European Data Centre Association's
Technical Committee

Water Usage Effectiveness (WUE) – What is it?

EUDCA White Paper

EUROPEAN
DATA CENTRE
ASSOCIATION

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1. Introduction

The continuing, rapid growth in the demand for digital services and data storage is driving the need for continued growth of data centre capacity. This growth places increasing demands on resources and reinforces the need for the industry to be efficient in the way that resources are used leading to the development of a suite of globally consistent Key Performance Indicators (KPIs) for data centres.

These KPIs have been published as ISO/IEC 30134 "Information Technology – Data Centres – Key performance indicators" and implemented in Europe through the EN 50600 "Information Technology – Data centre facilities and infrastructures" suite of standards.

The most well-known of these KPIs is Power Usage Effectiveness (PUE) (the ratio of total data centre energy use to the IT equipment energy use) but the ISO provides a broader suite of metrics for "Resource Usage Effectiveness" for assessing energy, carbon and server efficiency as well as Water Usage Effectiveness (WUE) which we will look at in more detail in this paper.

In many regions, data centre water use has come under increased scrutiny resulting in planning rejections and project cancellations with well-known cloud service providers now moving away from water use for cooling purposes in some locations. Water use in major cities, arid regions, and water-stressed regions are closely monitored by the municipalities and is of increasing concern to the public. Identifying suitable water sources and discharge locations becomes particularly difficult in water-challenged areas. These considerations mean data centre operators must increase their focus on water efficiency and consider water use during the earliest stages of site selection.

This paper introduces the WUE calculation and the Climate Neutral Data Centre Pact WUE_{max}. target.

2. What is Water Usage Effectiveness (WUE)?

Water Usage Effectiveness (WUE) assesses the efficiency of a data centre in terms of the water consumption caused by the operation of IT equipment as follows:

$$Water\ Usage\ Effectiveness = \frac{Annual\ Data\ Centre\ Water\ Consumption\ (m^3)}{Annual\ IT\ Equipment\ Energy\ Consumption\ (MWh)}$$

This is known as the Basic WUE (Category 1) calculation.

3. Why is WUE important?

Data centre equipment requires a climate-controlled environment, and their operation consumes energy resulting in heat generation. There are a wide range of cooling and environmental control technologies available for data centres including air cooled, water cooled and hybrid solutions with varying levels of power and water efficiency depending upon the local climate and application.

It is important to note that the power and water usage for cooling are interrelated – using more water can help to reduce the energy consumed for cooling. The process of selecting the most appropriate cooling technology for a site will need to take into consideration the relative importance of power and water efficiency for that location. Improving the WUE for a site may negatively impact the PUE of the site and a balance needs to be reached between these two objectives.

Metrics have a proven record of driving efficiency. Data centre power and cooling efficiencies have improved significantly. Substantial progress has been made by the industry since The Green Grid (TGG) first introduced PUE.

4. Climate Neutral Data Centre Pact WUE Targets

The Climate Neutral Data Centre Pact (CNDCP) has identified a maximum allowable WUE value (WUE_{max}) for all new data centres by 2025, and by December 31st 2040 existing data centres replacing a cooling system will also need to meet the WUE_{max} target applied to new data centres.

The CNDCP WUE_{max} target is based upon the WUE (category 1) calculation and takes into consideration how water stressed the site location is and the type of water being used.

The calculation of WUEmax value to be applied under the Climate Neutral Data Centre Pact will be as follows:

$$WUE_{max} = 0.4 \times K_{1_{climate}} \times K_{2_{stress}} \times K_{3_{water\ \ type}}$$

Where:

$K_{1_{climate}}$ = coefficient derived from cooling degree days to take into consideration local climate: **1.0** for cold climates (below cooling degree day measurement of less than 50 days above 21°C, based on annual data in 2019 for the NUTS 2 region compiled by Eurostat); **1.1** for warmer climates.

$K_{2_{stress}}$ = coefficient derived from Water Exploitation Index (WEI+) to take into consideration local water stress. Defined by the European Environment Agency Water Exploitation Index for river basin districts (1990-2015) for a given location: **5** for low stress areas (Exploitation Index 10 or lower); **4** for low-medium stress areas (Exploitation Index 11-20); **2.5** for medium-high stress areas (Exploitation Index 21-40); **1** for High stress areas (40 or greater).

$K_{3_{water\ type}}$ = coefficient to take into consideration the impact of the water type on the environment: **1** for potable water and fresh water; **3** for grey water; **6** for black, brackish or sea water

Data centre operators will report their actual WUE performance using the Basic (Category 1) calculation against the WUE_{max} value for their site.

This target set by the CNDCP aims to be flexible enough to allow for differentiation based on markets and location, but also to guide data centres towards optimal behaviour with some very important implications for cooling and efficiency:

1) Cooling towers are no longer acceptable in Europe unless the data centre operator puts in place a very robust water treatment facility. Effectively, this ensures that data centres are incentivised to adopt the most water-efficient solutions, as water wasteful systems will be

practically unusable under this target.

2) Mechanical cooling will still remain the most feasible option in water-stressed markets. This will prove to be a challenge as (1) PUE would go up, therefore data centres will need to engineer their facilities better and (2) operators will need to use new compliant chilling gases/liquids (with low Global Warming Potential (GWP)).

Effectively, this target is actually a set of different targets for different markets (and maybe even different scoring regimes based on geography). For instance, mechanical chilling in water stressed Spain may increase PUE but save water. Meanwhile, adiabatic cooling and or heat transfer may be better in the Nordics where data centres can achieve lower PUE, use more water but deliver heat into networks that are trying to decarbonize.

Further details of the target are available here: CNDCP

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