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Information Technology — Data Centres — Key Performance Indicators —

Part 3:
Renewable Energy Factor (REF)

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Contents

38

39 Foreword

40 ISO (the International Organization for Standardization) and IEC (the International Electrotechnical
41 Commission) form the specialized system for worldwide standardization. National bodies that are
42 members of ISO or IEC participate in the development of International Standards through technical
43 committees established by the respective organization to deal with particular fields of technical activity.
44 ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations,
45 governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

46 International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

Information Technology - Data Centres - Key Performance Indicators - Part 3: Renewable Energy Factor (REF)

Introduction

The global economy is now reliant on information and communication technologies and the associated generation, transmission, dissemination, computation and storage of digital data. All markets have experienced exponential growth in that data, for social, educational and business sectors and, whilst the internet backbone carries the traffic there are a wide variety of data centres at nodes and hubs within both private enterprise and shared/collocation facilities.

The historical data generation growth rate exceeds the capacity growth rate of the information and communications technology hardware and with less than half (in 2014) of the world's population having access to an internet connection, that growth in data can only accelerate. In addition, with many governments having ‚digital agendas' to provide both citizens and businesses with ever faster broadband access, the very increase in network speed and capacity will, by itself, generate ever more usage (Jevons Paradox). Data generation and the consequential increase in data manipulation and storage, is directly linked to increasing power consumption.

With this background it is clear that data centre growth, and power consumption in particular, is an inevitable consequence and that growth will demand increasing power consumption despite the most stringent energy efficiency strategies. This makes the need for Key Performance Indicators (KPIs) that cover the effective use of resources (including but not limited to energy) and the reduction of carbon emissions essential.

Within the ISO/IEC 30134 series, the term "resource usage effectiveness" is more generally used for KPIs in preference to "resource usage efficiency", which is restricted to situations where the input and output parameters used to define the KPI have the same units.

In order to determine the overall resource effectiveness or efficiency of a data centre, a holistic suite of metrics is required. This International Standard specifies the Renewable Energy Factor (REF) which provides a quantitative metric for the actual use of renewable energy (RE), in the form of electricity, in a data centre.

NOTE: This standard adopts the ISO/IEC definition of RE but defers to the definition that apply within local jurisdiction(s).

The use of and the demand for RE becomes increasingly popular, since it reduces or replaces the use of non-RE sources. In many countries, legislation promotes the use of RE and gives incentives in order to increase the diversity of energy dependence and improve the social sustainability. In several countries, governments have targets for the use of RE and/or companies have a target for the use of RE among all electricity consumed. The use of RE as one of the sources to power data centre becomes increasingly important as their electricity consumption has risen to a significant share of the total global electricity consumption.

The use of REF as a Key Performance Indicator (KPI) allows data centre managers to improve a data centre's energy procurement portfolio and increase the diversity of energy dependence. Data centre managers can confirm their achievement of the use of RE to their national or corporate targets.

This International Standard is one of a series of standards for such KPIs and has been produced in accordance with ISO/IEC 30134-1, which defines common requirements for a holistic suite of KPIs for data centre resource usage effectiveness or efficiency.

At the time of publication of this International Standard the ISO/IEC 30134 series comprises the following

- ISO/IEC 30134-1, *Information Technology - Data Centres - Key Performance Indicators - Part 1: Overview and General Requirements*,
- ISO/IEC 30134-2, *Information Technology - Data Centres - Key Performance Indicators - Part 2: Power Usage Effectiveness (PUE)*,
- ISO/IEC 30134-3, *Information Technology - Data Centres - Key Performance Indicators - Part 3: Renewable Energy Factor (REF)*,

- ISO/IEC 30134-4, *Information Technology - Data Centres - Key Performance Indicators - Part 4: IT Equipment Energy Efficiency for Servers ($ITEE_{SV}$)*,
- ISO/IEC 30134-5, *Information Technology - Data Centres - Key Performance Indicators - Part 5: IT Equipment Utilization for Servers ($ITEU_{SV}$)*.

Additional standards in the series ISO/IEC 30134 will be developed, each describing a specific KPI for resource usage effectiveness or efficiency.

These International Standards do not specify limits or targets for the KPI and do not describe or imply, unless specifically stated, any form of aggregation of individual KPIs into a combined of nor an overall KPI for data centre resource usage effectiveness or efficiency.

1 Scope

This International Standard

a) defines the Renewable Energy Factor (REF) of a data centre,

b) specifies a methodology to calculate and to present REF,

c) provides information on the correct interpretation of the REF.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 30134-1, *Information technology – Data centres – Key Performance Indicators – Part 1: Overview and general requirements for KPIs*

3 Terms, definitions, abbreviations and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 30134-1 and the following apply.

3.1.1
renewable energy (RE)
energy produced from renewable energy source

Note 1 to entry: Criteria to categorize an energy as renewable can differ amongst jurisdictions, based on local environmental or other reasons.

[SOURCE: ISO/IEC FDIS 13273-2:2014, 3.1.6]

3.1.2
renewable energy (RE) certificate
tradable energy commodities that represent proof that a certain amount of electricity (or other type of energy) was generated from a renewable energy source

3.1.3
Renewable Energy Factor (REF)
ratio of the renewable energy owned and controlled by a data centre to the total data centre energy

3.1.4
renewable energy (RE) source
energy source not depleted by extraction and naturally replenished at a rate faster than it is extracted

Note 1 to entry: Renewable energy source excludes recovered or wasted energy.

Note 2 to entry: Organic fraction of municipal waste may be considered as a renewable energy source.

Note 3 to entry: Whether the energy stored in a technical system is renewable or not depends upon the nature of the original energy source.

Note 4 to entry: Criteria to categorize an energy as renewable can differ amongst jurisdictions, based on local environmental or other reasons.

[SOURCE: ISO/IEC FDIS 13273-2:2014, 3.1.5]

3.1.5

total data centre energy

total annual energy consumption for all energy types serving the data centre, measured in kWh at its boundary

Note 1 to entry: Energy measured with energy metering devices at the boundary of the data centre.

Note 2 to entry: This includes electricity, natural gas and district utilities such as supplied chilled water or condensed water.

Note 3 to entry: Total annual energy includes supporting infrastructure.

3.2 Abbreviations

For the purposes of this document, the abbreviations given in ISO/IEC 30134-1 and the following apply:

KPI Key Performance Indicator

RE Renewable Energy

REF Renewable Energy Factor

3.3 Symbols

E_{DC} total data centre energy in kWh

E_{ren} renewable energy in kWh owned and controlled by a data centre

4 Relevance of Renewable Energy Factor (REF)

The Renewable Energy Factor (REF) metric describes the percentage of renewable energy (RE) over total data centre energy. REF provides an assessment of the mitigation of carbon emission originated from energy consumption in a data centre. REF is an effective tool with which to monitor the use of RE and to increase the diversity of energy dependence and improve the sustainability of a data centre by enhancing use of RE.

5 Definition of Renewable Energy Factor (REF)

REF is defined as the ratio of renewable energy (RE) used in comparison with the total data centre energy used, as shown in (1):

$$REF = \frac{E_{\mathrm{ren}}}{E_{\mathrm{DC}}} \quad (1)$$

where:

E_{ren} is the RE in kWh owned and controlled by a data centre (i.e. any energy for which the data centre owns the legal right to the environmental attributes of renewable generation) including that

a) generated on-site of the data centre and whose legal rights to the environmental attributes of RE are retired in a data centre (so that are no longer a commodity to be traded and are possessions of the last owner or the renewable certificate system administrator),

b) obtained by procurement of RE certificates and retired in the data centre.

c) portion of utility electricity, defined as RE, provided the data centre has obtained documented written evidence from the source utility provider(s) that the energy supplied, for the reporting period in question.

NOTE: This excludes RE generated in a data centre site but whose legal rights to the environmental attributes of RE were sold to other parties or the market

E_{DC} is the total data centre energy in kWh.

RE owned and controlled by the data centre shall not include RE which is generated in a data centre site but whose legal rights to the environmental attributes of RE were sold to other parties or the market.

REF shall have a maximum value of 1,0, indicating 100 % of the total data centre energy is RE.

On-site generation of RE beyond the need of the data centre shall not be accounted for REF. Therefore, a value greater than 1,0 is not possible.

Because the RE content of the KPI is based on legal ownership of the rights to the environmental benefits, it is important to clarify that the location of energy source does not change the calculation of the REF.

EXAMPLE: A data centre has a solar panel on its roof to generate power. If the data centre sells the RE certificates associated with this power, then the contribution of the solar panel is excluded as RE within the calculation of the REF. Conversely, a data centre that receives electricity entirely from a coal-fired plant can purchase RE certificates to off-set the entire electric use. These certificates are included as RE in the REF.

Examples of REF calculation are included in Annex B.

6 Measurement of Renewable Energy Factor (REF)

Measurements of E_{ren} and E_{DC} shall be undertaken using either

a) watt meters with the capability to report energy use,

or

b) kilowatt-hour (kWh) meters that report the “true” energy (true rms), via the simultaneous measurement of the voltage, current, and power factor over time.

NOTE: Kilovolt-ampere (kVA), the product of voltage and current, is not an acceptable measurement. Though the product of volts and amperes mathematically results in watts, “true” energy is determined by integrating a power factor corrected value of volts and amperes. The frequency, phase variance, and load reaction causes energy calculation difference between apparent energy and “true” energy. The error is inherently significant when power delivery includes alternating current (AC). Kilovolt-ampere (kVA) measurements may be used for other functions in the data centre, however, kVA is insufficient for efficiency measurements.

Energy input from local renewable sources also shall be measured with the same procedure as total data centre energy.

REF shall be determined as an annualized value.

7 Directions for use of Renewable Energy Factor (REF)

The use of this KPI allows data centre managers to improve a data centre’s energy procurement process and increase the diversity of energy dependence of a data centre. In addition, users of data centres can use this KPI as a guide to select an external data centre.

Furthermore, it is possible to establish a target value for the REF, measure its improvement during one year, publish the result and eventually disclose the data centre’s energy diversity and its contribution to environmental sustainability.

8 Reporting of Renewable Energy Factor (REF)

Due to regional differences in the definition of RE, all public reporting of REF should include

a) the definition of RE used in the context of the given reporting,

b) the entity/entities that has/have issued the RE certificates which are referred to in the context of the given reporting,

c) annual amount of RE from on-site generation,