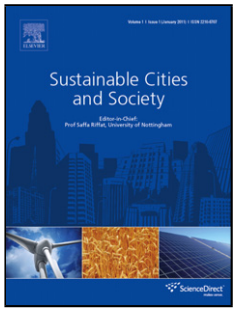

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Economic and Operational Benefits of Energy Storage Sharing for a Neighborhood of Prosumers in a Dynamic Pricing Environment

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Highlights

- An energy credit based optimization strategy is presented for NANs including a shared ESS and prosumers.
- The strategy aims to increase energy cost saving of consumers in a dynamic pricing context.
- Additional flexibility is also provided for supporting distribution system operation.
- The effectiveness of the proposed strategy is validated using real datasets.

Abstract

In this study, an energy management methodology is proposed for neighborhood area networks (NANs) composed of a shared energy storage system (ESS) and multiple consumer premises equipped with a distributed generation (DG) system, aiming to use ESS unit as a key tool for demand response (DR) programs. In the proposed methodology, an energy credit is provided to each household for the excess renewable energy the house provides to NAN and grid. For the mutual benefits of prosumers and load serving entities (LSEs), these credits are then used during peak periods, which results in a virtual shift of excess energy to the periods with higher energy prices. In order to account for the fairness between consumers in use of the shared ESS, a credit limit for each household is specifically predefined by LSE regarding its DG capacities. From the perspective of LSEs, the algorithm based on the implementation and scheduling the use of a shared ESS has the capability of supporting distribution network for decreasing peak demands, acting as an advanced DR strategy. The case studies based on actual data have shown that the proposed methodology enables to reduce the energy costs and peak demand significantly compared to a benchmark case.

Keywords: Distributed generation, dynamic pricing, energy management, energy storage sharing, neighborhood area network, photovoltaic power generation.

1. Nomenclature

The main sets and indices, parameters and variables used in this study are listed below. The abbreviations are defined where they first appear.

A. Sets and Indices

$h(H)$	index (set) of houses.
$t\ (T)$	index (set) of time intervals.

B. Parameters

CE^{BAT}	charging efficiency of the shared battery.

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