Simultaneous Planning of Location, Capacity, and Configuration of Biorefineries

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The concept of biorefineries comprises different technologies that produce a portfolio of different energetic, material, and pharmaceutical products from renewable resources that are capable of directly or indirectly replacing products currently produced from fossil resources. To use the available renewable resources in an efficient manner and to avoid competition to other usage options, especially food, residual biomasses are considered in this work as input for biorefineries. Because residual biomasses have a relatively low specific yield, their geographical distribution is included in strategic the planning process of a biorefinery using geographic information systems (GIS). Hence, the aim of this work is to strategically plan a biorefinery under consideration of the spatial availability of the input biomass. This results in a complex decision problem, where the location, capacity, and configuration of a biorefinery are interrelated and thus have to be optimized simultaneously.

To this end, a hybrid algorithm consisting of an exact nonlinear program nested in a heuristic Evolutionary Strategy. Such a procedure allows the simultaneous planning of a biorefinery's location, capacity, and configuration under consideration of the spatial availability of the residual input biomass with different biorefinery technologies and in different regions for the first time. The developed decision model is applied in two case studies, planning a Fischer-Tropsch biorefinery in Germany and a lignocellulose biorefinery in the Cariboo District, in British Columbia, Canada.