# Chapter 14
# Data Center Waste Management

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## ABSTRACT

*As the world's content becomes further digitized and consumers, corporations, and governments turn to cloud computing platforms – specifically the data center – for their storage and application needs, managing data center waste becomes increasingly important. Less than near full utilization rates for the computing resources, rising energy costs, and e-waste management are just a few of the reasons why a focused attention on practicing sustainable management in the data center is essential. This research identifies several key foci of waste within the management of data centers, including: power, emissions, computing resource lifespan, facilities, and packaging methods. Furthermore this research identifies four roadblocks, or challenges, facing sustainability improvements within the data center. These challenges include: IT prioritization pressures, (lack of) governmental regulation, consumption-oriented cultures, and lagging academic support and innovation. By first recognizing these forms of waste and then coming up with innovative ways to address the technological, regulatory, and managerial challenges faced in data centers across the globe, data center management can move from a position of lagging to a position of leadership in the sustainability movement.*

## INTRODUCTION: THE GROWTH OF THE DATA CENTER

In the past few decades, the data center has become the standard for supplying crucial services within an enterprise. Data centers contain servers of various shapes, sizes, and capabilities, computers, peripherals, telecommunications systems, storage devices, power supplies, network infrastructure, various security devices, various data backup mechanisms, and heating, ventilation, and air conditioning (HVAC) devices. Together the environment enables a centralization of resources to be intelligently utilized across demand generated by the business units within the enterprise, whether for critical applications or test environments. With

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the growth of cloud computing, the data center has quickly become a major focus and challenge for enterprises looking to supply internal solutions, but also software + services to external entities.

The proliferation of cloud services and digitalization breeds challenges with data growth, system performance and scalability, network congestion, and connectivity architecture (Adams & Mishra, 2010). Additionally, new demand strains current data center design and operation, fueled by rising energy costs, new regulation and taxation based on corporate carbon emissions, and the extradition of massive amounts of electronic waste (e-waste) into developing countries. Better, more sustainable solutions are needed to ensure efficient and effective operations in the future. Sustainable development can be defined as meeting the needs of the present without compromising the ability of future generations to meet their own needs (Rahman & Akhter, 2010). While varying by sector and geography, sustainability is increasingly one of the main strategic business priorities attracting marketing attention, investment and innovation, and technology development (Mingay, Tratz-Ryan, & Stokes, 2010). It is estimated that by 2013, more than half of the global 1000 companies will deploy a private cloud-computing solution, bypassing many of the public solutions which are growing today (Tratz-Ryan et al., 2010). Information Technology (IT) is continually asked to demonstrate value to the business and cloud-based solutions are the next evolution, but why is the growth of the data center a major challenge? This paper will discuss the challenges of data center waste, the paradigm shifts in thinking required for improvement, and provide ways to get these mounting issues on the right agendas.

## THE CHALLENGE: MOUNTING ISSUES WITH DATA CENTER WASTE

The exponential need for data center services has driven the importance of monitoring waste to new levels of value for the business. Amazon, Facebook, Google, Microsoft, Twitter, and many others are investing billions to meet the demand of the online services business. In a recent Gartner survey more than half of the respondents plan to expand capacity at their existing data center by the end of 2011, and 30% plan to build new data centers (Adams & Mishra, 2010). In the creation of these facilities and services, no business leader wants their resources to be inefficiently used or to see materials that could be used to create products or services of value being swept into the garbage. It is also unlikely that a leader would be comfortable with knowledge of direct exploitation of the environment. In the context of the data center, waste can be identified in the following ways.

- **Power**: The rate at which work is performed or energy is converted. Used by heating and cooling systems, hardware components, network infrastructure, and general use.
- **Emissions**: From power provider, heating and cooling systems, hardware components, and network infrastructure.
- **End-of-Life Equipment**: Personal computers (PCs), servers, network infrastructure, peripherals, other systems.
- **Facilities**: Physical location of data center storage and operations.
- **Packaging**: Materials used for transport and support of the respective product.

### Power

Data centers require massive amounts of energy to meet power requirements. Power is measured by watts, which are the typical measurement to understand the rate of energy conversion. In a data center, it is estimated that a high density rack requires 10-12kW, medium density requires 6-8kW, and a low density rack requires up to 5kW for use (Cappuccio, 2009). To put this into perspective, according to the Microsoft Corporation, one of