

WELCOME

ENERGY EFFICIENT DATA CENTERS

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INTRODUCTION

What are Data Centers?

Data center is a repository for the storage, management and disseminations of data.

Green data centers are energy efficient and environmentally responsible with a holistic design of flexible management solutions for monitoring energy consumption.

Looks for benefits in:

- › Reduction in power and cooling
- › Increase server/storage utilization
- › Improvement in data center space



Constructional

- Building, Interior, Brownfield, Greenfield



Mechanical

- Cooling, Fire Control, Pumps



Electrical

- Commercial power, No Break, Short Break, Main Boards, Sub Boards, Rack power



Room Infra

- Racks, Data cabling, PDU, Security



Management

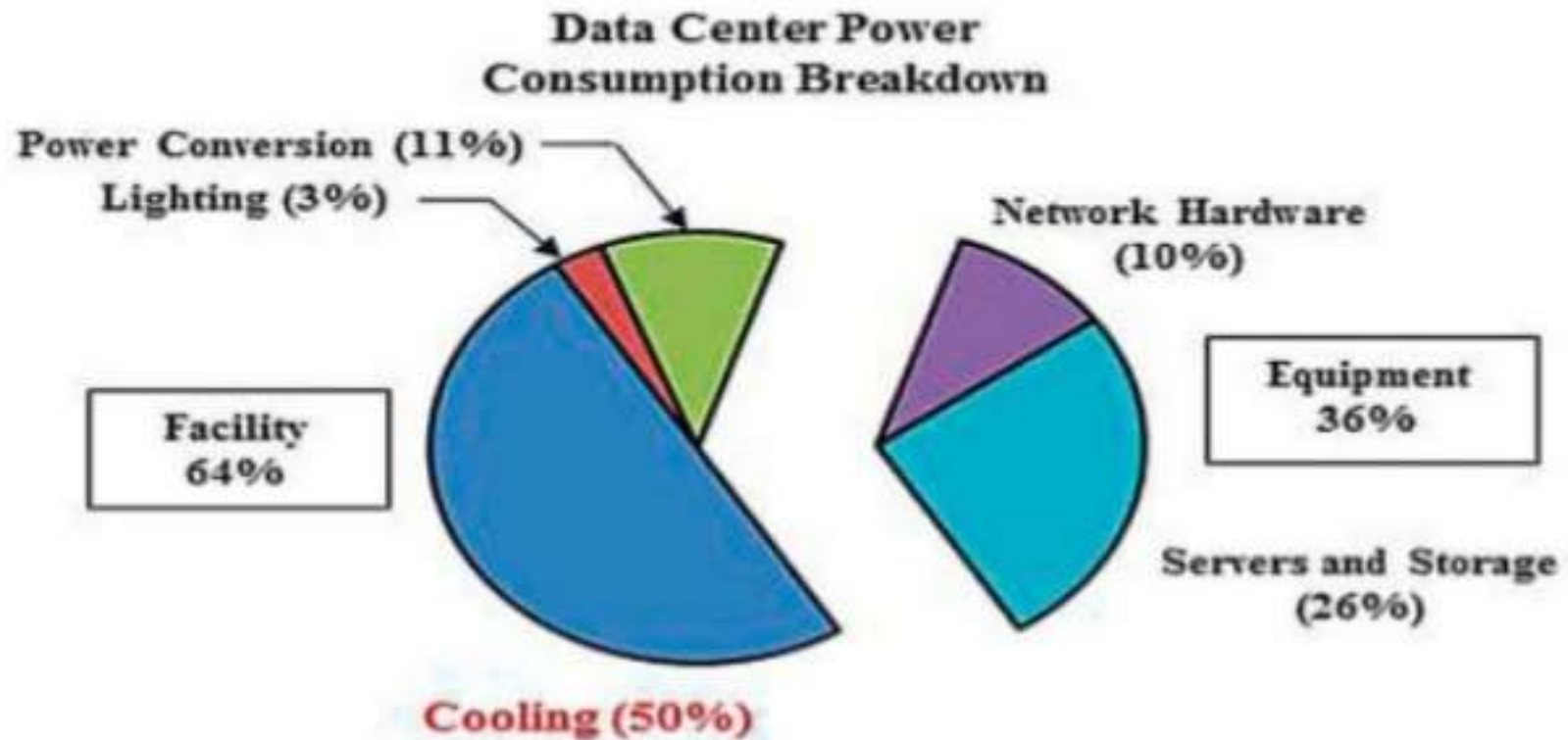
- Maintenance, 24/7 security staffing, Customer Implementation, Uptime DFI



Expertise

- Consultancy, Design, Quick scans, Audits

Distribution of data center energy consumption



PUE & DiCE

- **Power usage effectiveness (PUE)** is a measure of how efficiently a computer data center uses its power.
- PUE measures the amount of non-computing overhead energy to the amount of energy used to power the actual machines.

DCiE relationship to PUE

$$DCiE = \frac{1}{PUE} = \frac{IT \text{ equipment power}}{\text{Total facility power}}$$

A DCiE value of 33% (equivalent to a PUE of 3.0) suggests that the IT equipment consumes 33% of the power in the data center.

Thus, for 100 dollars spent in energy, only 33 dollars are really used by IT equipment.

Improvements in energy efficiency result in movement towards 100% DCiE, the ideal number.

Data center utilization, management and planning

- It is important to develop a holistic strategy and management approach to the data center to support economic efficiency and environmental benefits.

Organizational groups & General Policies

- ✓ Involve organizational groups: creation of Board approval, representatives from different departments. E.g. software, ICT, power cooling and other facilities)
- ✓ Ensure that the existing equipment has optimal use before making any new investment
- Resilience level and provisioning:
- ✓ Energy efficiency design:
 - ❖ Ensure Business Requirement and Disaster Recovery (BC/DR) in accordance with the architecture.
 - ❖ Avoid unnecessary fixed losses of provision of excess power and cooling capacity.
 - ❖ Maximize architecture design efficiency using variable ICT electrical load.

ICT equipment and services

Best practices

Selection of new ICT and telecom equipment:

- ✓ Tender process considering: energy performance, humidity and temperature
- ✓ Measurement of energy efficiency performance (eco-rating, service level, energy star)
- ✓ Max. temperature & humidity supported
- ✓ Compliance with green regulations (REACH and WEEE)
- ✓ Energy & temperature reporting hardware (IPMI, DCMI and SMASH)
- ✓ Selection of equipment suitable for the datacenter: power density and airflow direction

Results

Reduce power and cooling for the ICT equipment

Maximize efficiency in refrigeration and free cooling

Reduction of the use of hazardous materials

Suitable use and control of the electrical network



Energy Efficiency Rating



continues....

Best practices

Deployment of new ICT services

- ✓ Virtualization and consolidation of servers
- ✓ Select/develop efficient software
- ✓ Reduce hot/cold standby equipment

Management of existing ICT equipment and services

- ✓ Audit existing physical equipment and services (consider ITIL practices CMDB & SC)
- ✓ Decommission unused and low value services
- ✓ Management systems to control energy: ICT workloads

Data management

- ✓ Define policies to efficient storage of information
- ✓ Select lower power storage devices
- ✓ Use technologies such as de-duplication, compression, snapshots and thin provisioning

Results

- Reduce physical infrastructure
- Accurate information about ICT assets
- Improve storage efficiency
- Reduce large volume of data not required
- Meet the business service level requirement defined in data management policy



Cooling

Best practices

Airflow design and management

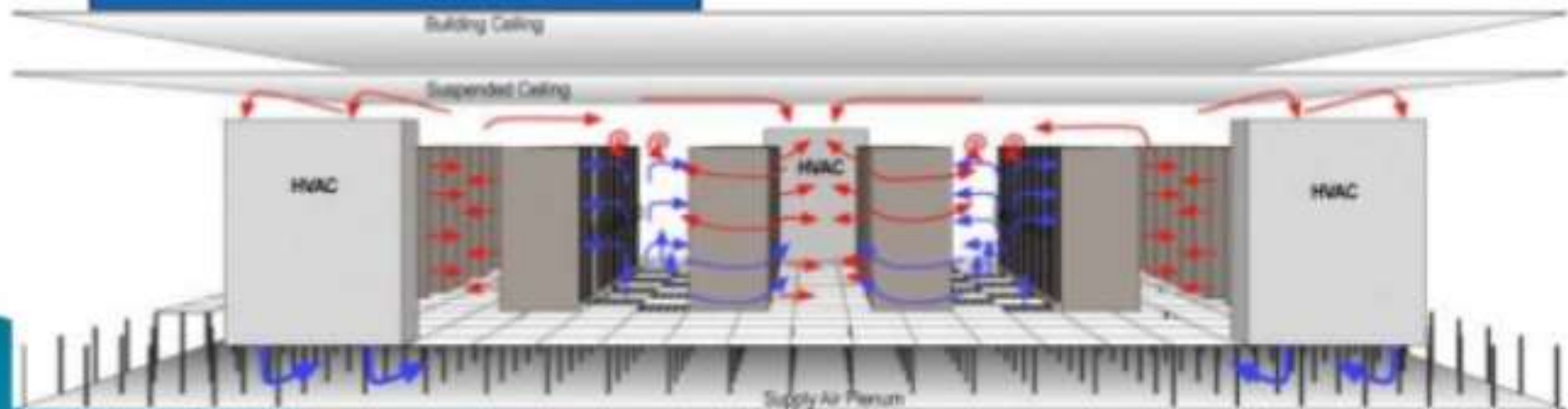
- ✓ Equipment should share same the airflow direction
- ✓ Design raised floor or suspended ceiling height
- ✓ Separate from external environment

Cooling Management

- ✓ CRAC settings with appropriate temperature and relative humidity
- ✓ Regular maintenance of cooling plant

Results

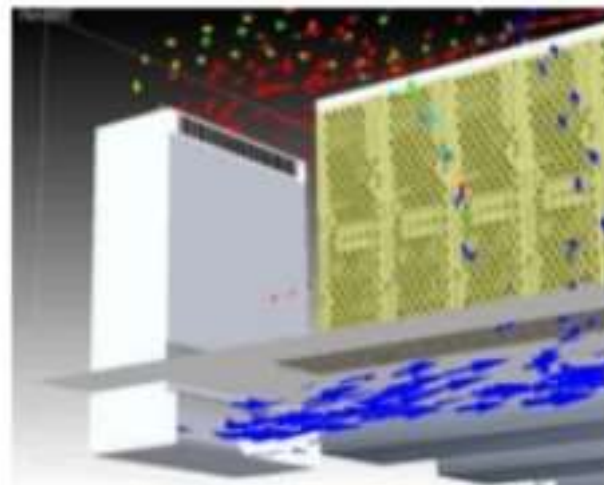
- Airflow protection of equipment
- Uniform equipment inlet temperatures
- Allow set points to be increased
- Control over CRAC



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Best practices

- ✓ Temperature and Humidity Settings: expanded ICT environmental conditions
- ✓ Free and economized cooling: Air and water direct/indirect free cooling
- ✓ High efficiency cooling plant: Select the adequate CRAC units, cooling towers, refrigerants, compressor,...
- ✓ Computer room air conditioners CRAC: Calculate the adequate cooling capacity, disposition and quantity of CRAC units
- ✓ Reuse of data center waste heat: Recycling the heat rejected from data center (can use heat pumps to raise temperature)



Results

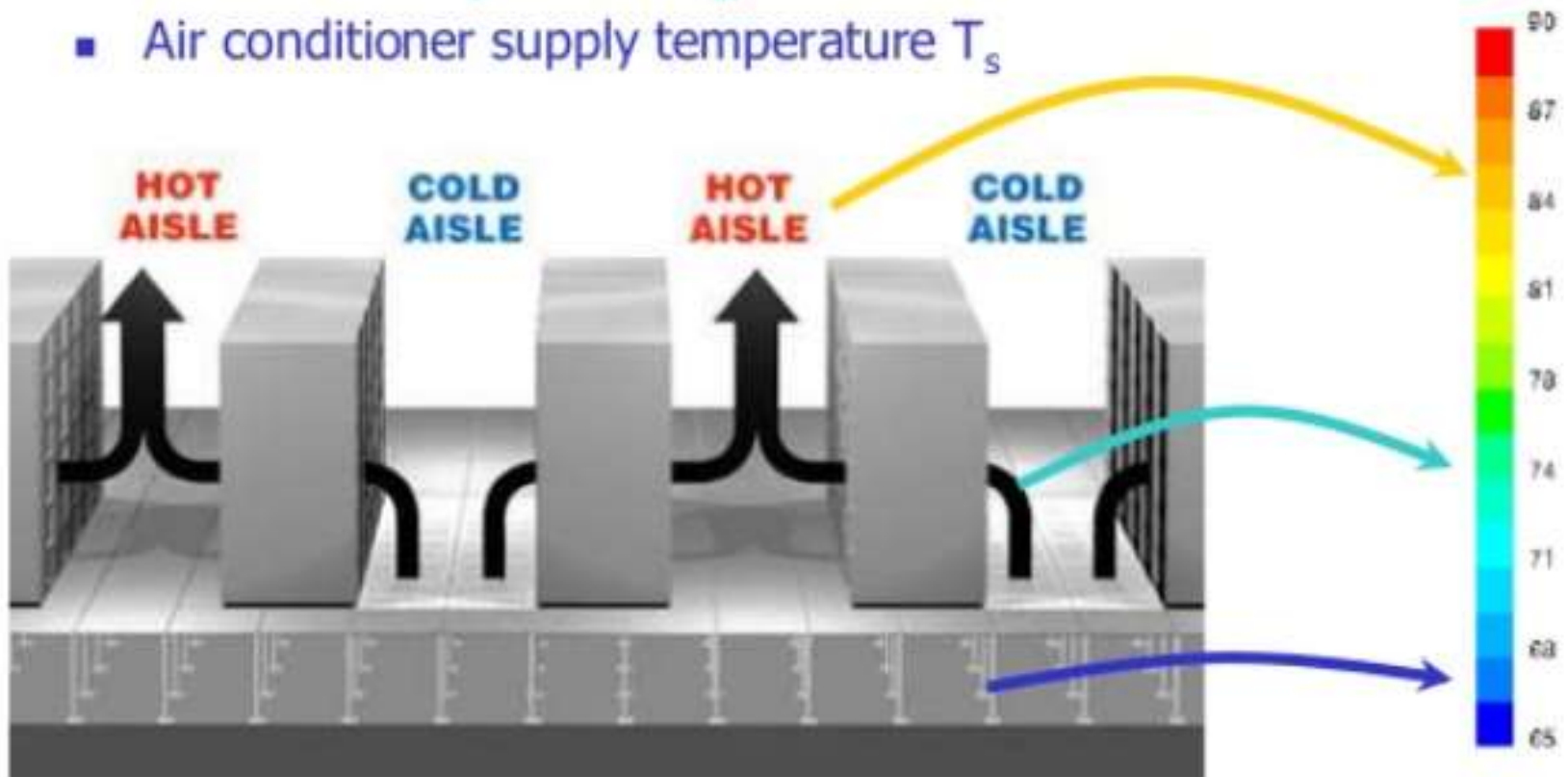
Optimizes cooling plants efficient operation, without compromising reliability

Improvement of CRAC system: reduce overcooling, decrease server temperatures

Increase server reliability and density

Re-used energy from the environment (air, waste heat, water..)

- Rack outlet temperature T_{out}
- Rack inlet temperature T_{in}
- Air conditioner supply temperature T_s



Data center power equipment

The other major part of the facility infrastructure is the power conditioning and delivery system.

This normally includes uninterruptible power supplies, power distribution units, and cabling, but may also include backup generators and other equipment.

Best practices

Selection and deployment of power equipment

- ✓ Power systems, UPS and cabinet panels
- ✓ Energy efficiency batteries
- ✓ Direct Current DC power technology
- ✓ Use new and renewable energy: solar, wind, hydraulic and geothermal

Management of power equipment

- ✓ Optimal power density
- ✓ Wired power cables under raised floor
- ✓ Load balance management

Results

- Reduction of capital cost and fixed overhead losses
- Reduce the amount of carbon emissions
- Distributed equal power energy to equipment
- Prevent damage and malfunction in datacenter equipment

Monitoring

The development and implementation of an energy monitoring and reporting management strategy is core to operating an efficient data center

Best practices

Energy use and environmental measurement

- ✓ Meters for measuring: incoming energy, ICT equipment, air temperature and humidity

Energy use and environmental collection and logging

- ✓ Periodic manual reading
- ✓ Automatic daily and hour reading

Energy use and environmental reporting

- ✓ Periodic written reports on energy consumption
- ✓ Energy and environmental reporting console to monitor energy

ICT reporting

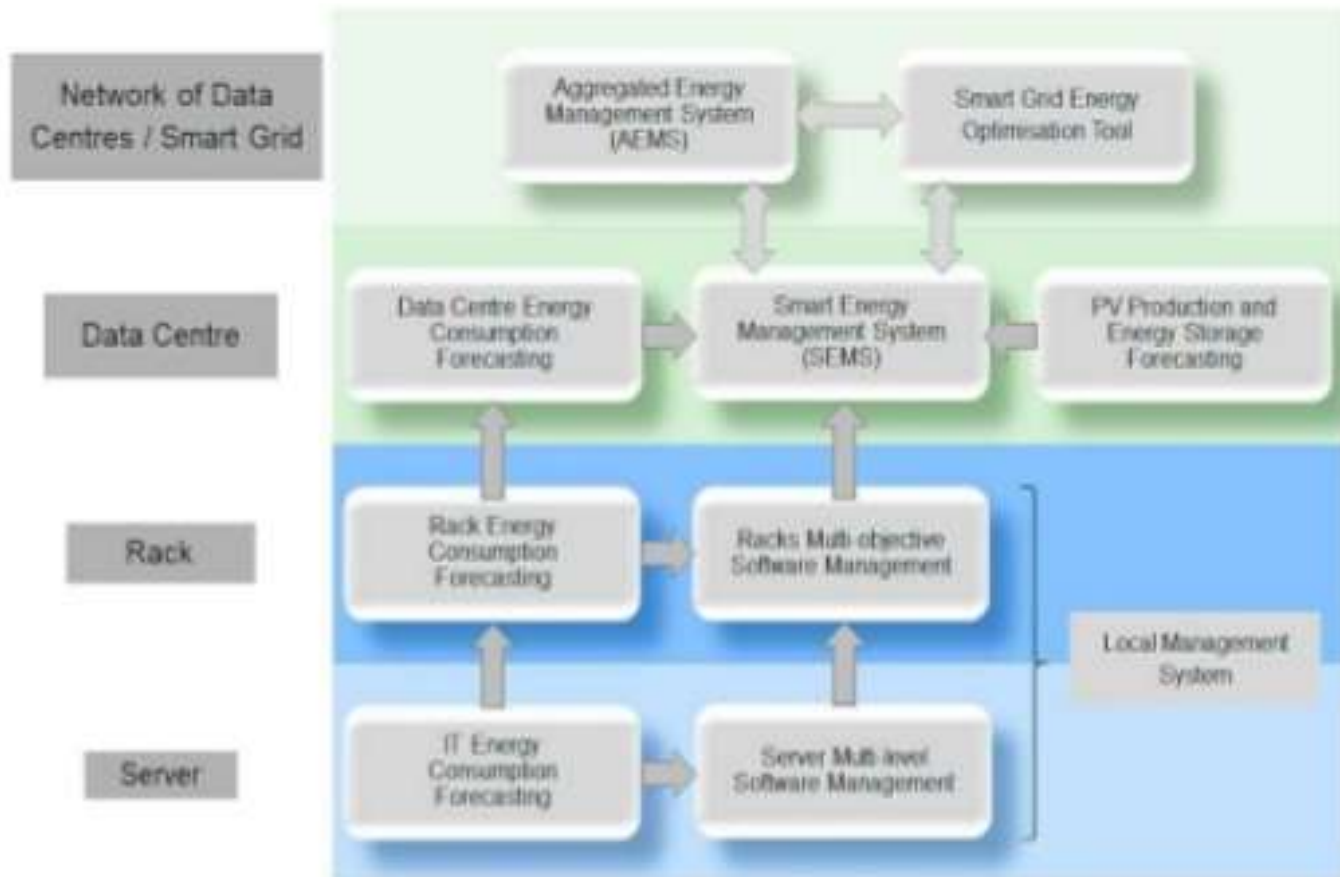
- ✓ Server, network and storage utilization



Results

- Improve visibility of data center infrastructure
- Managing the energy efficiency
- Proper use of ICT equipment and network

Monitoring and optimization from Rack to Grid



Annex forms

1- Possible methodology for cooling data centers by using of renewable energy in cold regions

- Data centers in cold regions
- General matters related to data center cooling
- Outdoor air cooling
- Snow and ice cooling

2- Possible methodology for cooling data centers with high density ICT devices

- Outline of air conditioning methods
- Selection of cooling systems suited to data center specifications

3- Practical solutions for correcting airflow direction for equipment

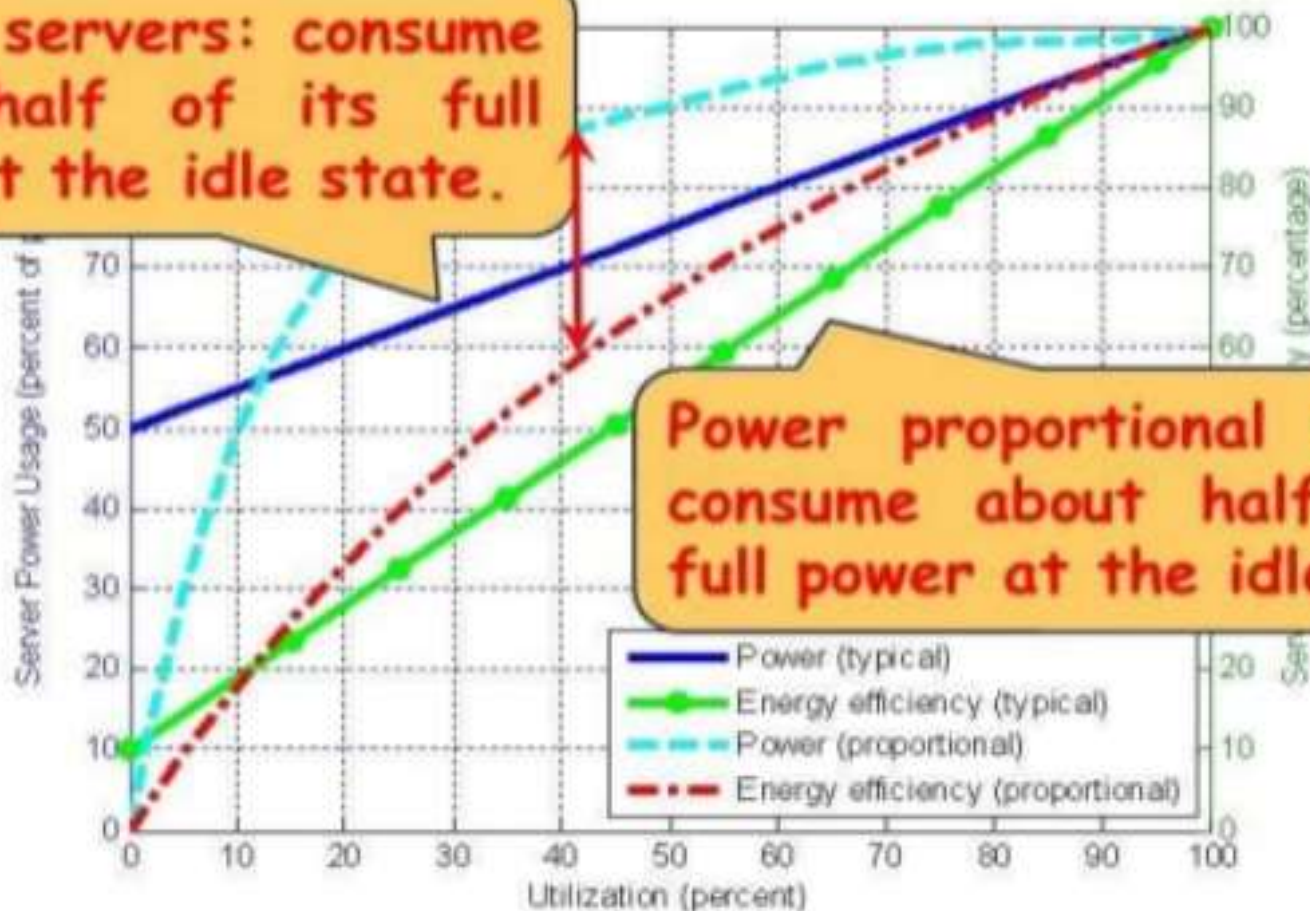
- Requirements for correcting airflow direction for equipment

4- Minimum data set for controlling data center equipment for energy saving management in data centers

- Data center equipment for energy saving

Energy Efficiency of Data Centers

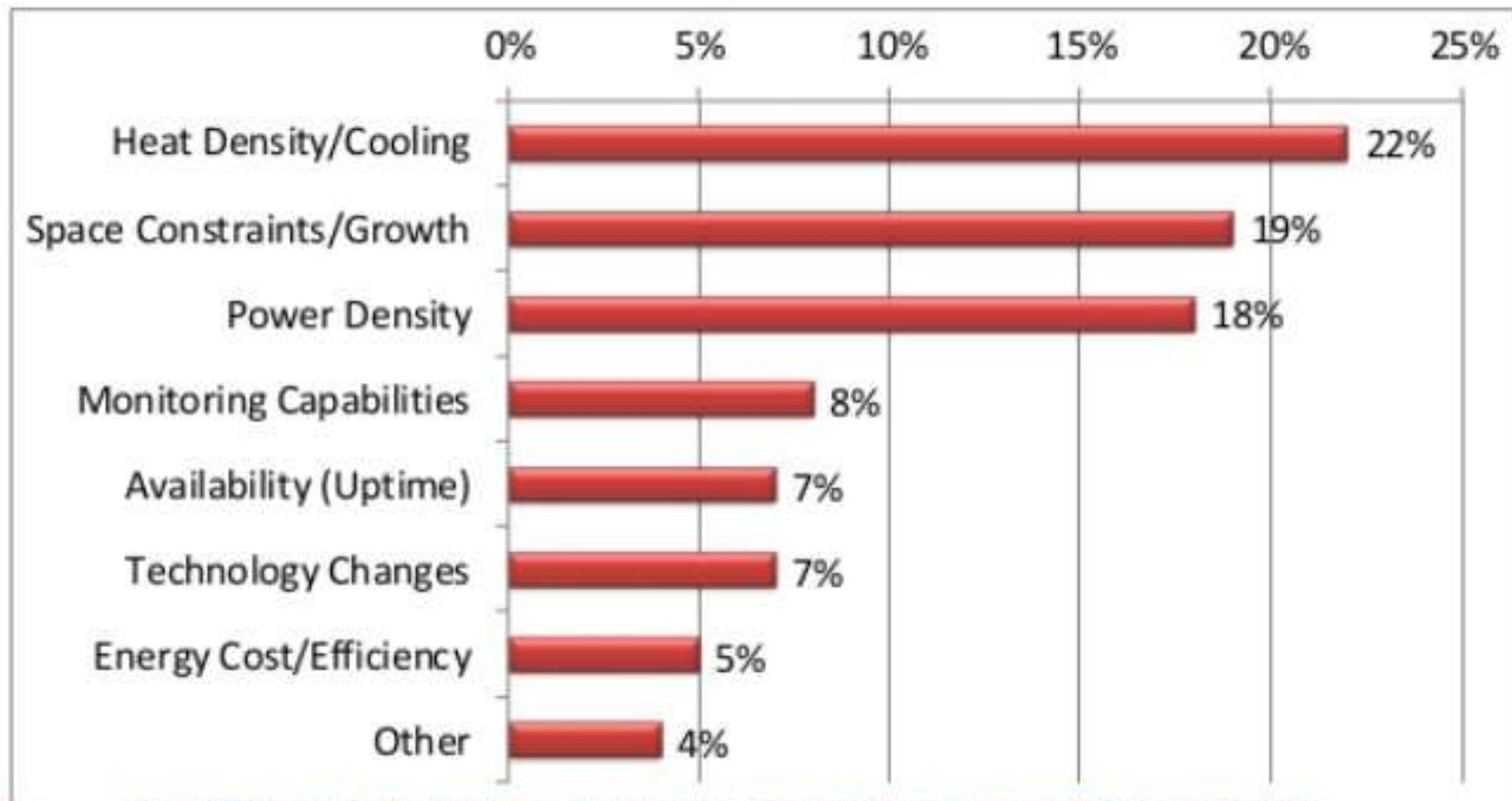
Typical servers: consume about half of its full power at the idle state.



Power proportional servers: consume about half of its full power at the idle state.

Server power usage and energy efficiency at varying utilization levels, from idle to peak performance (L. A. Barroso and U. Hölzle, "The Case for Energy-Proportional Computing," *Computer*, 40(12):33-37, Dec. 2007).

Key Issues Facing Data Centers



The Efficient Data Center : Improving Operational Economy & Availability

CONCLUSION

- **Design Data Centers to best standards.**
- **Audit it to make sure it meets requirements and standards.**
- **Implement for Energy Saving opportunities.**
- **Aim for best Energy Management.**

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Thank you