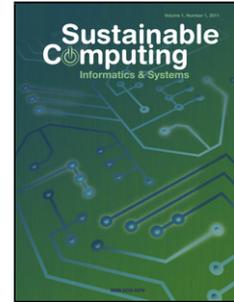


## Accepted Manuscript



Title: On Time-Sensitive Revenue Management in Green Data Centers

Author: Huangxin Wang Jean X. Zhang Bo Yang Fei Li

PII: S2210-5379(16)30121-4

DOI: <http://dx.doi.org/doi:10.1016/j.suscom.2017.01.002>

Reference: SUSCOM 162

To appear in:

Received date: 29-7-2016

Accepted date: 31-1-2017

Please cite this article as: Huangxin Wang, Jean X. Zhang, Bo Yang, Fei Li, On Time-Sensitive Revenue Management in Green Data Centers, <![CDATA[Sustainable Computing: Informatics and Systems]]> (2017), <http://dx.doi.org/10.1016/j.suscom.2017.01.002>

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Sustainable Computing: Informatics and Systems 00 (2017) 1–17

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# On Time-Sensitive Revenue Management in Green Data Centers<sup>☆</sup>

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## Abstract

In this paper, we design an analytically and experimentally better online energy and job scheduling algorithm with the objective of maximizing net profit for service providers in green data centers. We first study the previously known algorithms and conclude that these online algorithms have provable poor performance in their worst-case scenarios. To guarantee an online algorithm's performance in hindsight, we design a randomized algorithm to schedule energy and jobs in the data centers and prove the algorithm's expected competitive ratio in a special setting. Our algorithm is theoretical-sound and it outperforms the previously known algorithms in many settings using both real traces and simulated data. An optimal offline algorithm is also provided as an empirical benchmark.

**Keywords:** Green Data Centers, Revenue Management, Energy Scheduling, Job Scheduling

## 1. Introduction

A *data center* is a computing facility used to house computer systems and associated components such as communication and storage subsystems. Usually, a data center stores data and provides computing facilities to its customers. Through charging fees for data access and computing services, a data center gains revenue [6]. At the same time, to maintain its running structure, a

data center has to pay *operational costs*, including hardware costs (such as of upgrading computing and storage devices and air conditioning facilities), electrical bills for power supply, network connection costs, in addition to personnel costs. To maximize a data center's net profit, we need to increase the revenue collected and decrease the operational cost paid concurrently.

The ever increasing power costs and energy consumption in data centers have brought with many serious economic and environmental problems to our society and evoked significant attention recently. As reported, the energy consumption of all data centers consisted of 10% of the total U.S. energy consumption in 2006 and has increased 56% over the past five-year period [4]. The estimates of annual power cost for U.S.

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<sup>☆</sup>Part of this work has been published in the proceedings of IGSC'15 [29]

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