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Economic Feasibility of PV Mounting Structures on Industrial Roofs

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Abstract: This study determines the viability and profitability of photovoltaic (PV) mounting structures on industrial roofs. For this purpose, more than 656,000 different cases have been analyzed, combining different consumption patterns, energy prices, locations, inclinations, azimuths, capacity installed, and excess income. The results show that the industry's consumption pattern is a key factor, leading to significant reductions in the available assembly budget for inclined structures compared to the coplanar option when the pattern is seasonal and/or irregular. The increase in energy prices experienced in the last 2 years represents a substantial change in the viability of the structures. The budget for inclined structures increases by hundreds of euros compared to the coplanar option. Depending on the azimuth and inclination of the roof, the maximum available budget can vary by more than a thousand euros per kWp, being highly profitable in orientations close to the east and west and on roofs partially inclined to the north. Differences between low-irradiation and high-irradiation locations can mean variations in the average budget of more than 1 k€/kWp, especially with high electricity prices.

Keywords: photovoltaic; mounting structures; azimuth; inclination; industrial roofs; seasonality

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1. Introduction

The increase in energy prices experienced since mid-2021 has led to a significant rise in the energy bill, compromising the viability and competitiveness of many industries [1]. In this context, photovoltaic energy has been the main measure to mitigate the increase in costs in many sectors. The new context has significant effects on the viability and profitability of photovoltaic (PV) systems and their mounting structures, which, in many cases, are not taken into consideration. The adaptation to the new context requires adjustments in the sizing of PVs, which is also associated with changes in the return on investment [2]. In many cases, the design is carried out following established paradigms, with approximate calculations, without analyzing in detail the consumption pattern of the industry.

Load matching is an inevitable problem that restricts the development of PV systems used in buildings [3]. Optimal PV orientation should not only be based on maximizing energy production but also on expected demand patterns and market prices. In residential buildings, providing electricity not only around solar noon but also in the morning and late afternoon, when demand increases, helps to maximize self-consumption/-sufficiency and reduces costs for end-users and utilities [4]. Seasonality strongly conditions the optimal size of PV installations, the return on the investment, and the potential savings [2]. Differences between demand patterns caused large variations in optimal PV orientations [5].

Therefore, the optimization of PVs based on the consumption pattern has been analyzed in numerous specific cases, such as in residential buildings [5–7], commercial buildings [5,8], and military facilities [9]. Within the industrial sector, the causality is immense,