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Article

Feasibility of Photovoltaic Systems for the Agrifood Industry in the New Energy and Climate Change Context

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Abstract: The role of the agrifood industry is key to mitigating the impact of climate change, as it is one of the industrial sectors with the highest energy consumption. The optimisation of photovoltaic systems in agroindustries faces problems such as the fluctuation of energy prices or the evident seasonal nature of some producers. This paper provides a global view of the profitability and optimal sizing of photovoltaic (PV) systems in the new energy context. For this purpose, almost 4 million cases were analysed, including different consumption patterns, energy prices, etc. Some general conclusions can be drawn from the results. First, the adaptation to the new context requires adjustments in the sizing of PV systems in all industries analysed, which is also associated with changes in the return on investment. Second, seasonality strongly conditions the optimal size of PV installations, the return on the investment and the potential savings. Finally, in the face of future energy price variations, the ratio "Savings/payback" seems to be an appropriate reference for sizing, combining savings and profitability. In addition, they may justify special subsidies to seasonal industries. The conclusions of this paper should be considered to optimise the design of PVs.

Keywords: photovoltaic; agribusiness; winery; olive mill; fruits and vegetables; feed factory

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1. Introduction

Agrifood systems consume about 30% of the world's energy, having increased by 20% between 2000 and 2018 [1]. They also account for 20% of greenhouse gas emissions [2]. These figures are expected to continue rising as the world's population is predicted to reach well over 9 billion by 2050 [3]. The agrifood industry plays a major role in this consumption.

In the European Union, the agrifood industry represents more than 15% of the total turnover of the manufacturing industry, with a value of more than EUR 1.2 trillion and EUR 250,000,000 of added value [4], and its energy consumption accounts for more than 10% of the industrial total [5].

In some countries, the agrifood industry is the main sector of the manufacturing industry, as is the case in Spain, where it represents 23.3% of the industrial sector's GDP [6], with a turnover amounting to EUR 130,795.8 M, and it also employs roughly 500,000 people. As a result, the Spanish food and beverage industry was responsible for the highest industrial energy consumption in 2019, with 18.5%, more than EUR 2 billion [7]. The sector's high consumption of electrical energy stands out, with almost 60% of the total, exceeding 90% in some agroindustries, such as wineries.

The agroindustrial sector faces two major energy challenges. Firstly, it shows a noticeable seasonality in many sub-sectors, usually in agricultural production. Secondly, the