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Bioprocessing Technologies for Clean Sustainable Energy Production: Canadian Perspective †

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Abstract: Biofuels are gaining attention as renewable energy sources to address the rising energy demands, fluctuating crude oil prices, and greenhouse emissions from fossil fuels, and can be produced from a wide variety of renewable feedstocks and biogenic wastes through thermochemical, biological, and hybrid conversion technologies. This presentation will highlight the candidacy of a variety of bioprocessing technologies for a wide range of waste feedstocks such as lignocellulosic biomass (e.g., agricultural crop residues and woody biomass), energy crops, sewage sludge, municipal solid waste, food waste, waste cooking oil, waste tires as well as petroleum residues (e.g., heavy/light gas oils, bitumen, asphaltene, and petroleum coke) to produce clean, sustainable energy production. Although these waste residues are available in considerable amounts worldwide, their potential for resource recovery is least realized. This presentation will highlight some notable research studies conducted in the Catalysis and Chemical Reaction Engineering Laboratories (CCREL) over the past 25+ years at the University of Saskatchewan on biomass-to-gas (BTG) and biomass-to-liquid (BTL) conversion technologies to produce synthetic transportation fuels and carbon-rich solid products. The potential and performance of integrated clean technologies, especially hydrothermal gasification, liquefaction, pyrolysis, and Fischer-Tropsch synthesis, will be discussed, along with upgrading biocrude oils through catalytic hydrotreating. The current progress, challenges, and knowledge gaps in the R&D of BTG and BTL technologies for producing synthetic hydrocarbon fuels from waste resources and their opportunities to Canadian bio-economy will be comprehensively reviewed.

Keywords: green-house-gas emissions; utilizatioon of biowaste and residues; sustainable liquid fuels; biomass-to-gas; biomass-to-liquid; thermochemical conversion; heterogeneous catalysis.

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Conflicts of Interest

The authors declare no conflict of interest.