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PII: S0098-1354(16)30326-X
DOI: http://dx.doi.org/doi:10.1016/j.compchemeng.2016.10.010
Reference: CACE 5581

To appear in: *Computers and Chemical Engineering*

Received date: 15-7-2016
Revised date: 18-10-2016
Accepted date: 20-10-2016

Please cite this article as: Hennen, Maike., Postels, Sarah., Voll, Philip., Lampe, Matthias., & Bardow, André., Multi-Objective Synthesis of Energy Systems: Efficient Identification of Design Trade-Offs.*Computers and Chemical Engineering* http://dx.doi.org/10.1016/j.compchemeng.2016.10.010

Multi-Objective Synthesis of Energy Systems: Efficient Identification of Design Trade-Offs

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Highlights

- Reduction method to simplify the decision task in multi-objective optimization.
- Both the number of objective functions and the solution space are reduced.
- The most diverse objectives are selected.
- An aggregated cost measure is constrained to identify only promising solutions.
- Reduction method efficiently provides relevant trade-off solutions.

Abstract

The synthesis of energy systems usually has to consider several conflicting objectives leading to a large set of Pareto-optimal solutions with multiple trade-offs. From this large set of solutions, good compromise solutions have to be identified which is a complex and computationally demanding task. We therefore propose a method to reduce both the set of objectives and the solution space: First, the set of objectives is reduced by employing a method from the literature to determine the objectives best representing the design trade-offs. However, in practice, aggregated costs are the decisive criterion. Thus, in a second step, the solution space of the synthesis problem is restricted to an acceptable deviation from minimal aggregated costs. Thereby, only relevant solutions are obtained. The two steps significantly reduce the effort for multi-objective optimization focusing on the most relevant part of the solutions. The proposed method is applied to a real-world case study.

Keywords: Energy systems, Synthesis, Multi-objective optimization, Objective function, MILP