ALIGNED DATA CENTERS

COMPARING PUE BETWEEN COLOCATION DATA CENTERS – AND WHY IT MATTERS

Data center energy efficiency matters. But understanding the energy efficiency of one data center compared to another is made difficult by a lack of transparency into what metric is used.

This tech brief is designed to help you understand the different data center efficiency metrics – and give you the questions to ask prospective colocation providers in order to compare energy efficiency apples to apples. Why does it matter? Because the energy efficiency of a data center has a significant impact on the cost you'll pay for the data center, and your ability to scale within it.

QUICK VIEW

When measuring data center efficiency, both annualized PUE and design PUE matter – for different reasons.

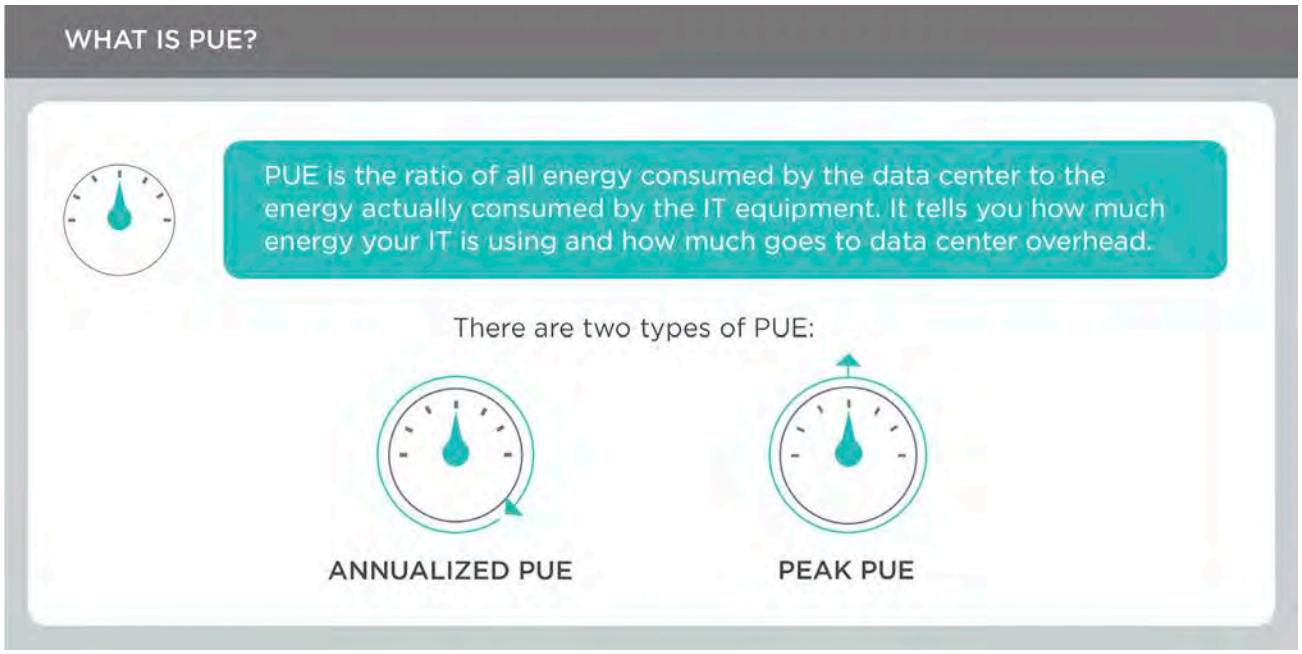
- Annualized PUE is a measure of operational efficiency, calculated as the ratio of the average annual energy consumption of the entire data center to the average annual energy consumption by IT equipment alone.
- Across all types of data centers, average annualized PUE is 1.8 - 1.9, according to the 2016 U.S. Data Center Energy Report.
- Peak PUE is a measure of design efficiency, calculated as the ratio of total energy consumed by the data center to energy consumed by the IT equipment alone during peak load conditions (for example, on the hottest day of the year). It determines how much power and cooling infrastructure has to be built to support the data center.

For comparing the energy efficiency of one colocation data center against another, the two metrics that matter are annualized PUE and peak PUE. Annualized PUE affects operating expenditures and peak PUE affects capital cost and, potentially, scalability.

- Colocating for 10 years at a data center with an annualized PUE of 1.7 is 48% more costly than colocating at a data center with a 1.15 annualized PUE.
- A data center with energy efficient design (1.25 peak PUE) requires 26% less infrastructure and leaves 37% more power load for IT than even an ASHRAE-compliant design (1.7 peak PUE).

Asking eight key questions is the best way to ensure an apples-to-apples comparison of annualized PUE and peak PUE between different data centers.

TABLE OF CONTENTS



INTRODUCTION

Without a consistent definition of PUE, and a standard for how it is measured, it is very difficult to compare the efficiency level (which ties directly to cost) of one data center to another. Our goal in this tech brief is to clear up the confusion – to clearly explain the new ASHRAE standard MLC and ELC, annualized PUE, peak PUE, and why they matter.

40% of enterprise IT managers are paying more for colocation contracts than they initially planned or expected, according to the Uptime 2016 Survey. Choosing the right data center can help you keep those costs in check.

If you're having trouble understanding how to determine how efficient a data center is and how to compare the claims each center makes, keep reading. You'll come away armed with questions to ask to make sure you understand what claims a data center operator is making. What are they measuring? What do they mean when they cite PUE? How is PUE written into the lease agreement, and how – specifically – will it affect your monthly costs?

A NEW STANDARD FOR DATA CENTER ENERGY EFFICIENCY

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) recently released a new energy efficiency design standard specifically for data centers. The new standard, ASHRAE 90.4, represents an evolution of ASHRAE 90.1, an energy efficiency standard for buildings.

As ASHRAE was creating 90.4, one of the key concerns from the data center industry was the ability of the standard to keep up with the rapid pace of data center innovation. In its final form, the standard recognizes that the industry is rapidly developing technologies to handle ever-increasing IT loads with both high reliability and energy efficiency. As Ron Jarnagin, chair of the 90.4 committee, explained, "We worked very hard to craft this standard in a manner that does not stifle innovation in the data center industry while simultaneously offering criteria to help ensure energy savings."

For each of 18 climate zones, ASHRAE 90.4 specifies minimum levels of energy efficiency that data centers must reach. It does not dictate precisely how those performance levels should be achieved. It's not a law or a mandatory regulation, but most forward-thinking data centers will adopt the standard, just as most buildings have adopted the 90.1 energy efficiency standard.

For each of 18 climate zones, ASHRAE 90.4 specifies minimum levels of energy efficiency that data centers must reach.

An early draft of the new standard proposed using design PUE to measure the efficiency of a facility's electrical and mechanical systems design. Design PUE, also referred to as peak PUE, is different from the PUE you're most likely familiar with (learn more on page 6). It measures the energy efficiency of the data center under peak load conditions – those are the conditions the data center must be designed to. In later drafts of the standard, ASHRAE replaced design PUE in favor of Mechanical Load Component and Electrical Loss Component, though they measure the same components (learn more on page 7).

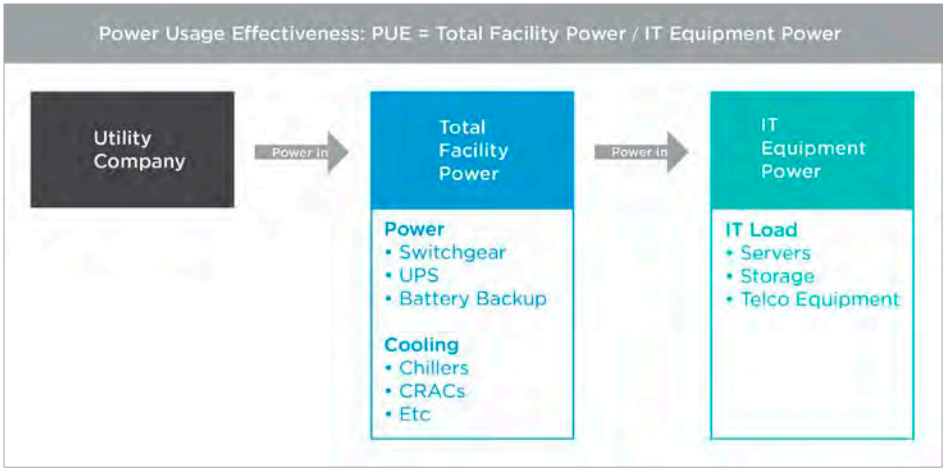
ASHRAE 90.4 alone doesn't provide a complete picture of a data center's energy efficiency. It doesn't account for operational efficiency the way annualized PUE does – a standard put forth by The Green Grid (learn more about it on page 6).

ANNUALIZED PUE AND PEAK PUE – EXPLAINED

The PUE, or Power Usage Effectiveness, metric was created in 2007 by a number of data center industry organizations including The Green Grid, ASHRAE, and the Uptime Institute. They were looking for a metric that could serve as a benchmark for improving data center energy efficiency.

PUE is the ratio of all energy consumed by the data center to the energy actually consumed by the IT equipment. PUE explains how much energy your IT load consumes and how much of it applies to data center overhead. Put very simply:

$$\text{PUE} = \frac{\text{(Energy Consumption by Cooling + Power + Lighting + IT)}}{\text{(Energy Consumption by IT)}}$$



A PUE of 2.0 means that for every kilowatt of IT power, an additional kilowatt is used to support the data center. The closer PUE is to 1.0, the more efficient the data center is – the more IT load you get out of a given unit of power. PUE can never be below 1.0 because even if the data center used power exclusively for IT load (no cooling, no lights, no electricity loss), PUE would be 1.0. So if you're comparing a data center with a PUE of 2.0 and one with a PUE of 1.5, the latter is twice as efficient.

The closer PUE is to 1.0, the more efficient the data center is – the more IT load you get out of a given unit of power.

When measuring data center energy efficiency, both annualized PUE and design PUE matter – for different reasons.

Variations in PUE are driven overwhelmingly by the data center's cooling system, and to a lesser extent, by the electrical conditioning, transformation, and distribution systems. Lighting is the only other system that contributes in a measurable way to PUE.

Sounds simple enough, right? But here's the challenge: annualized PUE and design PUE (also called peak PUE) are often confused. The fact is that when measuring data center energy efficiency, both annualized PUE and design PUE matter – for different reasons.

Annualized PUE (operational efficiency)

References to "PUE" often mean annualized PUE, which is a measure of operational efficiency. Annualized PUE is the ratio of the average annual energy consumption of the entire data center to the average annual energy consumption by the IT equipment alone. Because it's an annualized number, it accounts for energy consumption on the hottest days of the year and the coldest ones.

$$\text{Annualized PUE} = \frac{\text{(Average Daily Energy Consumption by Cooling + Power + Lighting + IT)}}{\text{(Average Daily Energy Consumption by IT)}}$$

Annualized PUE is good for:	Annualized PUE is not good for:
Annualized PUE is a great measure of operational efficiency in the data center. Your monthly utility bill is defined by the total energy you consumed all month. The more IT load you can get out of a given unit of power, the lower your costs. If you're looking to know how much your utility bill will be in a year, annualized PUE can give you that number.	Annualized PUE doesn't tell you anything about the energy efficiency of the data center under peak load conditions. It doesn't tell you anything about the power and cooling infrastructure that had to be built to support peak load conditions, regardless of average efficiency.

What is a "good" annualized PUE? A 2007 U.S. Data Center Energy Report estimated average annualized PUE, across all types of data centers, to be 2.0. A 2016 update to that report by the Lawrence Berkeley National Laboratory says that average annualized PUE has only modestly improved to about 1.8-1.9. "High end" data centers, which includes some colocation data centers, are somewhat more efficient with an average annualized PUE of 1.7. Hyperscale data centers are typically the most efficient, with an average annualized PUE of 1.2.

The following table shows 2014 average annualized PUEs by type of space, and the PUEs that could be achieved by 2020 under three different scenarios: current trends (efficiency is improving), with improved data center energy management, and with best practices data center energy management.

		2020 PUE		
Data Center Type	2014 PUE	Current Trends	Improved Management	Best Practices
Closet	2.0	2.0	2.0	2.0
Room	2.5	2.35	1.7	1.5
Mid-tier	1.9	1.79	1.7	1.4
High-end	1.7	1.6	1.51	1.3
Hyperscale	1.2	1.13	1.13	1.1

Source: June 2016 United States Data Center Energy Usage Report

Peak PUE (design efficiency)

While ASHRAE moved away from the term "design PUE" in favor of design mechanical load component (design MLC) and design electrical loss component (design ELC), those are still design standards rather than operating standards.[1] As such, they still reflect the infrastructure that must be built to support IT under peak load conditions. Added together, design MLC and design ELC equate to peak PUE, or "design PUE."

Peak PUE is the ratio of total energy consumed by the data center to energy consumed by the IT equipment alone during peak load conditions – for example, on the hottest day of the year. As such, peak PUE is always higher than annualized PUE.

As a snapshot of PUE at one moment in time, at peak load, peak PUE is not a good measure of operational efficiency. But it does determine how much power and cooling infrastructure is required to support IT load during those peak load conditions. That's why peak PUE is also referred to as design PUE – it measures the energy efficiency of the data center under the peak load conditions, which the data center must be designed to.

$$\text{Peak PUE} = \frac{(\text{Energy Consumption by Cooling} + \text{Power} + \text{Lighting} + \text{IT at Peak Load})}{(\text{Energy Consumption by IT at Peak Load})}$$

1. Mechanical Load Component (MLC) is defined as "the sum of all cooling, fan, pump, and heat rejection design power divided by the data center Information Technology Equipment (ITE) design power." Electrical loss component (ELC) is defined as "the combined losses (or the losses calculated from efficiencies) of three segments of the electrical chain."

Peak PUE is good for:	Peak PUE is not good for:
Peak PUE tells you the energy efficiency of the data center under peak load conditions. It tells you how much power and cooling infrastructure had to be built to support peak load conditions, regardless of average efficiency. After all, even if the power and cooling systems only reach peak PUE for one hour on one day of the year, the infrastructure has to be fully built out to support that peak or else the data center will go down.	Peak PUE is just a snapshot of one moment in time, so it's not a good measure of operational efficiency or expected utility costs. If you're comparing your annual utility bill between data centers, peak PUE will not provide that information because it only measures PUE under peak load conditions.

What is a "good" peak PUE? The best measure of a "good" peak PUE comes from the new ASHRAE standard, 90.4, which sets maximum values for design Mechanical Load Component (design MLC) and design Electrical Loss Component (design ELC), which together equate to peak PUE, or "design PUE."

ASHRAE Standard 90.4 Maximum Design Mechanical Load Component

Climate Zones As Listed In ASHRAE Standard 169	Maximum Design MLC At 100% and 50% IT Load
0A	0.48
0B	0.52
1A	0.46
1B	0.48
2A	0.45
3A	0.45
4A	0.44
5A	0.43
6A	0.55
2B	0.53
3B	0.51
4B	0.46
5B	0.48
6B	0.41
3C	0.38
4C	0.40
5C	0.38
7	0.40
8	0.38
Average	.45

Source: ANSI/ASHRAE Standard 90.4-2016, Table 6.2.1.1

ASHRAE Standard 90.4 Maximum Design Electrical Loss Component

IT Design Load	UPS Type	Maximum Design ELC
< 100 kW	Single Feed UPS (N, N+1, etc.) or No UPS - 100% of IT design load segment ELC	0.297
	Single Feed UPS or No UPS - 50% of IT design load segment ELC	0.265
	Active Dual Feed UPS (2N, 2N+1, etc.) - 50% of IT design load segment ELC	0.265
	Active Dual Feed UPS - 25% of IT design load segment ELC	0.302
≥ 100 kW	Single Feed UPS or No UPS - 100% of IT design load segment ELC	0.265
	Single Feed UPS or No UPS - 50% of IT design load segment ELC	0.231
	Active Dual Feed UPS - 50% of IT design load segment ELC	0.231
	Active Dual Feed UPS - 25% of IT design load segment ELC	0.258
	Average	0.26

Source: ANSI/ASHRAE Standard 90.4-2016, Table 8.2.1.1 and Table 8.2.1.2

The maximum MLC and ELC that ASHRAE has put forth depend on a variety of factors, including climate region (for MLC) and IT design load and UPS configuration (for ELC). On average, the maximum MLC is .45 and the maximum ELC is .26. Taken together, these metrics equate to a maximum peak PUE (or "design PUE") of 1.72.

As data centers work to comply with the new ASHRAE standards, they'll also push toward the "best practices" levels of annualized PUE targeted in the June 2016 United States Data Center Energy Usage Report (see page 7). At Aligned Data Centers, we've already achieved hyperscale-level efficiency, as measured by annualized PUE and peak PUE (learn how on page 13).

Partial PUE

A Partial PUE is a metric that only reflects a portion of a data center, rather than the facility as a whole. For example:

- Mechanical PUE, which reflects the efficiency of the cooling system alone. Mechanical PUE corresponds to ASHRAE's mechanical load component.
- Electrical PUE, which reflects the efficiency of the lighting system, transformer, and UPS. This corresponds to ASHRAE's electrical loss component.

Mechanical PUE and electrical PUE added together equal total PUE.

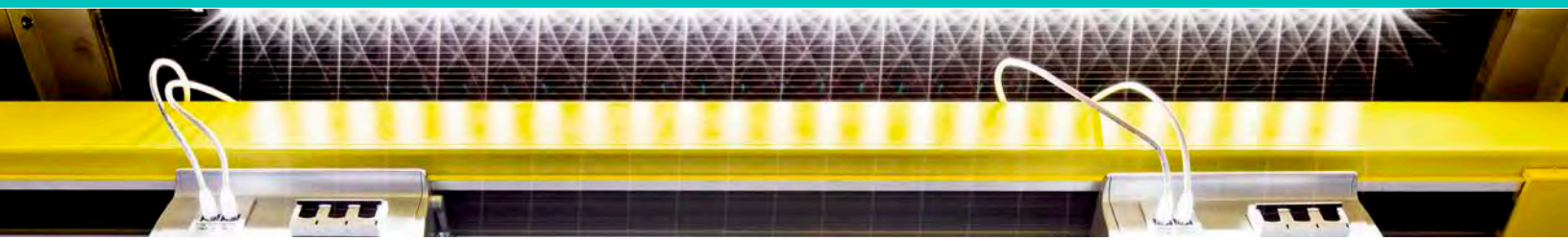
Another example of a partial PUE: our pricing model includes a guaranteed annualized PUE of 1.15, which is the "partial PUE" for the client's data pod(s) – since the PUE of their own footprint is all clients care about (and, in our model, all they pay for).

Trust, but verify

How will you know whether a data center's PUE is consistent with the industry's accepted definitions? The Green Grid recommends: "In order for a reported PUE to be meaningful, the reporting organization should provide additional information about the data collection process. This includes information about the manner in which the data was collected, the type of equipment from which the data was collected, the time frame covered by the reported value, and the frequency with which individual data points were collected."

"In order for a reported PUE to be meaningful, the reporting organization should provide additional information...including the manner in which the data was collected, the type of equipment from which the data was collected, the time frame covered by the reported value, and the frequency with which individual data points were collected."

– The Green Grid



HOW PUE IMPACTS THE COST AND SCALABILITY OF YOUR DATA CENTER

For comparing the energy efficiency of one colocation data center against another, the two metrics that matter are annualized PUE and peak PUE. Annualized PUE affects operating expenditures and peak PUE affects capital cost and, potentially, scalability.

Operating cost

Power typically represents 60-70% of the total operating cost of a data center. So as a colocation customer, the energy efficiency of the data center significantly affects your bottom line – for better or worse.

The metric that will help you assess power costs from one data center to another is annualized PUE, along with the local utility rate. If utility rates are equal, then the lower the data center's annualized PUE, the lower your costs. This assumes that energy costs, taking PUE into account, are passed directly from the colocation provider to you.

In the standard colocation pricing equation, monthly energy costs are represented as E where E is the power consumed (in kWh) multiplied by the cost of metered utility (in $ per kWh) multiplied by PUE. When PUE is included in the cost equation, it has a significant impact on your total monthly energy cost.

How PUE affects colocation costs:

Monthly Energy Cost = Power Consumption x Utility Rate x PUE

As you are assessing colocation providers, look for transparency in the lease agreement about what the PUE multiplier will actually be. Ask about the conditions under which you would actually qualify for the advertised PUE and the circumstances under which you could be charged a much higher PUE multiplier.

The Natural Resources Defense Council (NRDC), in its seminal report on data center energy use, recommends that colocation customers "negotiate for pricing models based on actual space and energy use, and explore options to renegotiate existing terms." The NRDC report also recommends that colocation customers do exactly what we're suggesting here – "request data center energy performance metrics, and consider energy and environmental performance as a part of the total cost of procuring data center services."

At Aligned Data Centers, the PUE we use to calculate our clients' monthly energy charges is 1.15. Guaranteed. No caveats, no exceptions, no matter the power density or capacity of the facility. We include a 1.15 PUE in our Service Level Agreement so our clients really do benefit from our energy efficiency. (Learn about the technology that makes our guaranteed PUE possible on page 13).

"Request data center energy performance metrics, and consider energy and environmental performance as a part of the total cost of procuring data center services."

– Natural Resources Defense Council

How much of a difference can PUE make to your colocation costs? A significant difference:

	Annualized PUE of 1.15 (Aligned Data Centers)	Annualized PUE of 1.4	Annualized PUE of 1.7
Annual Energy Consumption	10,074,000 kWh	12,264,000 kWh	14,892,000 kWh
Annual Energy Cost	$604,440	$735,840 (22% higher than Aligned Data Centers)	$893,520 (48% higher than Aligned Data Centers)
Assumption: Same location, 1 MW footprint, $.06/kWh utility rate			

Compounded over a 10-year lease, the difference that PUE makes is even more significant:

	Annualized PUE of 1.15 (Aligned Data Centers)	Annualized PUE of 1.4	Annualized PUE of 1.7
Energy Consumption Over 10 Years	100,740,000 kWh	122,640,000 kWh	148,920,000 kWh
Energy Cost Over 10 Years	$6,929,227	$8,435,581 (22% higher than Aligned Data Centers)	$10,243,205 (48% higher than Aligned Data Centers)
Assumption: Same location, 1 MW footprint, $.06/kWh utility rate with 3% annual increase			

Capital cost and scalability

Annualized PUE directly affects a colocation customer's operating costs through the PUE multiplier used in the monthly energy cost equation, but peak PUE can have an impact on the colocation customer as well. Recall that peak PUE tells you how much power and cooling infrastructure had to be built to support peak load conditions. As such, peak PUE affect capital costs, but not operating costs. Capital cost equals the amount of money required to build the infrastructure required to support the data center at peak load.

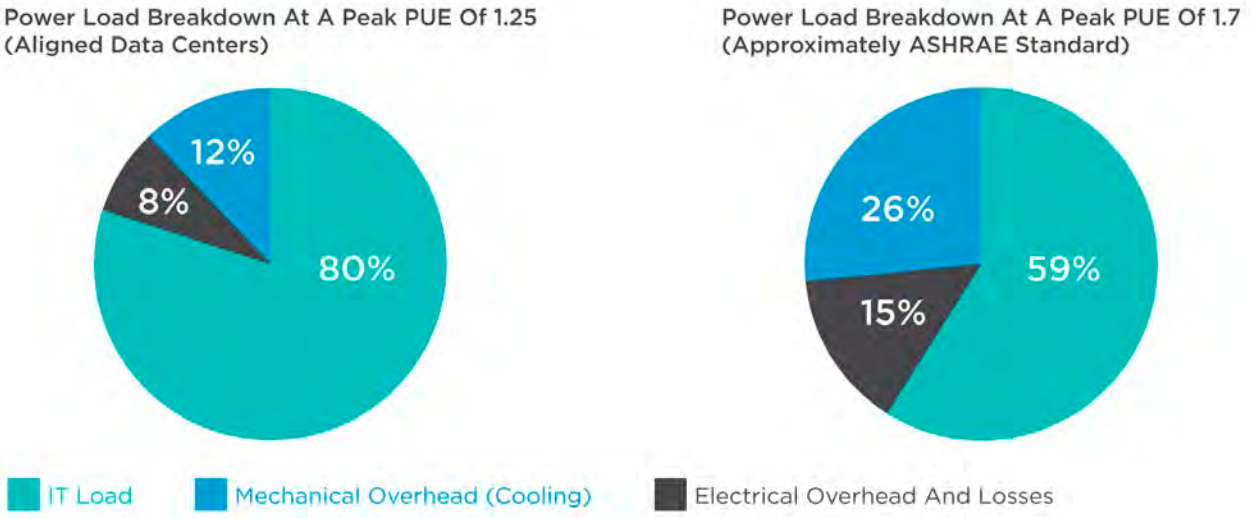
Of course, colocation customers don't directly assume the capital costs associated with data center construction, but to the extent that colocation providers pass on the savings, providers with a lower peak PUE (and hence, lower capital costs) can pass on greater savings.

Peak PUE also matters if there is a chance that you might scale up your IT load within a given colocation facility – either by expanding your physical footprint or increasing density within your existing footprint. The lower the peak PUE (the more energy efficient the data center design is), the more of the total utility load can be used for IT rather than data center overhead. As a colocation customer, that means the lower the peak PUE, the more room you potentially have to scale up your IT load within the facility.

For example, consider a 60 MW data center. Let's assume that the peak mechanical PUE and peak electrical PUE align with ASHRAE's new data center efficiency standard, so peak mechanical PUE is 1.45 and peak electrical PUE is 1.25, for a total peak PUE of 1.7. If we think of the total utility load – 60 MW – as a pie, then mechanical overhead accounts for 26% of the pie and electrical overhead and losses account for 15% of the pie. That leaves 59% of the pie – just over 35 MW – available for IT load.

Now consider a data center (Aligned Data Centers) with an ultra-efficient peak mechanical PUE of 1.15 and an ultra-efficient peak electrical PUE of 1.1 – so a total peak PUE of 1.25. Now, mechanical overhead accounts for 12% of the 60 MW pie and electrical overhead and losses account for 8%. That leaves 80% of the pie – 48 MW – available for IT load.

What does that mean for the colocation client? It means 26% less infrastructure that the data center provider had to expend capital on, and 37% more IT load to scale into.



LOWERING PUE IN THE DATA CENTER

IT gear is constantly improving, both increasing capacity and efficiency, yet the data center infrastructure that supports it – the cooling system, the transformers and UPSs – haven't changed much at all. So the biggest opportunity for energy savings in the data center is improving the efficiency of the cooling and electrical systems. Because the energy consumption associated with the cooling system is typically larger than the energy consumption associated with electrical overhead and losses, the single largest opportunity for efficiency gains in the data center is in the cooling system.

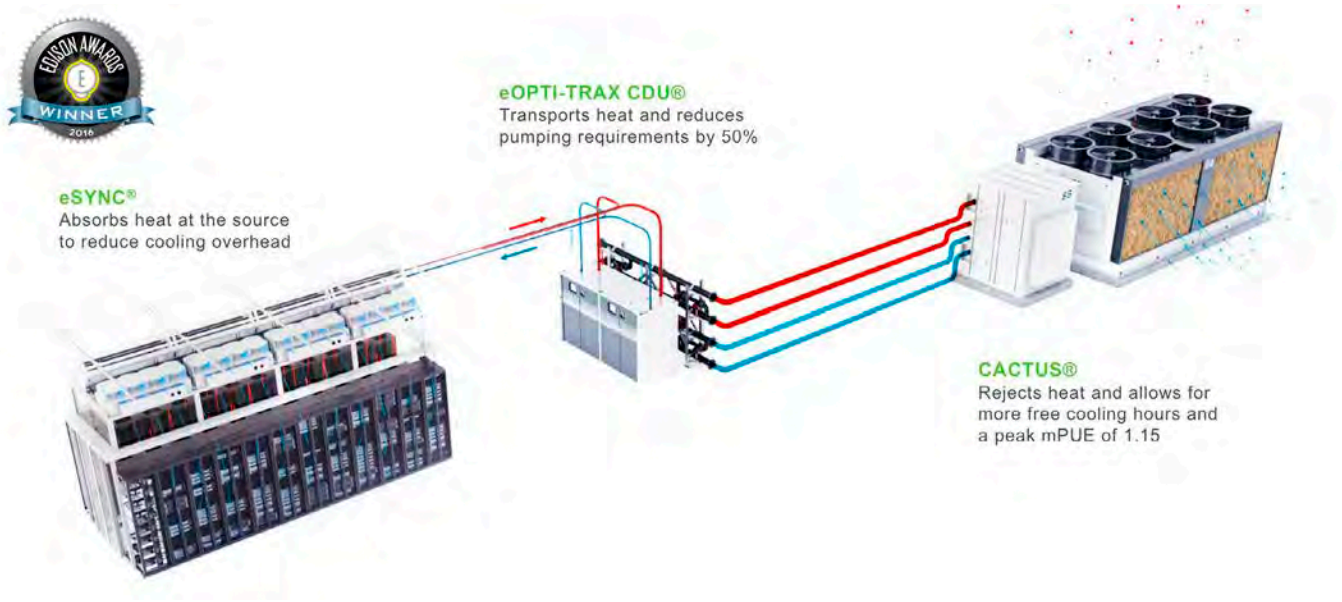
Data center innovations that lower annualized PUE (and reduce costs)

PUEs vary widely from data center to data center (see page 7). What drives those differences in energy efficiency? It's an important question to answer, as understanding what drives energy efficiency in the data center is key to assessing the relative ability of one data center versus another to live up to its PUE claims.

At Aligned Data Centers, we guarantee an annualized PUE of 1.15 (and we bake it into the lease agreement; see page 10). How do we get such hyperscale-level efficiency even in locations like Plano, Texas and Phoenix, Arizona? Through ultra-efficient power and cooling infrastructure.

Award-winning Inertech cooling system generates energy savings of up to 80%

The cooling system in use at Aligned Data Centers is the award-winning, patented system designed by Inertech, also an Aligned Energy company. The largest driver of efficiency is the year-round free cooling enabled by the Inertech technology. A compressor "trims" the atmosphere, adapting to the outdoor temperature, and only runs at full load for a small percentage of hours per year – optimizing energy efficiency, water efficiency, and reliability (a balance most free cooling systems don't strike). While the CACTUS cooler is the primary driver of energy and water savings, each CDU circuit cools up to 350kW and uses only 500 watts while providing 2N cooling distribution to the rack.



Higher efficiency in power delivery translates to lower PUE – and lower power costs

While the cooling system represents the largest opportunity for operating cost savings in the data center, energy efficiency in the power system also matters. At Aligned Data Centers, higher efficiency in power delivery supports our ultra-low annualized PUEs and lowers utility costs for our clients.

One driver of higher efficiency in power delivery at Aligned Data Centers is low-voltage switchgear, which improves electrical system efficiency – and uptime. Trip units provide for added intelligence that can substantially increase system efficiency and lower costs. Another driver is the UPS with efficiencies of over 98%. Unlike other UPS systems, Aligned Data Centers' UPS system only runs during power interruptions, and its single-conversion design eliminates the inefficiencies associated with converting input power twice before use by the critical load.

Together, cooling system efficiency and electrical system efficiency enable Aligned Data Centers to guarantee an annualized PUE of 1.15, which delivers significant cost savings for our clients. How much savings? In a test of our cooling system versus a traditional chiller in Plano, Texas, at a load of 5 MW, our system used 79% less energy annually, savings that flows directly to clients' bottom line in our pricing model.

Data center innovations that lower peak PUE (and increase scalability)

While it is annualized PUE that drives operating cost savings, peak PUE drives capital cost savings and IT load scalability. Here, in particular, is where caution is warranted. Traditional cooling systems can achieve relatively low annualized PUEs in many environments and still have very high peak PUEs (1.8 is not uncommon). So assessing prospective colocation data centers on both annualized PUE and peak PUE is essential for a truly accurate comparison of energy efficiency – and the impact it can have on your lease cost and IT load scalability.

Get up to 60% more IT capacity out of the same power utility

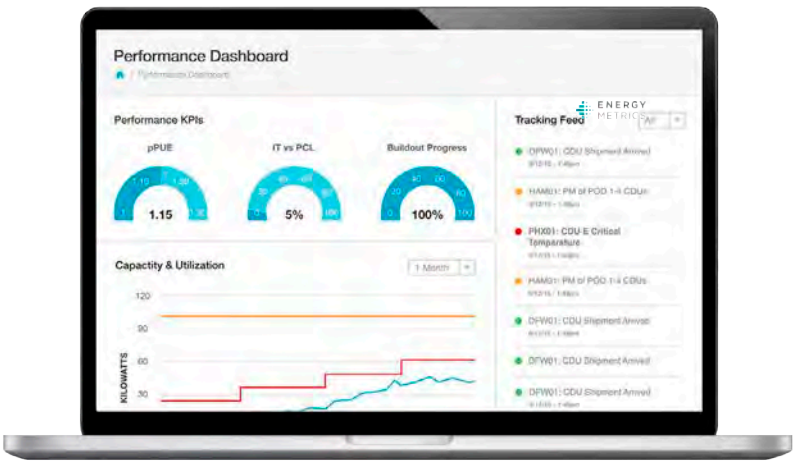
Because Aligned Data Centers is so efficient (a total peak PUE of 1.25), the power requirement is much lower than with a traditional system that might have a peak PUE of 1.8. Because the power requirement is lower, a greater share of the power utility can go to IT load. In other words, you get more IT load (more value) out of the same power utility (see page 12).

How much more value? In the same test of our cooling system versus a traditional chiller in Plano, Texas, at a load of 5 MW, the peak power draw of our system was 63% lower than the traditional chiller. Assuming equal electrical systems, that's 63% less infrastructure that has to be built to support our data center versus the traditional chiller plant data center. Less infrastructure means less capital cost, and more IT load to scale into.

Trust, but verify – part 2

At Aligned Data Centers, the Client Portal gives every client full visibility into the performance of their data center. The dashboard provides high-level and in-depth views of key performance indicators, both real time and historical. Energy KPIs that clients have visibility into include partial PUE (PUE for their data center footprint) in real-time and historical, cost per kWh, and peak power usage history per site or across multiple locations.

The Client Portal is powered by Energy Metrics, the Aligned Energy company behind the data center energy efficiency dashboard created for one of the world's largest ecommerce sites.



8 PUE QUESTIONS TO ASK WHEN COMPARING COLOCATION PROVIDERS

If you've been shopping for the right colocation data center, you'll know that many providers advertise PUE. How can you ensure an apples-to-apples comparison of annualized PUE and peak PUE between different data centers? By asking these eight questions.

1. What is the annualized PUE of the data center facility I'm considering? How is it calculated?

2. What is the peak PUE of the data center facility I'm considering? How is it calculated?

3. For both annualized PUE and peak PUE:

   - How was the data collected?
   - What type of equipment collected the data?
   - What is the time frame covered by the reported value?
   - At what frequency were the individual data points collected?

4. Is PUE used to determine my monthly energy costs? Which PUE number will be used for my pricing?

5. Is a defined annualized PUE guaranteed in the service level agreement (SLA)?

6. How much of utility load goes to mechanical overhead? How much to electrical overhead?

7. What about your technology drives energy efficiency?

8. What mechanism do you have for me to see real-time and historical PUE data?

BOTTOM LINE

Differences in energy efficiency from one data center to another will significantly impact your costs and scalability. Making a true comparison between data centers can be difficult, with a lack of transparency around what metrics providers use and how they're calculated. By understanding the differences between annualized PUE and peak PUE, and being armed with the eight questions above, you'll be able to accurately compare energy efficiency between colocation data centers.

Want to learn more about Aligned Data Centers?

Talk through these 8 questions with an Aligned Data Centers expert:
www.alignedatacenters.com/contact

Come see for yourself – schedule a data center tour:
www.alignedatacenters.com/data-centers/#tour