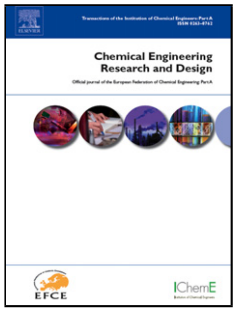

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An efficient uncertainty representation for the design of sustainable energy generation systems

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Highlights

- Permits efficient handling of various biomass quality in the energy SCs management.
- Novel and efficient solution strategy for MOO problems under uncertainty.
- Decision-making facilitated avoiding subjectivity in the solution selection.
- Resulting base model is generic and the strategy flexible for other real cases.

ABSTRACT.

Process sustainability is one of the major concerns in the process systems engineering area. Addressing this concept inevitably requires a multi-objective analysis to evaluate the social and environmental impacts in addition to the usual economic performance objective. Furthermore, the final sustainability of the proposed solutions very often depends on uncertain conditions, especially in the very frequent case that renewable resources are considered in order to enhance environmental sustainability: these resources are usually affected by unpredictable variations in their quality/quantity availability. But the approaches presented for solving multi-objective problems under uncertainty are limited by the amount of scenarios required to represent the unknown conditions. Here it is presented a solution strategy that combines a scenario reduction algorithm within the framework of a multi-objective formulation. Such a strategy is able to produce a fast and robust multi-objective optimization (MOO) while considering uncertainty in the raw material conditions (more precisely quality and availability). The solutions forming the resulting set of Pareto solutions are sorted hierarchically using the Elimination and Choice Expressing Reality IV (ELECTRE IV) method, which identifies the ones showing better overall performance considering the uncertain parameters space.

Keywords: *Uncertainty, Sustainability, scenario reduction, multi-criteria decision-making, computational efficiency.*