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TECH MEET 13.0**

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**SOLAR PANEL RECYCLING
CHALLENGES:
PREDICTION AND SOLUTIONS**

About Insolation Energy Ltd. (INA Solar)

Creating a sustainable future is the need of the hour. In this essential journey towards environmental responsibility, solar energy stands at the forefront. The duty to make eco-conscious decisions to create cleaner, greener energy solutions is ours.

A BSE SME-listed Company, Insolation Energy Limited (INA Solar) stands as India's leading manufacturer of High-Performance Solar Panels, Batteries & PCU. With more than 7 years of impeccable manufacturing records, The company currently operates with two manufacturing units located in Jaipur, whose combined production capacity is 1000 MW, which will increase to 4000 MW and aluminum frame 12000 metric tons annual capacity by 2024-25 and there are plans to set up units of solar cell manufacturing also for 1500 MW by 2025-26.

The company also plans to introduce the latest N-Type TOPCon technology to further consolidate the leadership in the industry. These advancements underscore our commitment to innovation and growth in renewable energy.

A rich history of successful operations in the industry, the company boasts an impressive record of more than 10,000 clients, more than 600 completed projects, and a strong network of more than 700 Channel Partners across 100+ Districts.

Fully equipped with self-driven machinery, assisted by the latest technologies, and overseen by industry experts, our solar products adhere to all international and domestic standards like the ISO, UL, ALMM, CE, BIS, and more. Driven by a commitment to quality, we focus on achieving the perfect balance between design, reliability, and performance.

Company has taken a positive step in the direction of fulfilling our Hon'ble Prime Minister's vision - to achieve Net-Zero emissions in India by the year 2070 through Make in India Initiative. In fulfilling this vision, INA Solar has supplied more than 700 MW of modules by participating in key government schemes like JJM, SECI, PM Kusum Yojana (A/B/C), PM Surya Ghar Yojana, BREDA, HAREDA, Rajasthan Rooftop Projects, Gujarat Rooftop Projects, BSNL, Solar Park and more.

Company's success is a symbol of the trust of the industry and its customers in our capabilities. With an unwavering commitment to innovation in the energy sector, we prioritize customer satisfaction to the fullest. With company's motto being "Together We Shine ", they strongly believe in sharing their successes with all stakeholders and consistently invest into innovation to create high performance products that contribute to a more energy-efficient world.

Background

India has made significant strides in adopting solar energy as a key source of renewable power. With a target to achieve 500 GW of renewable energy by 2030, solar energy is central to India's future energy landscape. As of 2024, India is one of the largest solar markets globally, with millions of solar panels installed across residential, commercial, and utility-scale applications. However, the issue of solar panel waste and recycling is becoming increasingly pressing, as solar panels typically have a lifespan of 25-30 years.

While solar panels are essential for India's energy future, the growing volume of used and end-of-life panels will create significant challenges in waste management, environmental protection, and resource recovery. Given that solar panels contain valuable materials like silicon, silver, and copper, and harmful materials such as cadmium, the proper recycling of these panels is critical to reduce environmental risks and conserve resources.

India faces additional challenges due to inadequate infrastructure for recycling, the need for cost-effective solutions, and a lack of awareness regarding the environmental impact of improper disposal.

Problem Description

Develop a predictive framework to assess the future challenges of solar panel waste management in India and propose viable, cost-effective, and environmentally sustainable solutions for solar panel recycling. This should consider the Indian context, including socio-economic conditions, technological limitations, and policy frameworks.

Your approach should address the following areas:

Prediction of Recycling Challenges in India

- **Growth in Solar Panel Waste**: Estimate the future volume of solar panel waste in India, considering the national solar installation targets, current solar panel adoption rates, and the expected lifespan of existing panels.
- **Recycling Infrastructure**: Identify gaps in the current solar panel recycling infrastructure in India and predict challenges related to recycling efficiency, scalability, and cost.
- **Transportation and Logistics**: Predict challenges related to the collection and transportation of end-of-life panels, especially in rural or remote regions where most solar panels are deployed.

Environmental Impact Assessment

- **Pollution and Contamination**: Assess the environmental risks posed by the improper disposal or non-recycling of solar panels, including the release of harmful chemicals such as cadmium, lead, or toxic by-products that can contaminate soil and water.
- **Resource Recovery**: Identify the key materials in solar panels that could be reclaimed, such as silicon, silver, and copper, and assess their potential economic value if recovered effectively.

Technological and Logistical Solutions

- **Innovative Recycling Methods**: Explore advanced recycling technologies (mechanical, chemical, and bio-recycling) suitable for the Indian market, and assess their feasibility in terms of cost, scalability, and energy efficiency.
- **Localized Recycling Units**: Propose solutions for decentralized recycling centers in both urban and rural areas, including community-based initiatives that can help address local waste management issues.
- **Role of Digital Technologies**: Explore the use of technologies such as AI, IoT, and machine learning to track, monitor, and optimize the solar panel waste management process across India.

Circular Economy in the Indian Solar Industry

- **Circular Models**: Propose a circular economy approach for the Indian solar industry, where solar panel components are reprocessed and reused in the production of new panels or other products. Consider the role of local industries and supply chains in this process.
- **Government and Industry Collaboration**: Suggest ways for Indian manufacturers, government agencies, and other stakeholders to collaborate in promoting recycling programs, such as Extended Producer Responsibility (EPR), incentives for recycling, and setting up a national recycling framework.

Policy and Economic Recommendations

- **Regulations and Standards**: Propose the development or strengthening of regulations and policies for solar panel disposal and recycling in India, including EPR, mandatory recycling quotas, or certification schemes for recycling centers.
- **Cost-Benefit Analysis**: Conduct an analysis of the costs involved in establishing a nationwide solar panel recycling infrastructure and compare this with the long-term environmental and economic benefits, such as job creation, resource conservation, and pollution reduction.
- **Incentives for Manufacturers**: Recommend policy measures that incentivize manufacturers to produce more recyclable solar panels, such as tax breaks, subsidies, or industry certifications that emphasize sustainability.

Key Deliverables

- **Prediction Model:** A data-driven model to predict the growth of solar panel waste in India, incorporating factors like installation rates, panel lifespan, and potential recycling capacity.
- **Recycling Solution Proposals:** A report or prototype detailing innovative and feasible solar panel recycling solutions specific to the Indian context, including cost-effective methods, logistical solutions, and technological interventions.
- **Environmental Impact Report:** An analysis of the potential environmental risks posed by improper disposal of solar panels, with recommendations for mitigation strategies.
- **Policy Roadmap:** A set of recommendations for the Indian government and solar industry stakeholders on policies, regulations, and strategies to improve solar panel recycling and encourage a circular economy.

Objective

The goal of this project is to develop scalable, sustainable, and economically viable solutions for the recycling of solar panels in India. The solution should address both the technological and infrastructural gaps in the current system, while also incorporating policy frameworks that can drive industry-wide changes.

Ultimately, the aim is to make solar energy truly sustainable throughout its lifecycle, reducing waste, conserving valuable resources, and minimizing environmental impacts in India.

Expected Outcomes

A detailed report and presentation comprising of:

- Comprehensive understanding of the challenges and risks associated with solar panel waste in India.
- Practical and innovative solutions for efficient solar panel recycling, adapted to the Indian socio-economic and technological landscape.
- Contributions to policy development that encourage the adoption of sustainable practices and a circular economy for the solar industry in India.
- Recommendations for building the necessary infrastructure to support solar panel recycling and resource recovery on a national scale.

Evaluation Matrix

Criteria	Description	Score
1. Problem Understanding & Background	Depth of understanding of the solar panel recycling challenges in India. Does the student adequately explore the context, including socio-economic, technological, and environmental factors?	10
2. Prediction of Recycling Challenges	Quality and accuracy of predictive model for solar panel waste volume in India. Are the assumptions, factors, and methodologies used clear and robust? How well are future challenges predicted?	10
3. Environmental Impact Assessment	Thoroughness of the analysis regarding environmental risks posed by improper disposal of solar panels (toxicity, contamination). Quality of recommendations for mitigating environmental impact.	10
4. Technological Solutions	Innovative and feasible solutions for recycling (mechanical, chemical, bio-recycling). Evaluation of the technologies' scalability, cost-efficiency, and potential for implementation in India.	20
5. Logistical Solutions & Transportation	Analysis of challenges related to the logistics of collection, transportation, and recycling of panels, especially in rural or remote areas. Proposals for decentralized solutions.	10
6. Circular Economy Framework	Design of a circular economy model specific to the Indian solar industry. Focus on reprocessing, reusing materials, and minimizing waste. Feasibility and potential impact of proposed models.	10

Criteria	Description	Score
7. Policy and Regulatory Recommendations	Strength of policy recommendations for improving solar panel recycling (EPR, regulations, incentives). Are the proposed policies practical and aligned with India's existing frameworks?	10
8. Cost-Benefit Analysis	Depth of the economic analysis, including cost of infrastructure vs. long-term benefits such as job creation, resource conservation, and pollution reduction. Realism and accuracy of analysis.	10
9. Feasibility of Implementation	Viability of the proposed solutions in terms of infrastructure, financial feasibility, and scalability across the country, particularly in rural and remote areas.	10