amazon sustainability

Amazon Web Services

Power Usage Effectiveness (PUE) Methodology

This document outlines the Power Usage Effectiveness (PUE) methodology used at AWS. PUE is a metric that measures data center energy efficiency by calculating the ratio of total facility energy to IT equipment energy. A lower PUE value indicates greater efficiency, with the theoretical minimum PUE being 1.0.

PUE provides a standardized way to track data center efficiency over time and compare across facilities. It accounts for the additional energy required to cool IT equipment and operate non-IT infrastructure. Without cooling, heat from servers could lead to equipment failure. PUE helps explain how well a data center minimizes this extra energy draw.

> PUE = Total Facility Energy (kWh) IT Energy (kWh)

AWS follows international standards from the International Organization for Standardization (ISO) and European Committee for Standardization (CEN) to ensure consistent and accurate PUE measurement. This includes ISO/IEC 30134-2:2016 and EN 50600-4-2. The AWS PUE program incorporates best practices for metering, calculation, and reporting.

Telemetry	 Metering Meter Type, Metering Accuracy, Metering Location Measurement & Data Handling Sampling, Frequency, Data extraction, Data Storage
Reporting	Data Analysis & Calculation PUE Calculation Reporting Reporting Method, Reporting Frequency

Telemetry, Metering and Reporting

AWS utilizes power meters installed at key points across our data centers to separately measure IT equipment energy and total facility energy, as illustrated in Figure 1. This meets the ISO/CEN Intermediate metering level.

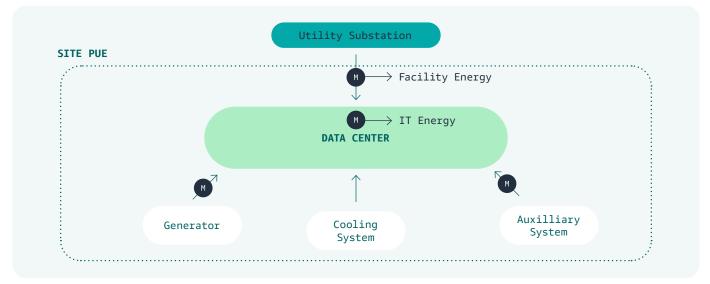


Figure 1 Framework for calculating PUE

The AWS metering system was designed for accuracy and scale. We are continually exploring ways to enhance it to meet future needs. Meter data is aggregated and used to calculate PUE at one-minute intervals. This provides near real-time visibility into efficiency. In addition, we analyze trends in PUE over daily, weekly, monthly, and trailing twelve-month periods. Regular reporting helps optimize operations of our data centers.