Towards a Resilient Bioeconomy: merging biotechnology, renewables and societal innovation.

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Abstract

During the last decade, countries across the globe have embraced a massive decarbonisation ambition, and started to replace fossil feedstocks (coal, natural gas, crude oil) for energy use by rapidly expanding wind, solar and bioenergy sectors. Depending on geographic opportunities, strategies lead to a diversity of portfolios biased to progressive electrification based on Offshore and Onshore Renewable Wind & Solar Energy (ORE) for many domestic, industrial and transport uses in Europe, while for Latin American countries such as Brazil, bioenergy contributes a larger fractions to the renewable energy portfolio. For a number of societal and industrial sectors however in Europe and Latin America alike, carbon atoms are an essential part of product and product performance such as for food & feed, plastics, and liquid fuels for long haul and air transport. This poses a new set of questions of sourcing carbon at industrial scale, how to purpose it in case of competing demands and limited resource, and growing need for self sufficiency.

A number of studies focus on conventional, non-combustion carbon (point) sources such as cement and steel industries. These however are non-biogenic nor (short cycle) circular sources, and most likely not eligible in the future. EU in its various energy related policies (REFUEL EU, REPOWER EU, RED II) clearly positions itself as mandating only biogenic and circular carbon which is only a fraction of current carbon flows. Fast-forwarding scenarios to significantly decarbonised futures (2050), it is easily understood that biogenic and circular carbon will become rare commodities. Carbon prices of today will logically increase when recovered from biogenic sources and even higher by Direct Air Capture, seriously affecting feasibility of business cases.

Typical sources of the European biomass are significantly heterogeneous which complicates further industrial use – therefore a priority is to develop commodity platforms with clear (industrial) specifications, that are tradable and give access to larger markets and uses. These molecular platforms could be eligible industrial gas feedstocks as biogas, biomethane and biogenic CO2, and / or liquid platforms (lower alcohols and acids). Technology (digestion, gas purification, fermentation technology or chemical reduction) is available at high TRL levels that enables reasonably fast industrialisation with modest technology risk for investors provided the infrastructural and planning hurdles are taken.

It is relevant to compare European developments to the Brazilian renewables situation. Brazilian sugar cane/ethanol and forestry industries have led to industrial scale biogenic commodities as sugar, ethanol, biogas, biogenic carbon dioxide, as well as cellulose and lignin that complement renewable power from bioenergy, and the increasing Brazilian wind and solar sectors. There are important lessons to learn for the European situation.

‘Biogenic’ will become an important qualifier, and therefore critically important is to develop and implement a certification system to guarantee industrial and other users verifiable sustainable origin of the biomass and biogenic carbon for processed products. Importantly, such systems should also identify and quantify contributions to social justice, contributing to sustainability goals. Those systems are being developed but not yet mainstream in EU or beyond.

BRIGHT, Novo Nordisk Foundation Biotechnology Research Institute for the Green Transition as DTU’s new research, innovation, and education hub in biotechnology and biomanufacturing is designed to develop biologically based products and solutions based on above insights and principles to make a real difference in the green transition, especially Sustainable materials, Microbial foods and Microorganisms for net-zero agriculture. Building on the strong foundation of the Center for Biosustainability at DTU, BRIGHT will join forces with leading international industrial and academic players in these domains to develop and scale up innovative biosolutions to become sustainable, competitive alternatives to fossil-based products and processes.

In this contribution, we will discuss BRIGHT plans building on or partnering with recent and starting international projects that explore technological innovation, sustainable and economic scenarios for purposing and optimising biogenic carbon sources across the key sectors of food (especially alternative proteins and cultured meat (Gallego et al, 2022)), circular materials (Santos et al., 2018) as plastics, and long haul fuels such as Sustainable Aviation Fuel (Alves et al, 2016) using a (bio)process systems approach (Van der Wielen et al, 2021) for selected European and Brazilian cases (Efe et al, 2005; Alves et al, 2016; Mendes Souza et al, 2017).

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