TOWARDS INTELLIGENT OPERATION OF DATA CENTRES INTEGRATING RENEWABLES AND SMART ENERGY SYSTEMS

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The significant increase in the energy consumed by data centres has recently been driving the efforts for the implementation of energy efficiency measures and the use of renewable energy sources. Due to their unique nature, data centres are ideal candidates for implementing actions to reduce the energy consumption and thus improve their ecological footprint while reducing their operational costs.

Introduction

Data centres which according to recent data account for almost 2% of the worldwide energy consumption and still growing, are a prime target for implementing energy efficiency strategies and renewable energy technologies. The aim of the paper is to assess using a developed energy model, the effect of different operational cooling parameters on the overall energy consumption of the infrastructure. Moreover, the potential use of on-site renewable energy generation represented by a PV system is evaluated too.

Methodology

- Three sample cities (Barcelona, London and Stockholm) were chosen to represent geographical and climate conditions.
- A standard bank data centre (1125 kWIT) with a total area of 1375 m^2 with 500 m^2 of whitespace is used as the reference case.
- The cooling system responsible to fulfil the thermal requirements consists of a vapour compression air cooled chiller with the support of a direct air free cooling system (Figure 1).
- A parametric study using the energy model was performed analysing different cooling management strategies:
  - The IT room air inlet temperature is increased.
  - The chilled water temperature from the chiller unit is increased.
  - The optimal operational point.

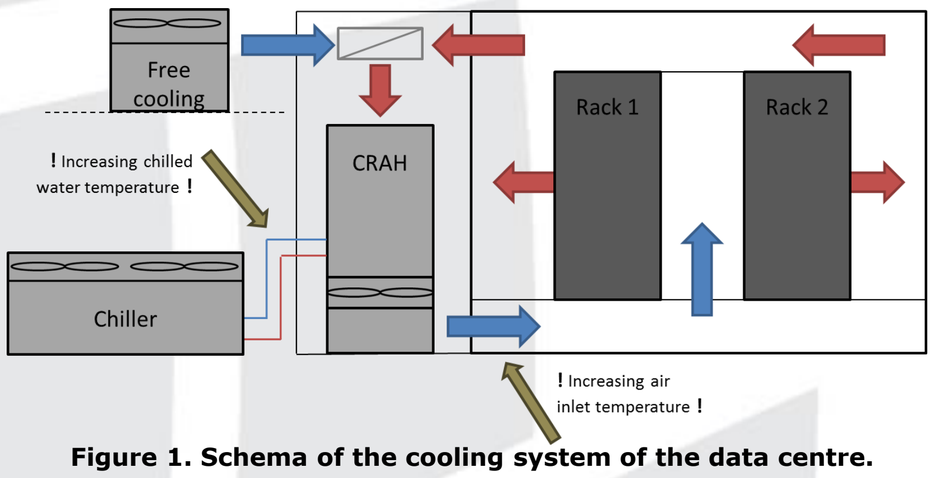

Figure 1. Schema of the cooling system of the data centre.

Results and discussion

The PV power generation has a small impact on the energy balance of the data centre, covering only less than 2% of its total consumption in the best case scenario, being this Barcelona. Therefore, the importance to undertake important energy efficiency measures in data centres and reduce their consumption are essential before implementing any RES.

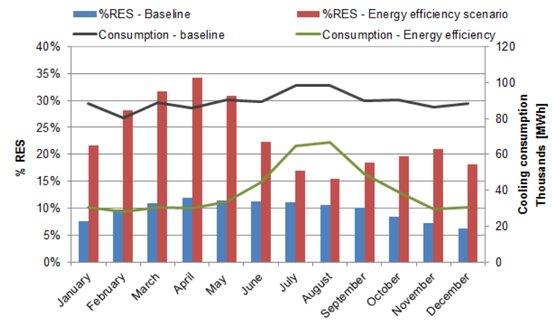

Figure 2. Percentage of the renewable energy used in cooling consumption (location: Barcelona).

Air inlet temperature and chilled water temperature increase effects on cooling system consumption:

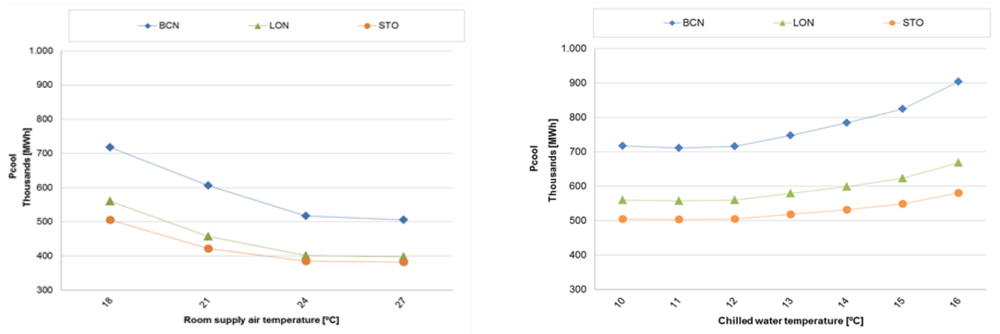

Figure 3. Cooling system energy demand for different cooling management strategies (location: Barcelona).

A proper cooling management strategy can drastically reduce the overall energy consumption. The optimal operational configuration is obtained when the chilled water temperature is between 7 and 8 ºC lower than the IT air inlet temperature.

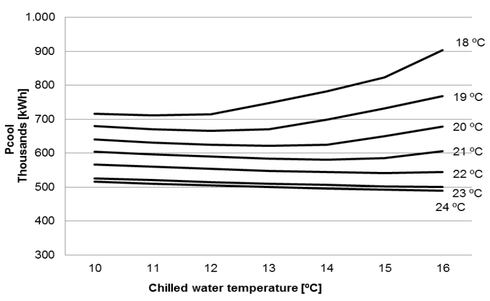

Figure 4. Cooling energy consumption for different cooling management strategies (location: Barcelona).

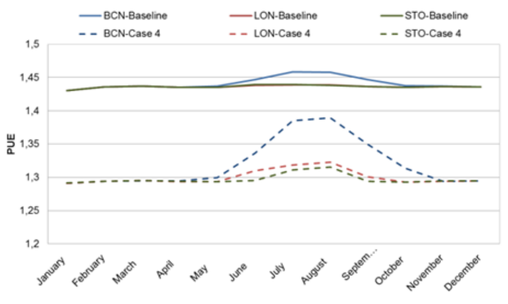

Figure 5. Monthly PUE values for the 3 selected locations.

- **Solely PV** systems resulted **not** to be an **effective measure** to lower the data centre energy demand.
- The **only increase of the IT room supply temperature** when operating with mechanical cooling has **no significant** decrease in the energy consumption.
- The use of direct **air free cooling strategy** leads to a energy **reduction** between **25 and 30%.**
- The solely strategy of **increasing the chilled water temperature** leads to **higher** energy **consumptions**.
- When **both strategies** are implemented together important **savings** can be achieved (up to **14 and 54%** in mechanical cooling and air free cooling systems, respectively).

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