Available online at www.sciencedirect.com
ScienceDirect
Procedia Environmental Sciences 38 (2017) 107 – 114
Procedia Environmental Sciences

International Conference on Sustainable Synergies from Buildings to the Urban Scale, SBE16

High Performance Data Centers and Energy Efficiency Potential in Greece

Constantinos A. Balaras[a,*], John Lelekis[b], Elena G. Dascalaki[a], Dimitris Atsidaftis[c]

[a]Institute for Environmental Research & Sustainable Development, National Observatory of Athens, P. Penteli GR15236, Greece
[b]Consulting Engineer, Marathonomahon 10A, Athens GR15124 Greece
[c]DIAMAR S.A., 22 Keas Str., Melissia GR 15127, Greece

Abstract

Data centers are amongst the most complex and energy demanding building environments. The trends of increasing data center capacity and power use by information technology equipment, re-emphasize the need to reduce cooling loads, first cost for HVAC equipment, and finally related energy and operational costs. The first part of the paper presents an overview of relevant information and available resources for the efficient design and operation of these critical environments. The second part considers two large data centers located in Athens that serve two major Hellenic banks as case studies in order to investigate and quantify the potential measures for improving their energy performance. The two facilities were audited and actual energy consumption were used for an energy assessment. According to simulation results of various efficiency measures, the Power Usage Effectiveness may be improved from 2.49 to 2.11 for the first case study and from 1.89 to 1.66 for the second one.
© 2017 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Peer-review under responsibility of the organizing committee of SBE16.

Keywords: data centers; high performance; ASHRAE datacom series; energy audit; power usage effectiveness; PUE

1. Introduction

Data centers (DCs) are amongst the most complex and energy demanding building indoor environments, as a result of high internal loads, low indoor temperature and humidity settings, and continuous (uninterrupted) operation. The facilities are characterized by very high concentration of information technology (IT) equipment, peripherals (e.g. servers, computers, data storage media, network devices, electronic accessories) and facility equipment, for

* Corresponding author. Tel.: +30-210-8109152; fax: +30-210-8109152.
E-mail address: costas@noa.gr

1878-0296 © 2017 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Peer-review under responsibility of the organizing committee of SBE16.
doi:10.1016/j.proenv.2017.03.091

example, power distribution equipment, standby generators, uninterruptible power supplies (UPS), cooling systems (chillers, fans, pumps etc.), computer room air conditioner (CRAC) units (air-handling units tailored for DCs that are situated on the DC floor), cooling towers, artificial lighting and ancillary services.

IT and HVAC equipment are the two major energy end-users. IT equipment consumes electrical energy but also generate very high internal heat loads. The HVAC systems in return consume more energy to remove the heat and maintain the proper indoor operating conditions. As a result, DCs consume up to 100 to 200 times as much electricity as standard office spaces[1]. Power demand can range significantly as a result of available space, type and arrangements of IT equipment. Values range from 54 W/m^2 as high as 2600 W/m^2 (including infrastructure draw) and frequently well over 1000 W/m^2 are reported[2]. Typical heat loads per product footprint depend on the equipment category, rack dimensions and occupancy, e.g. 16 kW/m^2 for storage servers, 40 kW/m^2 for high density, up to 96 kW/m^2 for extreme density communication equipment[3].

A typical breakdown from measured data in data centers[4] is illustrated in Fig. 1., although large variations can be observed in different facilities given the evolution of equipment efficiencies or depending on the type of cooling and air-handling system. A typical power installation process starts with the utility (or standby generator) electricity that is fed to UPS systems, which provide both power conditioning (typically supplied via a distribution transformer, switchgear and suitable bus bar and cabling systems) that are handled by power distribution units that then supply the rack distribution units and finally the IT equipment. There are some losses that occur in this sequence, but these are usually minor compared to the energy consumption of other facilities equipment.

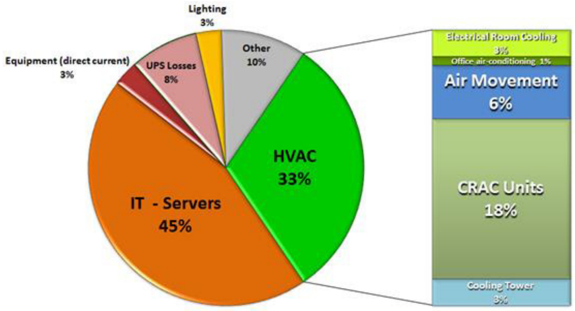

Fig. 1. Typical breakdown of data center energy use.

Energy demand of DCs is estimated at about 1.3% of global electricity consumption[5]. In the United States, DCs consume over 100 TWh of energy per year that is more than 2% of overall electricity use[6]. In Europe, DCs used ~78 TWh in 2015[7] from ~56 TWh in 2007 and is projected to reach 104 TWh in 2020[8]. An annual growth up to 15% is anticipated since technology developments that improve the efficiency and energy use of IT units are outbalanced by the increase of the absolute numbers of DCs to satisfy the quench for more computing power.

Given the trends of increasing DC capacity and power use by IT equipment re-emphasize the need to reduce cooling loads, first cost for HVAC equipment, and finally related energy and operational cost in these critical environments. There are several metrics and assessment methods that can be used to monitor and benchmark DC performance, depending on the available data and the stakeholder or business objectives[2]. The most commonly used benchmark is the Power Usage Effectiveness (PUE), which was introduced by the Green Grid to represent the amount of energy consumption (or peak electric power demand) for the entire facility (including IT equipment and supporting infrastructure) per unit delivered to the IT equipment. A typical PUE ranges about 2.0, which means that for every kWh that is delivered to IT equipment, an additional kWh is required for cooling and infrastructure. Improved operations could result to a PUE of 1.7, best practice installations average 1.3, while state-of-the-art facilities reach 1.06 or better[9]. The reciprocal of PUE is defined as the Data Centre infrastructure Efficiency (DCiE), i.e. the IT equipment power divided by the total facility power.

The first part of the paper presents an overview of available resources like the ASHRAE Datacom Series and from on-going European efforts and work in the frame of related projects, complemented by an overview of popular energy efficiency measures. The second part of the paper considers two large data centers in Athens, Greece that

Download English Version:

https://daneshyari.com/en/article/5745019

Download Persian Version:

https://daneshyari.com/article/5745019

Daneshyari.com