A compact linear programming model to supply a local bioraffinery

Birome Holo Ba*[1], Christian Prins[1], and Caroline Prodhon[1]

[1]Université de Technologie de Troyes (LOSI) – Université de Technologie de Troyes – France

Abstract

This contribution addresses the problem of modeling and optimizing biomass supply chains for biorefineries. Indeed, efficient supply chains are essential to provide conversion facilities with sufficient quantities of quality biomass at reasonable prices. The problem is described and modeled.
A network model and a data model are developed to allow describing the structure of the supply chain and its data, without affecting the underlying mathematical model. For given refinery needs, its exact resolution by CPLEX specifies the logistic activities in the network (amounts harvested, baled, transported, stored etc.) and the necessary equipment, in order to minimize a total cost including harvesting costs, transport costs and storage costs. We develop a compact mathematical model capable of dealing with instances corresponding to the system envisaged for a biorefinery located near Compiegne, France with more than 400 farms, and 46 storage locations in 52 weeks planning horizon. To find a good compromise between quality and finesse of the solution, a linear program (LP), based on the state-task network, aggregates certain activities of a farm through a "macro-task" management. The macro-tasks are used as "black boxes" in order to approximate the costs of the harvest in a farm. The mathematical model is able cope with large-scale instances. Case studies are described to illustrate this multi-biomass and multi-period tactical planning model. Tests and analyzes of the results are presented. In less than one minute, a LP with nearly 600 000 variables and almost as many constraints is solved for real case study.

*Speaker