Production of Bio-ethylene

INSIGHTS FOR POLICY MAKERS

Ethylene is one of the basic organic chemicals serving as feedstock for a number of downstream chemical products. With a production exceeding 140 million tonnes per year, ethylene is by far the largest bulk chemical (in volume) used for the production of around half of all plastics. The demand for ethylene is expected to continue to rise, particularly in the emerging economies. Today, almost all ethylene is produced from petroleum derivatives, but biomass can also be used as an alternative feedstock for the production of bio-ethylene. Ethylene and bioethylene are chemically identical, so existing equipment and production capacity can use both to produce plastics or other downstream products. At present, the first bio-ethylene plants in Brazil and India account for approximately 0.3% of the global ethylene capacity, and the largest plants produce around 200 kt of bio-ethylene per year. However, the global market for biopolymer production is growing fast and several production plants are under construction or planned (e.g. China).

Bio-ethylene is produced from bio-ethanol, a liquid biofuel that is widely used in the transportation sector with an annual production of around 100 billion liters. At present, the United States (using corn) and Brazil (using sugarcane) are the largest producers of bio-ethanol, accounting for respectively 63% and 24% of the global production. Ligno-cellulosic biomass from wood and straw can also be used to produce bio-ethanol, but related production processes still need a full commercial demonstration. The advantage of using ligno-cellulosic feedstock instead of sugar and starchy biomass (e.g. sugarcane and corn) is that it does not compete with food production and requires less or no arable land and water to be produced.

The potential for bio-ethylene production is large, but its implementation will depend on the future availability and price of the biomass feedstock, which are linked to developments in food demand and the use of biomass for biofuels, heat and electricity production. The cost of bio-ethylene is highly dependent on the local price of the biomass feedstock and is still higher than that of petrochemical ethylene in most situations. At the same time, bio-based plastics can attract premium prices on the market, which could make them a competitive business in regions with abundant and cheap biomass feedstock. In Brazil and India, due to the availability of cheap biomass resources and Brazil's long-standing tradition of using bio-ethanol for transportation purposes, bio-ethylene costs are estimated to be almost equal to petrochemical ethylene.

The environmental performance of bio-ethylene depends largely on the regional conditions for the production of bio-ethanol, the greenhouse gas (GHG) emissions eventually due to land use changes, and the conditions of the incumbent energy systems. In general, bio-ethylene can signifi cantly reduce the environmental impact of the chemical industry. Based on recent estimates, bio-ethylene can reduce GHG emissions byup to 40% and save fossil energy by up to 60% compared to petrochemical ethylene. In addition, bio-ethylene and other bio-based products made from local resources can reduce a country's dependence on fossil energy imports and stimulate local economies.

Biomass availability and the price gap with petrochemical ethylene are the two most important determinants for the future of bio-ethylene, although bioethylene can also contribute to energy security in oil-importing countries. While promoting the optimal use of biomass, including cascading use in various sectors of the economy, policy measures can support the deployment of bio-ethylene production capacity by supporting the use of bio-based materials via incentives, carbon tax schemes, eco-labeling or information campaigns, and removing import tariffs on bio-ethanol. In any case, future fossil fuel prices will remain a key factor in determining to what extent bio-ethylene can substitute for petrochemical ethylene.

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