Energy Consumption in Critical Power (IT/Facilities/Imaging)

June 2023

Critical Power Energy Efficiency in Healthcare Facilities

It is no secret that when comparing Energy Use Intensity (EUI) Hospitals are some of the highest energy consumers on the planet (EnergyStar Portfolio Manager).

In addition, many of these facilities require critical power that includes power quality protection and/or isolation, adding complexity to their power infrastructure, and decreasing efficiency. Medical Imaging, IT Infrastructure (including data centers), and Life Safety are all often powered by means of an Uninterruptible Power Supply (UPS), lighting inverter, or other power quality device.

Where hospitals see a lot of energy in-efficiencies is in IT infrastructure/data centers and other healthcare facility networks. Healthcare Facilities specialize in patient care, but not always in IT or data center infrastructural efficiency. When most of us think about a high energy-consuming data center, we think of hyper-scale data centers like Microsoft, Amazon, or Facebook, but there are all types of IT "Data Centers" that include server closets, data rooms, localized data centers, midtier data centers, high-end data centers, and hyper-scale data centers. But of these different data center segments, which ones are surprisingly the worst in energy efficiency?

According to the Department of Energy, as of 2020, small to medium-sized data centers (servers closets, data rooms, small localized data centers) have the least efficient levels of power usage effectiveness(PUE). These small to medium-sized data centers are not only energy inefficient but combined across all market segments, are larger energy consumers than the large hyperscale data centers combined.

If a healthcare facility is looking to reduce energy consumption and improve efficiency within its IT infrastructure or small to medium-sized data centers, start by having a conversation with key stakeholders. In this conversation, you should identify your critical power path and review critical equipment like cooling, UPS systems, and IT equipment to measure efficiency.

How to take action, achieve energy efficiency, and save money?

To demonstrate how a healthcare facility, or any facility, can identify its own energy inefficiencies within its critical power infrastructure, let's walk through a case study that displays how to properly measure the energy efficiency of a facility's critical power systems.

June 2023

Case Study: Review of Power Systems Efficiency

Below is an example of a simple power study on UPS systems throughout a healthcare facility to measure and monitor their efficiency. To start, a review of a facility 1-line and walkthrough of the facility was completed. During this, it was key to determine all UPS systems used, including in any Data Centers, network closets, medical imaging or other areas. These units were documented, and often, display readings were available from the device, or a recent service report was available with load readings. Once this was completed, each device was reviewed for energy losses.

Measuring your UPS's energy efficiency

Let's start with measurement. How is energy measured on a UPS? It is measured in terms of kilowatt per hour (kWh) demand in versus kWh demand out. The first thing to note is when comparing the input current and output current on typical UPS units, there will be a loss from the utility input load to the output load on the unit. This is because the UPS system or inverter itself requires power, and energy loss is wasted as heat and electrical capacitance, which affects overall efficiency.

Aside from system input and output, one of the first things that should be considered regarding UPS efficiency is sizing your UPS unit properly. All UPS units have different efficiency curves, typically low efficiency at low utilization. A large capacity UPS that is lightly loaded can waste more than energy that you might think!

Other factors to consider when measuring UPS efficiency are:

1. The total UPS size versus the load the UPS is rated for. Some equipment may have large peak inrush demands, which requires an oversized UPS.

2. Percent load on the UPS. A great UPS model may be running at a low percentage load, which lowers its efficiency.

3. Cost of energy per kilowatt hour (kWh). The higher the cost, the more effect UPS inefficiency has on the company's bottom line.

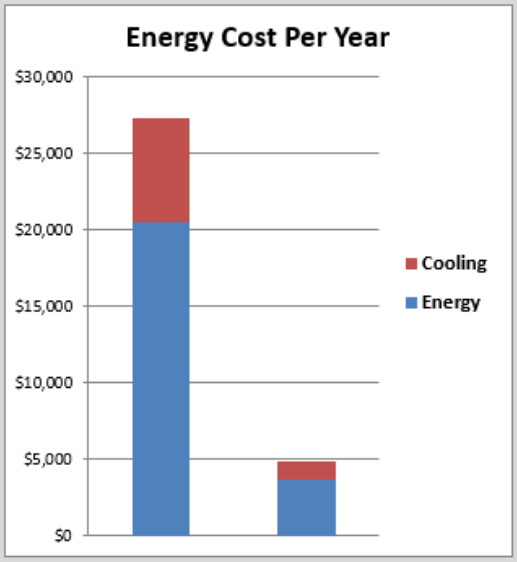
The site that was reviewed had a 500kVA UPS with a power factor of .8. Due to the power factor, the UPS is only rated for 400kW of load. Operating loads were known to be at 25%. Lastly, the cost per kWh was estimated at 10 cents. Over the life of the UPS system, we noted that over $300,000.00 was wasted utility expense simply due to inefficiency. This number can be compounded with more than one unit, or over a number of years.

UPS Efficiency Loss Cost Savings Comparison

YOUR CURRENT UPS vs. Best in Industry*

focus on energy
Partnering with Wisconsin utilities

Existing UPS		Liebert Npower
New UPS		Toshiba G9000
UPS size (kVA)		500
Power Factor of Load (pF)		0.8
Rated Load (KW)		400
Quantity of Units		1
% Load per UPS		25%
Total Energy Cost per kW/H: (FOUND ON ENERGY COST TAB)		$0.10
Double Conversion Efficiency - (USE FORMULA FOUND ON HOW TO USE TAB - AUTOPOPULATES)	Liebert Npower	81.0%
	Toshiba G9000	96.0%
Annual Cost of Energy Loss	Liebert Npower	$20,505
	Toshiba G9000	$3,650
Heat Loss of Power (BTU/hr)	Liebert Npower	319,562
	Toshiba G9000	56,883
Annual Cooling Cost	Liebert Npower	$6,835
	Toshiba G9000	$1,217
Annual Total Cost of Energy + Cooling	Liebert Npower	$27,340
	Toshiba G9000	$4,867
Total Annual Energy Savings	Toshiba G9000	$22,473.53



SAVINGS	# of Years	Savings
	1	$22,474
	2	$44,947
	3	$67,421
	4	$89,894
	5	$112,368
	10	$224,735
	15	$337,103

As displayed in the cost savings comparison chart for an illustration (numbers are examples.) As seen in the cost savings chart an efficient UPS's savings add up over the years.

The data found in the calculations chart above can help guide numerous decisions about an emergency power system and other aspects of the businesses data center energy consumption, which can include:

- Replacing an aging UPS versus continuing to repair it, as repairs can become costly over time
- Resizing a UPS that is not properly loaded, to reduce space, heat, and electricity costs
- Investing in a more efficient UPS to save money through potential credits
- Possible reduction in cooling

All these decisions are beneficial towards saving time, space, or money that can be reinvested back into the business. While simultaneously reducing a facility's contribution to energy consumption.

How can WHEA members support Energy Efficiency for Critical Power Infrastructure in Healthcare Facilities?

As WHEA members we can be a resource to healthcare facilities. Either by providing insight into the energy inefficiencies that exist in a healthcare facility's data center infrastructure, or by guiding them to other resources, like the energy efficiency calculator used above, that can aid in helping a facility understand its current inefficiencies.