

# Biorefineries design and implementation in crisis times: A challenge for sustainable development.

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## 1. Introduction

The green policies in many countries together with the Sustainable Development Goals have encouraged the increase in attention to biomass (in the real definition comprising all the renewable organic matter coming from plants and animals, not only lignocellulosics as usually misunderstood) during last years.

However, recent times created challenging scenario for using biomass. The Covid 2019 pandemics demonstrated how the resources distribution in the world is directly related to the concept “Survival of the fittest is a law of nature”. The richest countries had accessibility to all the resources including technologies to produce ethanol from biomass, equipment for hospitals and vaccines at high scales. Some of them were able to buy vaccines doses at quantities higher than required. Poor countries having the biomass, but not the technologies to produce ethanol suffer the blocked market consequences and at the same time were not able to buy the required vaccines and medical equipment at time as the richest countries had the priority. But in terms of value chains and biomass processing the logistics crisis in world production and transport of goods was the breaking point. Inflation and goods scarcity were the direct consequences affecting all the value chains, increasing more poverty.

The current Russian war in Ukraine made even more difficult the post-covid scenario causing the increase in oil prices and fertilizers, or additionally the scarcity of energy increased for many rich countries. Some countries as Germany had to reverse their green policies, coming back to the non-sustainable coal as source of energy. In this case value chains related to Biomass and agriculture suffered the negative consequences and the poverty again has increased.

Biorefineries are the most common and efficient way to process biomass today. The concept behind the Biorefineries is an integral approach to use as more as possible the biomass to obtain a range of different products. Unfortunately, the Covid 2019 pandemics as well as the Russia Ukraine war affected notoriously the projection and development of Biorefineries in the world against the nice purposes of Green Policies and Sustainable development goals. The present work analyzes this statement deeply and propose the key points and strategies to achieve the desired Sustainability through Biorefineries during future years.

## 2. Methodology

The market problems in processing and commercializing biomass and their products during the last 4 years was analyzed based on the open literature and companies' information. It included the logistics and transport problems derived from Covid 2019 pandemics and the recent Russia and Ukraine war. Additionally, 57 Biorefineries with different Technological Readiness Level and production scales were analyzed in terms of their market problems last 4 years and their sustainability evolution in a geographical defined regions. Additionally, a base case of a large scale Biorefinery, processing sugarcane to obtain different products was analyzed

## 3. Results

The main results are summarized in the key points and strategies to develop Biorefineries in the next 15 years:

1. Biorefineries should not be considered just as a processing strategy of Biomass. This concept must turn to a mandatory approach or way of sustainability in processing Biomass.
2. Small and Middle scale Biorefineries are preferred over large-scale sizes to ensure fair distribution of resources especially in crisis times.
3. The products governing the future of Biorefineries are Food (including food additives), Feed, Bioenergy, and Biofertilizers. Biomaterials and Pharmaceutical products belong to other processing and market dynamics based on the policies of Polymers and Pharmaceutical industries respectively.
4. The accurate and robust design of Biorefineries is mandatory and it should include the sensitivity analysis for all the involved variables.
5. The context and the social analysis and impacts should be strengthened in next years as part of the sustainability analysis using the sustainability index (but in an objective way).

#### **4. Conclusions**

The biorefinery concept has more importance today than 3 or 4 years ago as the world understood in dramatic way how the right and sustainable use of resources, including biomass, ensures the future of humans in the earth. But at the same time the green policies were so weak that the challenges for their stability in crisis times were not accomplished. The proposed key points and strategies are demonstrated to satisfy the resilience of our countries to the crisis times that could come in next 15 years.

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