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Project-level multi-modal energy system design - Novel approach for considering detailed component models and example case study for airports

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- 1 Project-level multi-modal energy system design Novel approach for considering
- 2 detailed component models and example case study for airports
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10 **Abstract**

- 11 The current situation, which is driven by environmental concerns and increased air traffic, forces airport
- 12 operators to examine their energy systems in an integrated approach. In order to optimize total
- expenditures, demands of energy in all forms must be considered. This paper introduces a novel method
- 14 for the optimal design of multi-modal energy systems, which will be put to further use in the European
- 15 Union Horizon 2020 MODER project. The optimization problem was formulated as mixed-integer linear
- 16 programming based on a superstructure approach, including all feasible state-of-the-art technologies.
- 17 Part-load efficiencies as well as the influence of ambient conditions on available output capacities were
- 18 considered. The model took into account several types of energy storages, i.e., electrochemical, thermal
- and water storages. For fifteen locations, the optimal set of technologies, their capacity and operation was
- identified. Results showed that for this load range, combined heat and power plants were economically very attractive. Furthermore, photovoltaic energy was a viable option, even without designated feed-in
- tariff. Last but not least, compression chillers with chilled water storages offered an attractive option for
- taini. Last but not least, compression chiners with chined water storages offered an attractive option for
- enhanced flexibility. Combined total cost savings by using both the described method and on-site
- 24 generation of up to 61% were achieved.

25 **Keywords**

- 26 Multi-modal energy systems; Distributed energy systems; Energy system design; Optimal design; MILP;
- 27 Airports

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28 Highlights

- Optimal design of airport energy systems
- Optimization of installation, capacity and operation considering detailed models
- Multi-modal energy systems including electric, heat, cold and water demand
- Evaporative and active turbine inlet air cooling
- Evaluation for fifteen different locations

34 Nomenclature

35 Abbreviations

AC	Absorption chiller
AC0	Absorption chiller with normal cooling supply temperature (8 °C)
ACi	Absorption chiller in ice mode (-5 °C supply temperature)
ВОМ	Mumbai
CAPEX	Capital expenditures

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