



By Albert Esser, Ph.D.

EFFICIENT ENTERPRISE: MAKING A SUCCESSFUL TRANSITION TO A GREEN IT INFRASTRUCTURE

Adopting a green IT infrastructure is the key to sustainable growth, and in today's economic climate can often be the difference between simply surviving and flourishing. CIOs can accelerate this transition by cost-justifying strategic IT investments that advance enterprise efficiency while helping to simplify management and reduce operational costs—thereby contributing to a healthy bottom line and a healthy environment.

Between rapidly growing IT infrastructures and high power and cooling costs, today's technology executives have more than enough reasons to explore green, sustainable IT strategies. An ever-increasing demand for IT innovation that advances strategic organizational goals only compounds these challenges. This is why CIOs are striving to drive costs out of IT infrastructures to help free capital resources for strategic investments.

Adopting a green IT strategy can help enterprises to minimize power consumption, maximize resource utilization, reduce management complexity, and decrease operational costs. At the same time, green IT has the potential to dramatically improve overall enterprise efficiency—advancing productivity while facilitating fast, flexible response to evolving business conditions.

Although demonstrating environmental responsibility can be an important motivator for going green, these efforts can have concrete benefits for the bottom line as well. Quantifying data center efficiency helps to establish return on investment (ROI) for IT projects and data center infrastructure costs. In addition, measuring efficiency in terms of IT work performed—not just energy consumed—can be critical to building a true picture of the value of green IT.

To help organizations address the challenges of efficiency and sustainability, Dell has developed a “compute more, consume less” approach to analyze total data center efficiency with the potential to provide important guidance on IT policy changes, offering a solid foundation for cost-efficient IT implementations. This approach is also designed to quantify financial returns in language that helps business executives understand how strategic IT investments can pay off on the bottom line. The goals of the Dell methodology: refresh aging IT infrastructures with efficient, high-performance systems such as 11th-generation Dell™ PowerEdge™ servers with the Intel® Xeon® processor 5500 series; virtualize systems to help reduce data center power and space requirements, streamline administration, and lower costs; and reduce CO₂ emissions.

FOCUSING ON DATA CENTER EFFICIENCY

Data centers account for a significant proportion of the energy used within most organizations—and energy use is synonymous with greenhouse gas (GHG) emissions. Therefore, a green efficiency approach to IT makes good business sense as well as environmental sense—helping enterprises save on operational expenditures through decreased energy use while also contributing significantly toward reducing GHG emissions.

However, many data centers have a lot of room for improvement. Dell estimates that by transitioning to a green IT strategy, a typical traditional data center can potentially become more than 10 times less carbon intensive than it is now (see the example scenarios in the “Step 2: Examine policies affecting green efficiency” section in this article). Reducing GHG emissions from the data center can also translate to enormous cost savings.

A variety of tactics can help CIOs enhance data center efficiency and reduce GHG emissions, including the following:

- Refresh legacy servers and standardize with energy-efficient, latest-generation models.
- Specify efficiency levels—for example, power supply units (PSUs) with efficiency ratings of 90 percent or higher—and make them part of every request for quotation (RFQ).
- Set ROI goals for IT that are just as rigorous as those set for other business units, such as factories and operations.
- Set quantifiable cost-efficiency goals. Through small up-front investments, green IT helps drive cost-effectiveness in the data center by providing the foundation for heightened efficiency levels.
- Buy renewable energy.
- Use recyclable and recycled materials.
- Give every team within the IT department a goal that contributes toward making the IT infrastructure green. Going green requires support throughout the organization—it cannot be a top-down or solo effort.

TAKING KEY STEPS ALONG THE PATH TO GREEN IT

Getting started along the path to a green data center does not have to be a complex undertaking. Three critical steps—evaluating energy use, examining policies affecting green efficiency, and taking action—can empower CIOs to reduce both infrastructure costs and GHG emissions.

Step 1: Evaluate energy use

The first step in managing energy use is to be able to measure and quantify it. To establish a baseline on which to improve, IT executives should start by conducting an energy audit. By categorizing energy use by purpose (such as IT work or ancillary functions like cooling), they can understand where energy is actually being used within the data center and examine the tasks that consume a disproportionate share of overall costs. System-level instrumentation in Dell PowerEdge servers with the Intel Xeon processor 5500 series can help organizations understand how much power these systems consume under normal operating conditions.

Step 2: Examine policies affecting green efficiency

Objectively assessing the value of IT expenditures, especially for green IT investments, can be done by using a holistic metric that can describe the efficiency of the entire data center. Data Center Infrastructure Efficiency (DCiE)—the conventional measure IT leaders have used to evaluate the effectiveness of power

consumption in the physical infrastructure—can be expanded by looking at additional aspects contributing to data center efficiency. DCiE does not factor in overall IT productivity or take into account whether the IT equipment is idle or heavily used. For these reasons, Dell suggests augmenting DCiE to measure the total value delivered by the data center.

Measuring four basic types of efficiency can help IT leaders assess the ability of their data centers to convert electricity into IT work: DCiE, IT Age Mix Efficiency (ITAME), IT Utilization Efficiency (ITUE), and IT Efficiency (ITE). Multiplying these values offers a way to assess overall data center efficiency—which also allows organizations to compare productivity across data centers with different configurations and different workloads. Dell calls this comprehensive assessment Total Data Center Efficiency (TDCE):

$$TDCE = DCiE \times ITAME \times ITUE \times ITE$$

TDCE describes the efficiency of converting energy into IT work. Because it accounts for the relationship between work production and resources used, it does not require a definition of the absolute IT work done in units, assuming the same useful IT work is desired. It also provides an approximation that can be used to assess the level of CO₂ efficiency or “greenness” of a data center. The goal: allow IT decision makers to quickly identify specific areas to target for improvement. Figure 1 illustrates several scenarios using a variety of example values for each

	DCiE (physical infrastructure)	ITAME (capital expenditure write-off schedule)	ITUE (virtualization)	ITE (OEM and vendor qualification)	TDCE (total efficiency)	Relative CO ₂ efficiency (operational energy cost)
Typical	50.0%	56.0%	15.0%	100.0%	4.2%	100.0%
Improved	60.0%	63.8%	29.0%	100.0%	11.1%	37.8%
Better	70.0%	73.4%	52.0%	100.0%	26.7%	15.7%
Very good	75.0%	85.4%	71.0%	100.0%	45.5%	9.2%
Excellent	80.0%	100.0%	79.0%	100.0%	63.2%	6.6%

Figure 1. Example values showing how increased data center efficiency can help reduce CO₂ emissions

metric, demonstrating how they affect TDCE and the resulting CO₂ efficiency relative to the “typical” scenario.

In these calculations, DCiE measures the power used to run IT equipment as a percentage of power used to run the entire data center. This metric shows how much of the power going to the data center is being used to run equipment that actually handles the IT workloads, as opposed to power used for cooling and other support functions.

ITAME approximates the effect of Moore’s Law in the data center, which conservatively describes the phenomenon where computing ability doubles every two years. The ITAME metric is designed to characterize the effect that server refresh rates have on computing capacity, which in turn contributes to data center efficiency. Applying the converse of Moore’s Law would characterize two-year-old equipment as having only 50 percent of the computing capability of new equipment—which, mathematically, can be described as an exponential decay with a half-life of two years.

ITAME is calculated by using this decay to determine the efficiency of legacy servers relative to latest-generation servers; a data center with all-new hardware would have an ITAME of 100 percent. If

IT equipment is purchased annually and the entire server infrastructure is refreshed every five years (that is, the oldest 20 percent of servers in the data center are retired each year), then the ITAME at the end of five years would be just 56 percent, indicating that the data center is operating at only 56 percent of the capacity it would have if all the servers were new. In comparison, if IT equipment is on a three-year refresh cycle and the oldest third of the server population is replaced each year, ITAME after three years would be 73.4 percent.

ITAME can have a significant impact on the number of servers required to do the same amount of IT work. For example, in a data center with 1,000 servers, switching from a five-year depreciation schedule to a three-year schedule can reduce overall server count to 763—a 24 percent reduction. By avoiding the installation of these physical servers, the organization in this example scenario could expect to emit about 24 percent less CO₂ than if it were using a five-year depreciation schedule. This approach can also lead to savings on data center power, cooling, space, and administration overhead.

The next metric, ITUE, describes the ability of servers to convert electricity into IT work, defined as processor utilization

divided by power consumption as a percentage of total possible power consumption. Energy use by servers does not increase at the same rate ITUE increases, indicating that servers have the capacity to perform more work per unit of energy used (see Figure 2). Underutilization of IT equipment can be one of the most significant sources of inefficiency in the data center. Because virtualization is designed to increase resource utilization, it can help significantly boost ITUE.

Finally, the ITE metric quantifies the relative efficiency with which IT hardware such as servers and storage devices convert energy into useful IT work; the hardware with the lowest power consumption at a specific desired configuration is defined as having an ITE of 100 percent. Not all IT equipment uses the same amount of electricity to perform IT work, and the differences between hardware from different vendors can be significant. Dell helps to address ITE by focusing on Dell Energy Smart technologies within its server and storage product families.

Step 3: Take action

After IT leaders have established the baseline values for energy use and applied this methodology to assess the data center’s overall efficiency, they can take a variety of measures to enhance efficiency in specific areas. By reducing or eliminating power consumption in targeted areas and converting to renewable energy sources wherever possible, IT executives encourage sustainable growth and can significantly boost the bottom line—often with improving service levels for vital business processes.

Several strategies, used alone or in combination, help advance data center efficiency:

- **Refresh data center hardware:** Typically, IT equipment is used for five years or longer. Assuming that the server infrastructure leverages virtualization technologies, reducing the server lifetime to three years can produce significant

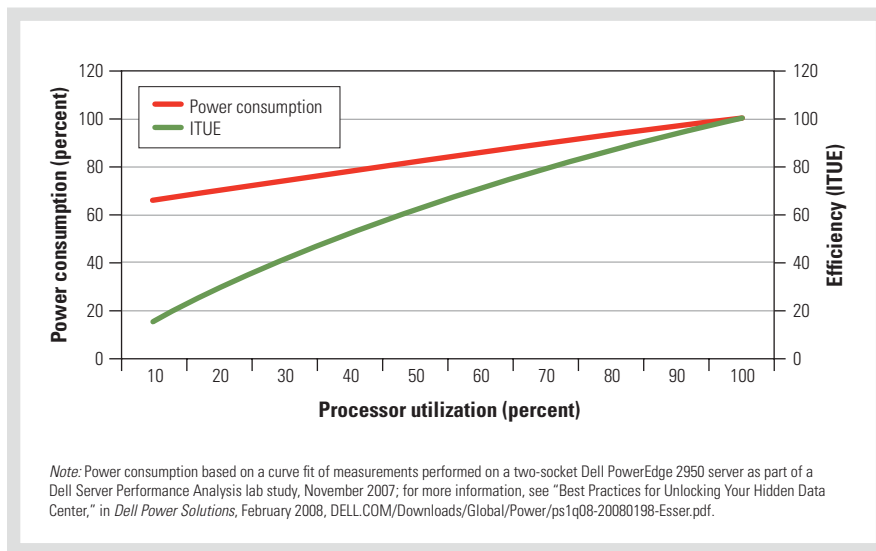


Figure 2. ITUE values as processor utilization increases, showing how virtualization can be a major contributor to efficiency

“Green IT equals efficient IT—and that equals an efficient and sustainable enterprise with a healthy bottom line.”

savings in total server acquisition and maintenance costs because of the efficiencies realized by more recent server technology. For example, the multi-core Intel Xeon processor 5500 series in 11th-generation Dell PowerEdge servers is designed to provide up to 2.25 times the performance of the Intel Xeon processor 5400 series in a similar power envelope¹ while consuming less idle and peak power, helping to maximize performance, optimize energy use, and enable dramatic reductions in server count for the same amount of processing power.


- **Virtualize to increase utilization:** IT equipment in traditional data centers typically runs at only a fraction of its capacity. At this level, servers are extremely inefficient at converting electricity into IT work—but increasing that utilization can lead to major increases in efficiency. For example, as shown in Figure 2, going from 10 percent processor utilization (a typical level in non-virtualized environments) to 40 percent utilization (typical of virtualized environments) on a typical two-socket, 2U server can increase the IT work output of that server by a factor of four while only consuming 17 percent more power—resulting in a more than threefold increase in ITUE, with the accompanying reductions in power consumption, operating costs, and CO₂ emissions. Dell PowerEdge servers with the Intel Xeon processor 5500 series can utilize Intel Virtualization Technology to significantly

increase virtualization performance, further enhancing the efficiency benefits of virtualization.

- **Avoid the cost of building new data centers:** By upgrading their facilities and IT equipment, organizations can dramatically increase the efficiency of their existing data center and potentially avoid the massive cost of building a new one. Investing in these upgrades following the approach described in this article can yield a rapid ROI—even in as little as 12 months, depending on the specific environment. And by taking advantage of power and temperature data accessed through instrumentation in 11th-generation Dell PowerEdge servers with the Intel Xeon processor 5500 series, organizations can also manage facility-level power and cooling based on the actual requirements of the IT equipment, helping significantly reduce operational costs.
- **Update facilities:** Moving a data center from a “typical” DCiE value of 50 percent to a “better” value of 70 percent, as defined in Figure 1—for example, by investing in improvements to existing power and cooling systems or by deploying new, state-of-the-art systems—can offer an immediate and significant improvement in IT efficiency.

MAXIMIZING EFFICIENCY THROUGH GREEN IT STRATEGIES

This Dell methodology shows that green IT equals efficient IT—and that equals an efficient and sustainable enterprise with a

healthy bottom line. Through three key steps, CIOs can help their enterprises get on the path to green IT and enhanced data center efficiency. Evaluating energy use through an energy audit helps establish a baseline for future improvements. Using the Total Data Center Efficiency approach to examine the organization’s policies affecting green efficiency is designed to suggest specific actions organizations can take to improve their overall data center efficiency. And taking action to enhance efficiency and avoid building new data centers—particularly by refreshing systems to gain the advantages of 11th-generation Dell PowerEdge servers with the Intel Xeon processor 5500 series—helps IT executives achieve both reduced GHG emissions and significant cost savings. 

Albert Esser, Ph.D., is the CEO and founder of Econdius LLC, a company focusing on green IT, sustainable energy technology solutions, and technology management consulting and services. Previously, Albert served as vice president for data center infrastructure at Dell, where he was responsible for enhancing Dell’s enterprise-class IT solutions by sharing insights gained from customers with the company’s server, storage, data center solutions, and services teams. Albert has an M.S. and a Ph.D. in Electrical Engineering from the University of Aachen. He holds 12 U.S. patents.

¹Based on Intel internal measurements in February 2009; for more information, see “Intel Xeon Processor 5500 Series: An Intelligent Approach to IT Challenges,” by Intel, www.intel.com/assets/pdf/prodbrief/321579.pdf. Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products, visit www.intel.com/performance/resources/limits.htm.

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