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Editorial

Why We Should Support Biofuel Production

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We are currently in a dynamic phase of civilisation, in which the technological progress that has drastically altered our lives is accompanied by other historical events that forcibly affect and will affect future choices. In this sense, the world's states' dependence on fossil resources is undergoing a reorganisation not only driven by environmental issues, but also by geopolitical ones. It is imperative to turn our attention to other energy vectors, assessing their impact in terms of total greenhouse gas emissions (GHGs) to promote the construction of a sustainable and innovative circular system. For example, according to data provided by the UN Environment Emission Gap Report [1], the total greenhouse gase (GHG) emission for the road transport sector was around 54 gigatons of CO_2 equivalent in 2014, which will increase to 87 gigatons equivalent in 2050, impacting natural resources and environments via pollution and global climate change [2]. The production of biofuels and their use would meet the need to reduce GHG emissions as a carbon-neutral pathway due to the fact that biomass, which is extracted and used to create biofuels, absorbs a significant quantity of the CO_2 released into the atmosphere [3]. However, after a surge of biofuel production in the 2000s (+18%/year), due to industrialisation, the growth of global biofuel production slowed down sharply in the decade 2010–2019 (+3.9%/year). In 2020, global production declined for the first time in 20 years, as the biofuel sector was hit hard by the COVID-19 crisis and related border blockades and closures that reduced fuel demand for all transport modes. The decline in global biofuel production has been even more severe than that in fossil fuels. In 2021, production recovered (+13%), due to the expected recovery in oil demand and the maintenance or strengthening of policies to support biomass fuels. However, traffic restrictions in 2021 negatively affected the production level, which remained below the 2019 level [4].

At the same time, the research activity in this sector has strived to overcome the limitations represented by first-generation technologies and the associated contradiction of exploiting resources otherwise destined for the food chain. In fact, second, third, and fourth generations envisage an intensification in the use of algal cultures and other microorganisms with a focus on metabolic [5] or genetic [6] engineering strategies to favour a better capture of CO_2, a higher productivity in lipids and bio-based subproducts. The new generations for biofuel production are also focusing on other methodologies such as pyrolysis, solar to fuel, and gasification, i.e., on strategies that complement the classical method of production and do not need to provide for a limitation in the use of non-fossil, but not inexhaustible, biomasses and feedstocks.

Despite all the efforts of the scientific sector in exploring alternative and low-energy technologies and approaches while progressively improving production performances, the response of the economic-industrial sector is not yet up to the mark. Biofuels currently supply less than 1% of global final energy consumption and around 3% in the transportation sector [7]. Equally controversial is the reaction of the public opinion. In general, it is in support of biofuels, although public knowledge is limited, but it is vulnerable to dominant media and social media talk [8]. Løkke et al. [8] argued that a greater likelihood of support from an informed and educated public would be achieved through the implementation of a biofuel production system perceived as fair.

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The challenge is, therefore, to create a clearer vulgarisation that is able to highlight current innovations and an in-depth analysis of risk redistribution management, since the way in which risks are perceived is one of the main obstacles to a large-scale implementation of new technologies, including alternative energy systems [9]. Biofuels were fundamentally introduced to mitigate climate change risks; consequently, their implementation fundamentally implies the possibility of trade-offs resulting from the comparison with the reference situation, i.e., a situation of harmful climate change induced by high fossil fuel consumption [8].

There are several innovative approaches identified and well shown by different reviews, such as that recently published by Khan et al. [10]. Among all possible reviews, special attention should be paid to the use of nanotechnology not only for the production of biofuels, but also to solve problems related to biosensing and wastewater treatment. With regard to the subject of biofuels, chemical interaction with nanomaterials allows for more homogeneous combustion. At the same time, the use of nanomaterials to immobilise enzymes for biofuel production has become increasingly popular because it reduces enzyme costs [11,12]. Furthermore, nanomaterials can improve the thermal and mechanical properties of fuels, including heat capacity and mass diffusion [13].

In conclusion, the need to meet environmental requirements and, at the same time, the need to steer biofuel production towards higher productivity, producing more sustainable costs, would be met by the use of nanotechnologies that can, in fact, bring cost reductions in the biofuel industries through the reuse of immobilised enzymes and an increase in biofuel yields, and additionally, when blended with fuels, are capable of reducing toxic exhaust gases.

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