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END-OF-LIFE MANAGEMENT OF PHOTOVOLTAIC PANELS: A MODEL FOR FORECASTING AND ECONOMIC EVALUATION

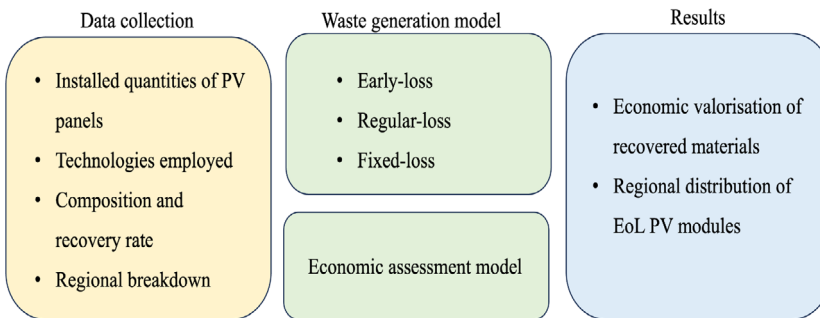
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Abstract – The global surge in photovoltaic (PV) panel deployment since the 2000s has contributed to advancing the renewable energy sector. However, this proliferation raises concerns about the increasing number of PV modules that will end their operational life in the coming years, necessitating effective planning for their decommissioning and recovery. This paper addresses this imminent challenge by presenting a predictive model to estimate the volume of decommissioned modules from existing installations. To take into account the variability associated with the operational life duration of PV panels, three distinct scenarios were considered: early loss, regular loss (both modelled through the Weibull function) and fixed loss. Furthermore, the article introduces a methodology for the economic valorisation of materials recovered from decommissioned PV modules, according to the different technologies employed. This approach encourages sustainable practices by assigning an economic value to recovered materials, promoting a circular economy in the renewable energy sector. The economic valuation methodology adds practicality to dismantling, emphasising responsible waste management’s potential economic benefits. In order to illustrate the applicability of the model, the study focuses on the Italian case, providing a detailed regional breakdown. The regional analysis not only improves the accuracy of the predictive model but also offers insights into localised PV module disposal patterns. By adapting the model to the individual Italian regions, the article serves as a concrete and valuable resource during the programming and planning phases, facilitating the implementation of a strategy to efficiently recover PV modules and consequently minimising the environmental impact associated with decommissioning activities.

Keywords – Circular economy; economic assessment; EoL PV modules; recovery; sustainability



Research phases.