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Optimization-based identification and quantification of demand-side management potential for distributed energy supply systems

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- 1 **Title:** Optimization-based identification and quantification of demand-side
2 management potential for distributed energy supply systems
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10 **Keywords:** Demand-Side Management, Optimization, Distributed Energy Supply System,
11 Cogeneration, Trigeneration, Process System.

12 Abstract

13 A method is presented to identify the potential for demand-side management (DSM) in energy
14 supply systems. Optimization of energy supply systems usually considers energy demands as
15 fixed constraints. Thereby, possible changes on the demand side are neglected. However,
16 demand changes can lead to a better overall solution. Thus, DSM measures should be
17 integrated into the optimization of energy systems.
18 However, integrating optimization of DSM measures generally requires problem-specific
19 process models. To avoid the need for problem-specific process models, we present a generic
20 method applicable to various process domains. The method identifies a merit order of time
21 steps with large potential for DSM and quantifies potential cost savings by DSM. Targets for
22 demand-side measures are provided in a *DSM map* as guidance for the process engineer.
23 The merits of the novel method are illustrated for an industrial case study. In this study, 9.6%
24 of all time steps are promising for DSM measures since they show a high sensitivity to
25 demand changes. In particular, the method identifies non-intuitive time steps with high cost
26 saving potential through DSM. We identify potential cost savings of more than 10% if DSM
27 measures are implemented.

28 1 Introduction

29 We consider energy systems which consist of a distributed energy supply system (DESS) and
30 a process system (Figure 1): The DESS converts primary and secondary energy to final
31 energy required by the process system. The process system employs the final energy in
32 technical processes, e.g., manufacturing.

33 Today, distributed energy supply system and process system are usually assumed to interact
34 via a fixed interface: The processes demand a fixed amount of final energy in various forms,
35 e.g., heating, cooling, or electricity; the demanded energy flows are provided by the DESS
36 [1]. Fixed demands allow analyzing the distributed energy supply system and process system
37 independently. Independent analysis of both systems is less complex and allows the use of
38 domain-specific tools and case-specific models [2]. In practice, the interface also often
39 represents industrial reality since distributed energy supply system and process system are
40 usually operated by separate divisions in a company (or even two separate companies).
41 However, independent analysis of the DESS and process system neglects any synergies and

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