ENERGY STAR Rating for Data Centers
Frequently Asked Questions

EPA's energy performance rating system helps energy managers assess how efficiently their buildings use energy, relative to similar buildings nationwide. Organizations can obtain energy performance ratings through Portfolio Manager, an interactive energy management tool that allows users to track energy and water consumption of buildings in a secure online environment. The energy performance of a building is expressed on a 1-to-100 scale — a rating of 50 indicates that the building performs better than 50% of all similar buildings, while a rating of 75 indicates that the building performs better than 75% of all similar buildings. EPA released a 1-to-100 energy performance rating for data centers in Portfolio Manager on June 7, 2010. The questions below are designed to help data center owners and operators better understand the rating and benchmark their buildings in Portfolio Manager.

What is the definition of "Data Center"?

Data Center applies to spaces specifically designed and equipped to meet the needs of high density computing equipment such as server racks used for data storage and processing. Typically these facilities require dedicated uninterruptible power supplies and cooling systems. Data Center functions may include traditional enterprise services, on-demand enterprise services, high performance computing, internet facilities, and/or hosting facilities. Often Data Centers are free-standing, mission-critical computing centers. When a Data Center is located within a larger building, it usually has its own power and cooling systems. It is also common to have raised floor space to facilitate equipment cooling. The Data Center space is intended for sophisticated computing and server functions; it should not be used to represent a server closet or computer training area.

What dataset was used to create the ENERGY STAR rating for Data Centers?

Because there is no known national data set available on the market for understanding energy consumption in Data Centers, the data used to create the ENERGY STAR rating for Data Centers is based on an EPA-led data collection effort. In late 2007, EPA began working with stakeholders and industry leaders, and by the summer of 2009, EPA had collected complete energy consumption and operating data from 120 Data Centers representing various sizes, types, and locations. The regression model was developed using data from stand-alone Data Centers, but rating results for Data Centers located within larger buildings (e.g., office building) were found to be consistent with the stand-alone results.

Does the Data Center rating adjust for the climate effects of geographic location?

No. Analysis of Data Center energy consumption reveals that there is no significant difference in the energy consumption of Data Centers from different locations in the country. The energy required to cool the IT equipment of a Data Center can be 10 times the amount of energy required by outdoor air temperatures. It is these internal loads - not outdoor conditions – that dominate the Data Center's energy consumption. Hence, the typical Data Center does not show different energy consumption during different months or seasons of the year.

The performance rating scale for Data Centers is based on observed energy consumption. Therefore, modifications that reduce energy consumption will increase the ENERGY STAR rating. This may include modifications such as improvements in ventilation or the installation of an air-side economizer. The scale is not specifically designed to award points for these technologies. However, if they are installed and operated correctly and lower the Data Center energy use, then the ENERGY STAR rating will be higher.

What is the Power Usage Effectiveness (PUE) metric for a Data Center and how is it calculated?

Power Usage Effectiveness (PUE) is a standard measure of facility infrastructure efficiency in the IT industry. It is equal to the total energy consumption of a Data Center (for all fuels) divided by the energy consumption used for the IT equipment. That is: PUE = Total Facility Source Energy/ IT Source Energy.

The PUE generally ranges from 1.25 to 3.0 for most Data Centers. PUE is a measure of how much energy is consumed by the power supply and cooling systems in a Data Center relative to the amount of energy delivered directly to the IT equipment. For more information on PUE, refer to The Green Grid paper: *Usage and Public Reporting Guidelines for The Green Grid's Infrastructure Metrics PUE/DCiE*. In Portfolio Manager, PUE is calculated by dividing the total energy for the building from all fuel sources (in source kBtu) by the annual IT energy consumption as measured at the output of the UPS meter (converted to source kBtu).

Where should I measure the IT energy consumption to get a Data Center rating?

IT Energy readings should be taken at the output of the Uninterruptible Power Supply (UPS). In the dataset used to create rating methodology for Data Center, IT energy was measured at the output of the UPS. Thus, a measurement at this location will provide the most accurate rating (see "A" in figure below). The UPS output is a standard, uniform measurement location typically available to Data Center owners. See the schematic below of where a UPS meter may be placed. Many UPS systems already have energy consumption meters on them. In this case you will just need to begin tracking this consumption month to month. However, if your facility does not have an energy meter installed at the UPS, you will need to install one and begin collecting 12 months of IT energy in order to receive a rating.

If the UPS system supports non-IT loads that amount to more than 10% of its load (e.g., cooling equipment), this load can be sub-metered (see "B" in figure below). When entering "Annual IT Energy" numbers in Portfolio Manager, users will need to subtract the sub-metered energy from the UPS output meter. The difference is the energy used for IT equipment, which is entered into Portfolio Manager.

There are two exceptions to the UPS output requirement: first, if there no UPS system; and second, if the UPS system supports non-IT loads that amount to more than 10% of its load (e.g., cooling equipment) and cannot be sub-metered. In both of these cases, you should provide the IT energy consumption measured at the input to the Power Distribution Unit (PDU) (see "C" in figure below).

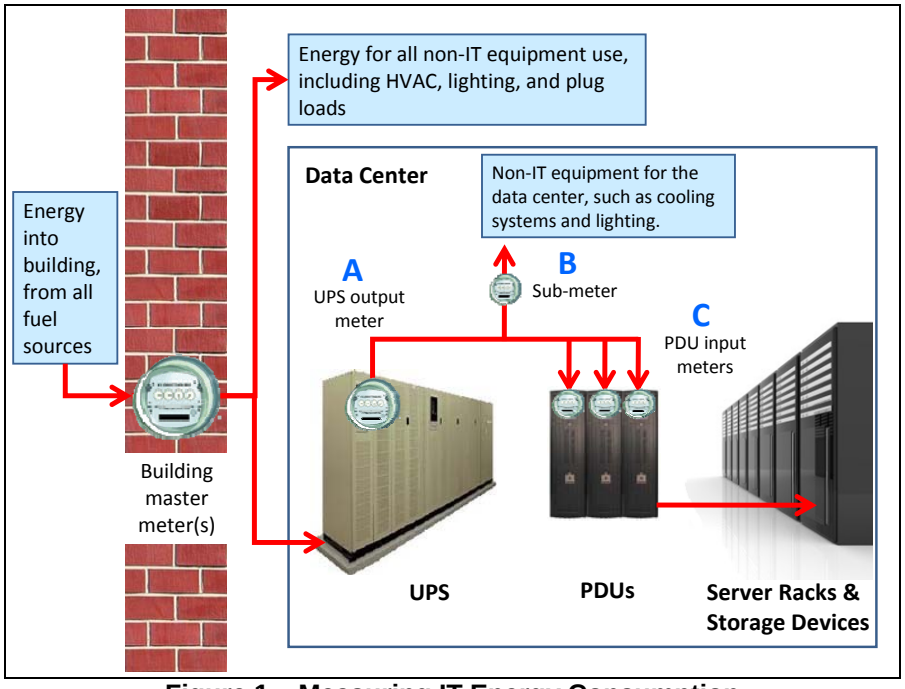

Figure 1 – Measuring IT Energy Consumption

The data center space located within my office building is already sub-metered (either for direct billing from the utility or so that the landlord can bill back the tenant for its energy use). Can we use this information to enter "IT Energy Consumption" for the data center when benchmarking in Portfolio Manager?

No. If the data center in your office building has already been sub-metered by the utility or landlord, then the energy consumption being tracked through the main meters to the building will reflect the total energy consumed within that space – including lighting and space conditioning. While this is very useful information to have, as it helps to identify the contribution of the data center space to overall building energy consumption, it does not meet Portfolio Manager's definition of "IT Energy Consumption."

When using Portfolio Manager to benchmark a stand alone data center, or a mixed use facility that contains a "data center," you must be able to measure, track, and input the specific amount of energy delivered directly to IT equipment (servers, storage devices, etc.). For this reason, measurements must be obtained at the output of the Uninterruptable Power Supply (UPS) or, in some cases, the input of the Power Distribution Unit (PDU). Measurement at the output of the UPS or input of the PDU is commonplace in the industry and is consistent with how the data was collected for development of the Data Center energy performance score. For more information, see the FAQ, "Where should I measure the IT energy consumption to get a Data Center rating?"

Many UPS systems already include meters that are capable of measuring electricity consumption (kWh). However, some UPS systems do not have integrated meters, or else only track demand (kW). In cases where there is no UPS meter, or where the UPS meter is only tracking kW, it will be necessary to install a new meter to begin isolating and tracking IT energy consumption (kWh) on a monthly basis. If the UPS meter is already tracking consumption but the UPS system supports non-IT equipment (e.g., cooling, lighting) that amounts to more than 10% of its load, then this supplemental load must be sub-metered and subtracted from the "IT Energy" numbers that are entered into Portfolio Manager.

A number of vendors provide simple, cost-effective sub-metering technologies that can be installed without any system downtime. These can usually be installed by the vendor or any professional electrician, and some can be linked to the building's EMS for remote monitoring. For the purpose of benchmarking in Portfolio Manager, the preferred location for installing such a sub-meter is at the output of the UPS.

PLEASE NOTE: there is no requirement to sub-meter your entire data center space – only the "IT Energy Consumption" within that space needs to be sub-metered so that IT equipment consumption (kwh) can be accounted for properly. The total energy consumption of your building, including the data center non-IT loads, will be captured when you enter your whole-building consumption information into the "Energy Meters" section of Portfolio Manager, on the "Facility Summary" page. Furthermore, by entering your IT energy, you are not double-counting your data center energy consumption. The "IT Energy Consumption" input is used for normalization purposes within the data center energy performance score. It can be thought of as being analogous to other operational characteristics in the office model like "number of workers" or "operating hours per week."

Can I enter power readings for the annual IT energy consumption if my UPS or PDU meter only provides power readings (kW)?

No. Portfolio Manager requires energy consumption (kWh) readings.

The ENERGY STAR score is designed to evaluate the total annual energy use of a building. The whole building metrics used in Portfolio Manager measure total energy use over the course of a year, in order to account for differences in fuel types utilized, interactions among energy-using systems within a building, and the efficiency of buildings at both peak and non-peak times. These effects cannot be captured by one-time power readings.

Many UPS meters can be configured to record energy consumption, reading cumulative total energy, which can be assessed at the end of each month. If your equipment does not have these settings, you will need to install an energy meter.

Why can't I measure my Data Center IT load closer to the actual IT equipment, like at the PDU output or at individual servers?

EPA's rating methodology is based on a statistical analysis of a data set in which IT energy was measured at the UPS output. In order to receive the most accurate rating on this scale, it is necessary to take measurements at the same location. For this reason, EPA requires measurements at the UPS output. Measurements at the PDU output or on the servers are not permitted and will not improve your rating.

However, meters located at the PDU output, or on the servers directly, may be extremely valuable for your organization. These allow for a more advanced calculation of PUE which can help you measure and improve efficiency of power distribution at your facility. Therefore EPA encourages you to install this type of meter at your facility. At the time of EPA's study, PDU and server metering were not commonplace and therefore could not be analyzed. However, EPA has identified this as a future area of research.

Can I get a rating that applies just to a Data Center located within a building?

No. The energy performance ratings are designed to assess whole building energy consumption. If you have a larger commercial building (e.g., Office) that contains a Data Center, you should enter the entire building. Within Portfolio Manager you should enter two spaces: Office and Data Center. Enter the appropriate data in the required fields for each space, and then enter your total building energy consumption. Portfolio Manager will provide a single rating for the building.