Exploring the Future Environmental Impact of Chemical

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The chemical sector belongs to the three most climate polluting industry sectors worldwide. Life Cycle Assessment can identify environmental hotspots of chemical production and identify improvement potentials. However, large blind spots exist in the assessment of chemicals. New predictive tools based on machine learning close data gaps for petrochemicals and have become able to assess most chemicals on the market today. In combination with environmental data on renewable and alternative feedstocks (biomass, CO2, chemical recycling feedstock), they can also serve to assess drop-in future chemicals. Large differences exist in availability and environmental impacts of renewable feedstock type and regions, in particular with regard to biodiversity and health impacts. Good prospective resource management is therefore crucial to avoid problem shifting. The feedstock analysis and information on future downstream drop-in production routes have been combined with optimization algorithms to identify strategies for net-zero plastics production. The results show that the transition to net-zero carbon is theoretically possible, but extremely challenging. It requires a combination of feedstock switch, maximum recycling, carbon capture and sequestration, decarbonization of energy mix, early phase-out of fossil infrastructure, and regional collaboration. In addition, net-zero carbon scenarios come with trade-offs in biodiversity and health impacts that need to be carefully managed.