

## **Chapter 7**

### **CONCLUSION**

Due to the end-of-life waste that solar photovoltaic panel mass production generates, which is expected to reach millions of tones by the middle of the century, there is a socio-environmental risk. Poor management of the world's PV waste can lead to a lack of access to renewable energy, hence neutral sustainability practices should be used. Adoption of sustainable PV waste requires combined effort towards environmental, economic, and social elements of PV waste. According to life-cycle-environmental studies, recycling PV can lessen these effects, with a considerable drop in human toxicity and freshwater Eco toxicity of about 78%. According to a social market survey, the local populace is ready to support recycling. Programs for mass training are advised for social acceptance.

EoL solar PV waste management is appropriate under self-standing EPR regulations. The rapid and widespread deployment of photovoltaic modules causes a significant amount of solar waste to be produced 2050. Resource recovery, circular economy, and consequent environmental impact reduction necessitate a rigorous recycling methods for recovering resources from PV end life. The recovery of tellurium, indium, selenium, and gallium from second-generation PVs and silicon, silver, copper, lead, and tin from first-generation solar cells are the key targets. The development of regulatory frameworks and guidelines, creative business models, and the expansion of local institutions' capacities as well as the PV recycling sector have all been found to be crucial towards PV end life management system.

Some nations that are only beginning to address the difficulties associated with PV recycling can benefit from the EU's experience in building legislative frameworks and best practices while also working closely with PV manufacturers. To significantly lessen the damaging effects of the production and recycling of solar panels on the environment, a closed-loop management system must be implemented. As was already said, the present processes for recycling solar panels are laborious and time-consuming. PV panels are made of materials such as gallium, indium, and germanium, but only silicon, which is used in the panel terminals, can be recycled. The subsequent release of solvent pollutants, another issue with recycling operations, can be lessened by using an activated carbon fiber adsorption recycling condensation device. To promote

economic growth throughout the chain comprising both production and consumption stakeholders, many measures are required. This brief review examined the viability of managing PV panel waste and offered several directions for future research and development in the PV industry to address the numerous challenges that still face this field's growth. The novel policy designed hereby can be successfully implemented for BSDU Solar Photovoltaic Plant to tackle the end-life waste generation and to establish it as a sustainable setup.

To understand models that might enable systematic change for economic purposes, policy officials, institutions, and the business community must work together. It is advised that stakeholders use a variety of tools within a regulatory framework to collaborate effectively on recycling agreements. PV module development should involve the usage of environmentally friendly materials. Manufacturers of modules should emphasize using high-quality materials throughout production. The LCA is crucial for designing the next panels in a way that minimizes the effects of recycling and increases recovery. In addition to the solar PV industry's rapid development, it is suggested that an appropriate strategy be used to recover and recycle EoL wastes.

To further protect the environment, Asian nations should build eco-friendly companies for handling and removing such trash. Therefore, it is advised that recycling become a requirement for all manufacturing firms following their EoL. In conclusion, the government must enact such regulations to make sure that all firms take the environmental impact of their waste into account. It is crucial to mandate that the entire solar manufacturing industry practice responsible behavior and recycle, reuse, and recover their products. Users must be made aware of PV recycling through the media and governmental institutions.

To deal with these suggestions are concluded as: when developing various PV plant components, all module makers should take the EoL stage for panels into consideration. Each stakeholder involved in the treatment of these wastes should have their obligations and responsibilities clarified. Collection, treatment, and disposal standards for PV waste are necessary. To handle waste, it is important to strengthen groups like producer responsibility organizations. It is important to promote agreements like reciprocal recycling between module makers, developers, and buyers. Surveys on recycling treatment could be used to raise awareness. Promotion should only be given to PV

recycling facilities that concentrate on high-value waste recovery.

The assessment of the sustainable management of solar PV panels is aided by this study. Future academics will be better equipped to understand the problems associated with recycling solar energy, which will help to promote sustainable development. The current study filled in the gaps between various stakeholders by examining their perceptions of the management of end-of-life solar waste and brought the issue of end-of-life photovoltaic waste before the government, policymakers, and waste regulators. The results unequivocally show that the key elements influencing the treatment of end-of-life panels are self-take-back collection and recycling facilities, material recovery, and recycling incentives. Understanding the results of the current study on consumers and manufacturers attitudes toward the problem of solar waste and their readiness to engage in recycling efforts is important for policymakers.

The study will serve as a database for the creation of a closed-loop supply chain, economic feasibility assessments, and life-cycle analyses, as well as aid decision-makers and researchers in their field research. For the efficient collection, disassembly, and recycling of e-waste, this study could be expanded to perform classifications of the metals present, a material flow analysis, and a cost-benefit analysis. International organizations, decision-makers, and communities are concerned about the deployment of PV waste management strategies. This has to do with making a long-term plan and putting it into action. It also has to do with life cycle environmental consequences. Last but not least, developing a global monitoring system that systematically tracks the quantity of PV waste and treatments on different scales, including microscopic, macroscopic, and mesoscopic levels, may aid decision-makers, investors, and businesses in developing more dependable solutions and potential management strategies.