diversify Import Sources

Diversification of international suppliers can help mitigate risks associated with geopolitical or health crises. Engaging with multiple trade partners for solar imports can reduce over-reliance on any one country and enhance supply chain stability.

12.3. Develop Strategic Component Reserves

stablishing buffer stocks or strategic reserves of critical solar components can help project developers continue work during periods of global or domestic disruptions.

12.4. Promote Supply Chain Digitization

Encouraging the use of digital tools and real-time tracking systems across the solar supply chain can help stakeholders anticipate disruptions, monitor inventory, and respond quickly to supply issues.

12.5. Support MSMEs in Solar Sector

Small and medium enterprises involved in solar production and services should be supported through financial aid, capacity building, and easier access to raw materials to ensure their resilience during crises.

12.6. Enhance Policy Coordination and Flexibility

Government policies should include emergency response frameworks that allow for quick adjustments in project deadlines, import duties, and financing terms during global disruptions.

12.7. Invest in Research and Development (R&D)

Increased investment in R&D can foster innovation in alternative materials, manufacturing processes, and storage technologies, thereby reducing reliance on global supply chains and enhancing energy independence.

12.8. Policy Implications of the Study

The reveals of this study highlight critical policy considerations for strengthening the resilience and sustainability of India's solar energy sector. First, the pandemic has emphasized the urgent need for policies that promote domestic manufacturing of solar components through long-term financial incentives, technology support, and infrastructure development. This aligns with national initiatives such as Aatmanirbhar Bharat and the Production Linked Incentive (PLI) scheme, which must be expanded and made more accessible, particularly to medium and small-scale enterprises.

Second, the disruption underscores the importance of diversifying international trade relations for solar imports. Policymakers should revisit trade agreements, ease regulatory barriers, and reduce dependency on a single country for critical components. Establishing strategic reserves of essential solar equipment may also be considered to mitigate future supply shocks.

Third, the study indicates the need for integrating risk assessment and crisis preparedness into renewable energy policy frameworks. Flexible project timelines, financial safeguards, and adaptive regulatory mechanisms should be embedded into solar energy policies to allow timely responses to global crises.

Finally, there is a growing need for enhanced investment in R&D and innovation ecosystems that can support the development of next-generation solar technologies and alternative supply chain models. Strengthening public-private collaboration in this space will be key to ensuring long-term energy security and resilience.

13. Findings of the Study

The findings of this study highlight that the COVID-19 pandemic had a profound impact on the solar energy sector in India, primarily due to its dependence on imported components such as photovoltaic modules, inverters, and raw materials. Disruptions in global manufacturing and logistics chains caused significant delays in project implementation and led to rising costs across the value chain. Many solar developers faced challenges related to labor shortages, shipping bottlenecks, and increased operational risks. The pandemic also exposed the limited capacity of India's domestic solar manufacturing, highlighting the need for scaling up local production. Although government interventions eventually provided some relief through deadline extensions and policy adjustments, the initial response lacked agility. Importantly, the crisis triggered a broader realization of the need for supply chain resilience, leading to increased focus on self-reliance,

diversification of sourcing strategies, and the development of risk mitigation mechanisms. These findings underscore the importance of long-term planning, robust policy frameworks, and investment in domestic infrastructure to protect the sector from future global disruptions.

14. Conclusion

To conclude the preceding passage, we have explored the future of solar energy. On May 5, 2015, at the National Press Club in Washington, DC, an MIT team released "The Future of Solar Energy," the latest of seven multidisciplinary MIT reports examining the role of various energy sources in meeting demand in a carbon-constrained future.Solar electricity generation stands out as one of the few low-carbon energy technologies with the potential to scale significantly. In recent years, there has been rapid growth in installed solar generating capacity, substantial improvements in technology, price, and performance, and the emergence of innovative business models fostering investment in residential solar systems. However, further progress is necessary to facilitate a substantial increase in solar penetration at socially acceptable costs. The Future of Solar Energy study, involving over 30 experts, explored the potential for expanding solar generating capacity to the multi-terawatt scale by midcentury. This massive expansion is seen as a necessary component of any serious strategy to mitigate climate change. Fortunately, the solar resource surpasses current and projected future electricity demand. Despite the substantial decrease in solar costs and rapid capacity growth, solar energy presently constitutes only about 1% of US and global electricity generation. Achieving the required solar output may not be feasible at a tolerable cost without significant changes in government policies, especially if a substantial price is not placed on carbon dioxide emissions.

The PLI Scheme marks a monumental push for domestic manufacturing, boosting capacity and positioning India as a solar powerhouse. The future holds limitless possibilities with innovations like solar paint and space-based solar panels.To sustain India's solar ambitions, the focus must shift towards making solar energy more sustainable and efficient. Scientific research points towards tandem cells and organic semiconductors with a Power Conversion Efficiency (PCE) of 20.6%, a critical parameter for solar cell applications. This leap in performance aligns with a future where solar energy becomes a powerhouse of clean, efficient power. India's path to sustainability involves combining materials within the solar cell, leading us to a greener and more sustainable future.

References

A. Shahsavari; M. Akbari; Potential of solar energy in developing countries for reducing energy-related emissions; Renew; Sustain; Energy Rev; 90; 2018; PP-275-29.

I. IEA; India Energy Outlook; US Energy Information; 2015

S. Teske; S. Sawyer; O. Schäfer; T. Pregger; S. Simon; T. Naegler; S. Schmid; E.D. Özdemir; J. Pagenkopf; F. Kleiner; J. Rutovitz; Energy [r] Evolution-A Sustainable World Energy Outlook; 2015.

A. Gulagi; D. Bogdanov; C. Breyer; The role of storage technologies in energy transition pathways towards achieving a fully sustainable energy system for India; Journal of Energy Storage; 17; 2018; pp. 525-539.

International Energy Agency (IEA); CO2 Emission from Fuel Combustion; 2015.

M.K. Hairat; S. Ghosh; 100 GW solar power in India by 2022–A critical review; Renew; Sustain; Energy Rev; 73; 2017; pp. 1041-1050.

E.A. Moallemi; L. Aye; J.M. Webb; F.J. de Haan; B.A. George; India's on-grid solar power development: historical transitions, present status and future driving forces;

Renew; Sustain; Energy Rev; 69; 2017; pp. 239-247.

M. Mukherjee; Private Participation in the Indian Power Sector: Lessons from Two Decades of Experience; The World Bank; 2014.

N.U. Kamble; S.D. Patil; Techno-Economic Analysis of Solar Pv System; 2018

N. Kannan; D. Vakeesan; Solar energy for future world:-A review;

Renew; Sustain; Energy Rev; 62; 2016; pp. 1092-1105.

(2016). Centre for Public Impact A BCG Foundation. https://www.centreforpublicimpact.org/wp-content/uploads/2024/09/CPI-Public-Impact-Fundamentals-Report-English.pdf

Z. Dobrotkova; K. Surana; P. Audinet; The price of solar energy: comparing competitive auctions for utility-scale solar PV in developing countries; Energy Policy; 118; 2018; pp. 133-148

Stauffer W. Nancy ; The Future of Solar Energy : A summary and recommendations for policymakers; MITEI; December 14, 2015.

Narayan, S., & Datta, S. (2020). Bangladesh at 50. Orient Blackswan .

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