Synthetic Fuels – Opportunities and Challenges Spanning Biomass, E-Fuels, and Solar Fuels

Dr. Randy D. Cortright, Senior Research Advisor
Dr. Bill Tumas, Associate Lab Director

National Renewable Energy Laboratory
Golden, Colorado
e-mails
Randy.Cortright@nrel.gov
Bill.Tumas@nrel.gov

The transition to a low-carbon energy system requires sustainable pathways for producing liquid and gaseous fuels that can complement electrification and enable deep decarbonization across hard-to-electrify sectors such as aviation, shipping, and heavy industry. This talk will highlight three key approaches: **biofuels**, produced from renewable biomass and waste streams; **e-fuels**, synthesized using renewable electricity, water, and captured CO_2 through electrochemical and thermochemical processes; and **solar fuels**, generated by harnessing sunlight directly to drive chemical transformations. Each approach offers unique opportunities and challenges in terms of feedstock availability, conversion efficiency, infrastructure compatibility, and lifecycle carbon reduction. By comparing their technology readiness, sustainability metrics, and potential for integration into existing energy systems, this presentation will explore how these fuel pathways—individually and in combination—can form a critical pillar of the global energy transition.