INDUSTRIAL ECOLOGY AND OPTIMIZATION

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"Although not fully exploited, optimization can play an important role in industrial ecology in deciding even what to model, whether the data is adequate for the model, validating and calibrating a model, and reducing uncertainties in the model formulation."

Optimization has long been a valuable tool in design and manufacturing. Traditionally, the optimization has been structured to produce the highest quantity and / or quality of a product at the least cost, with the ultimate goal being the maximization of profitability. In recent years, environmental regulation has led to the inclusion of emission constraints as part of the optimization problem. Pollution prevention has thus moved from being a separate, add-on consideration, made only once the initial design is completed, to one that is integrated within the overall design of the product and its manufacturing process. However, industrial ecology brings the potential and perspective for the next step - where environmental considerations are not merely a constraint imposed by regulations, but rather an intrinsic part of the objective function. Environmental impacts must also be weighed and balanced against other concerns, such as cost, long-term sustainability, employment, responsiveness to customers, etc. Furthermore, there are likely to be multiple stakeholders with different perspectives. Thus, multi-objective, or multi-attribute methods are necessary to handle the different, often conflicting objectives. Whether optimization is used at the local, regional, or global level, uncertainties cannot be completely eliminated from the data or models, or from the objective definition. In summary, industrial ecology can gain significantly from the use of optimization methods. These methods can be applied when constructing, validating and calibrating models, and when solving local, regional, or global scale material and energy flow problems. This course on "Industrial Ecology and Optimization" provides an introduction to the optimization methods and tools to be used in the various areas of industrial ecology. It is a breadth-level course designed to address the interdisciplinary nature of industrial ecology. The course covers wide variety of topics starting with linear programming, nonlinear programming, discrete optimization, multi-objective optimization, and optimization under uncertainty.

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