New design strategies for energy saving

UNIFLAIR™

Optimized Management

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Optimized Management

The efficient management and use of renewable resources represent the latest challenges for data centers, and are distinctive characteristics of the latest generation of designs.

There are various design approaches, some more traditional, others more innovative.

There is certainly no single method for improving functioning and design for all possible conditions and situations. A thorough assessment of all options is therefore needed to Optimize the overall design of data centers.

Optimized Management is a design strategy that maximizes the efficiency and flexibility of data centers. Though it follows an innovative new approach, it does not require radical changes to conventional operating methods.

General features

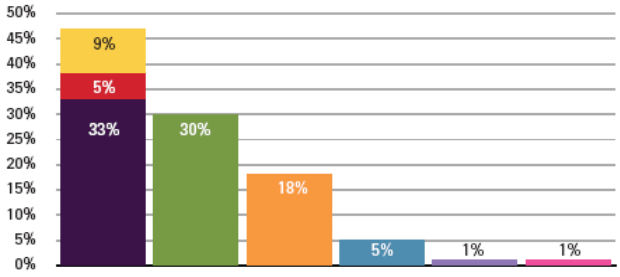
Conditioning system designers today seldom have to face more complex tasks than that of designing a cooling system for a modern data center.

Conditioning systems in data centers are critical not only for the need to guarantee continuity of service, but also for the need to reduce the high levels of energy consumption typically associated with them.

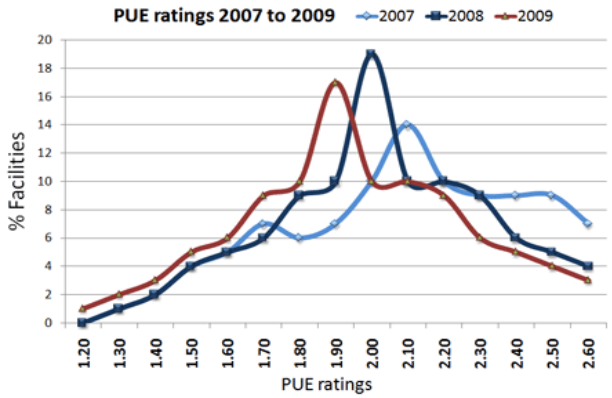
Cooling systems account for around 50%[1] of the total energy consumed by data centers. It is obvious, therefore, that the optimization of chiller and conditioner functioning is an essential first step towards improving a data center's overall energy efficiency.

Efficient chiller and conditioner functioning is crucial to minimizing PUE[2] values for the entire data center.

There are many approaches to tackling this problem, but very few are able to make any substantial difference.



Power consumtion on datacenters
Source: Uptime Institute



While energy efficiency clearly demands the use of top quality systems, designed for the specific purpose in hand, it is becoming increasingly clear that all aspects of operation have to be Optimized.

Uniflair chillers and air conditioners are designed to deliver the highest levels of efficiency. They have also been developed for use in inter-connected systems that optimize global system performance to suit variations in load level and operating conditions

[1] Uptime Institute

[2] Power Usage Effectiveness (PUE) is a measurement of how efficient a data center is in its use of electrical energy. As a parameter, PUE indicates how much electrical energy is dedicated to powering IT systems against the amount consumed by auxiliary systems such as air conditioning or lost by UPS systems. PUE is the ratio between the data center's total power consumption (PT) and that of its IT systems alone (PIT). In other words: A PUE rating of 1 (the theoretically ideal value) indicates that all the energy consumed by the center is used for IT systems alone.

Water chillers with variable speed compressors

Variable speed compressors, especially inverter controlled, are a valid technical solution that is finding ever greater favour in modern cooling systems.

Variable speed compressors offer significant benefits in terms of energy saving, while also ensuring high levels of reliability and versatility.

One of the main advantages deriving from the use of compressors that are able to modulate their cooling power is that they enable chillers to provide instant cooling power to dissipate thermal load. Variable speed compressors are therefore ideal for use in modern data centers, where large variations in thermal load can occur from one day to the next.

Generally speaking, chillers are more efficient when actual load is less than rated load, as this enables the units to function under more favorable conditions.

The use of inverter controlled compressors in chillers maximizes the benefits obtained under these conditions (the most frequent conditions), and guarantees up to 40% greater efficiency compared to conventional solutions.

Free-cooling

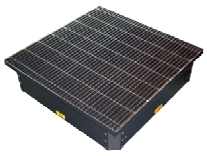
Because they operate all year round, data centers often function with outdoor temperatures that are low enough to make indirect free-cooling feasible under extremely favorable conditions.

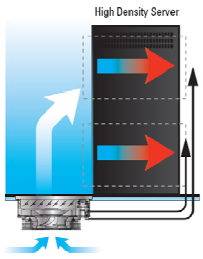
The basic concept behind free-cooling is that, when outdoor temperature is below the temperature of the return water circuit from the data center, outside air alone can partly dissipate thermal load using only the chiller's fan.

Indirect free-cooling units also ensure effective control over indoor temperature, humidity and air quality under all operating conditions, irrespective of air quality outdoors.

Since the use of free-cooling depends on outdoor air temperature and on the set-point of the chilled water circuit, it is clear that the higher the water temperature demanded by the data center, the greater the benefit of free-cooling. This can make the application of free-cooling technology profitable even in climates traditionally considered unsuitable for it.

Active Floor®





Active Floor® modules represent a versatile and modular solution for optimizing data center air distribution in areas characterized by particularly high specific load density.

Integrated in the raised floor, and installed in front of the server/rack air intake, Uniflair Active Floor® modules supply air at a constant temperature right across the intake, ensuring that racks function under nominal design conditions.

Conditioned air flow is varied according to instantaneous thermal load, and is monitored by two sensors in the servers' air outlet.

This solution ensures efficient dissipation of thermal loads of up to 25 kW / 40 kW[3] per module.

[3] Data certified by TÜV.

AFPS

AFPS (Automatic Floor Pressurization System) is an automatic control system for under-floor air pressure, designed to maximize the efficiency and effectiveness of air conditioning in server rooms throughout their life cycle.
AFPS modules provide efficient fan speed control in all phases of operation.
The system consists of the following main parts:

- Precision conditioners with modulating ventilation and electronically commutated (EC) motors.
- Under-floor pressure measurement system with anti-fouling device.

AFPS guarantees constant under-floor pressure even during scheduled maintenance operations, and avoids the formation of hot-spots.
It also adapts automatically to the installation of additional equipment and consequent rises in thermal load in server rooms.
AFPS helps improve the effectiveness of air conditioning and ensures prompt flagging of critical situations.
By monitoring under-floor pressure and modulating air flow at perimeter units, the system can adapt to variations in the room's thermal load over time, minimising energy consumption under all operating conditions.

"Optimized Management"

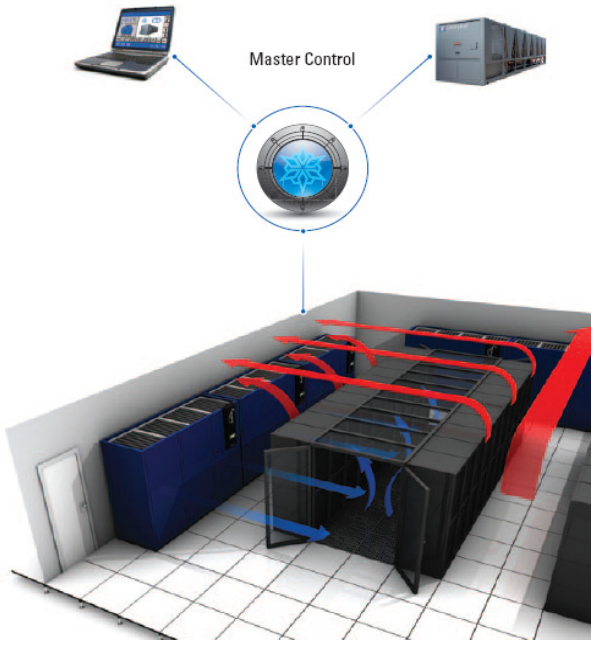
The toughest challenge is to ensure the efficient management and use of all available renewable resources. This is what distinguishes the latest generation of data centers from their predecessors.
Uniflair chillers and conditioners are designed to deliver high efficiency from each individual unit, and to optimize overall system performance on the basis of variations in load level and operating conditions.
Optimized Management is the Uniflair solution for adapting all operating parameters to meet real needs and, in particular, for adapting the chiller set-point to site conditions.
Traditional data center air conditioning units modulate water flow to control indoor temperature.
This method of control uses a fixed chilled water set-point and is therefore unable to optimize chiller functioning when operation at higher temperatures could effectively improve efficiency.
Instead of controlling server room temperature and humidity by means of the water flow control valve alone, if the chiller water delivery set-point can be incremented when actual load is below rated load, major benefits can be achieved in terms of energy savings.
Inter-connection of conditioners and chillers in a local network allows the water flow control valve to be regulated, and the chilled water set-point to be varied, on the basis of actual conditions inside the data center. The system can therefore dissipate thermal load and control humidity (where needed) according to instantaneous needs, and even manage emergency conditions caused by failures or extremely critical temperatures.
Optimized Management therefore maximizes the benefits offered by modulating chillers and free-cooling, and reduces the energy impact of the entire data center.

Master Control

If the data center is arranged in a number of different rooms operating under different conditions, a modular solution is obviously a valid possibility for optimizing performance.

Sometimes, however, it is simply impossible to install a modular system, and in these circumstances system layouts fall back on more traditional designs. Master Control provides an effective way of optimizing even these systems.

Master Control permits the effective management, control and supervision of the perimeter conditioning units, Active Floor® modules and chillers installed in the system.



The Master Control module collects information from all the units in the system, analyses their status and adjusts their operating parameters to optimize overall functioning.

Advanced control logic reduces the conditioning system's energy consumption without allowing unwanted hot-spots to form.

Master Control monitors the server room, the perimeter units and all main system components, and can transmit parameters to all common BMS systems.

Thanks to the temperature sensors linked to the Active Floor modules, even the operating temperature of high load density servers can be effectively monitored to ensure complete temperature control.

Humidity control

One of the key characteristics of precision air conditioning units is their ability to maintain fixed temperature and humidity levels to a high degree of accuracy.

Chilled water conditioners maintain the desired humidity by humidifying or dehumidifying processed air. To dehumidify air, their control system modulates the valve regulating the chilled water flow to increase cooling power and to cool the air to a temperature below dew point in order to remove airborne moisture.

Optimized Management performs this function by dynamically adapting the set-point of the chilled water. Conditioners are therefore always supplied with chilled water at the temperature that permits the most effective dehumidification. If a conditioner does not need to provide dehumidification, *Optimized Management* modulates its water flow valve to increase cooling efficiency instead.

Data centers of the latest generation are designed and built in such a way that a great deal of dehumidification is not generally needed. Dehumidification can therefore be optimized using a dedicated unit with a direct expansion circuit or a dual (direct expansion and chilled water) circuit.

Case Study

The application of *Optimized Management* logic delivers a significant reduction in energy consumption along with many other advantages.

To illustrate these benefits, let us examine the case of one particular data center that implements *Optimized Management*.

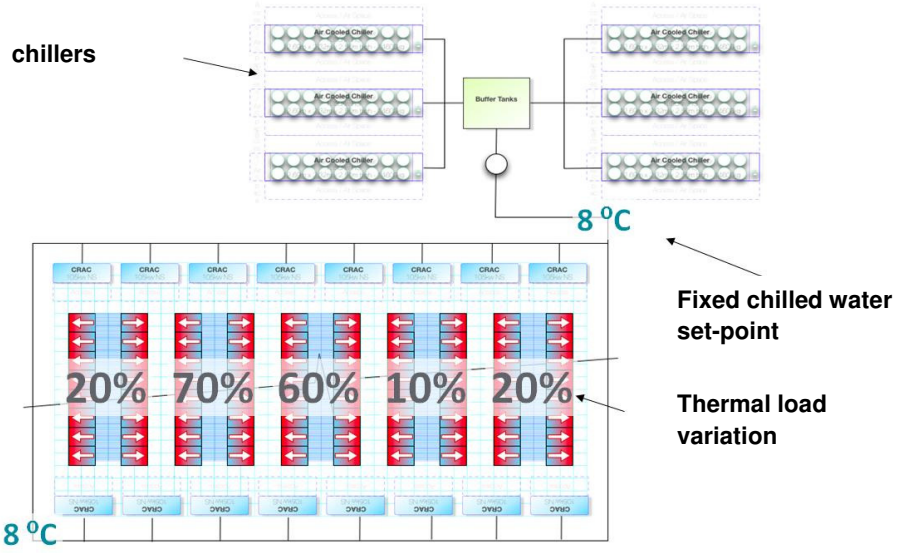
The site in question, near Newbury in the UK, generates a total thermal load of around 2 MW.

There are various ways to assess the energy requirements of a medium size data center of this type.

The operators of the site in question assessed consumption both for traditional air conditioning and for a modular, flexible system running Optimized Management logic.

The operators had initially intended to take the traditional approach and install conditioning units connected to external chillers by one or more water circuits.

This traditional solution uses a flow of chilled water at a constant temperature. Variations in the data center's thermal load would therefore be catered for by modulating the flow control valves, thus changing the temperature of the water returned to the chiller.



Traditional lay-out for a datacenter

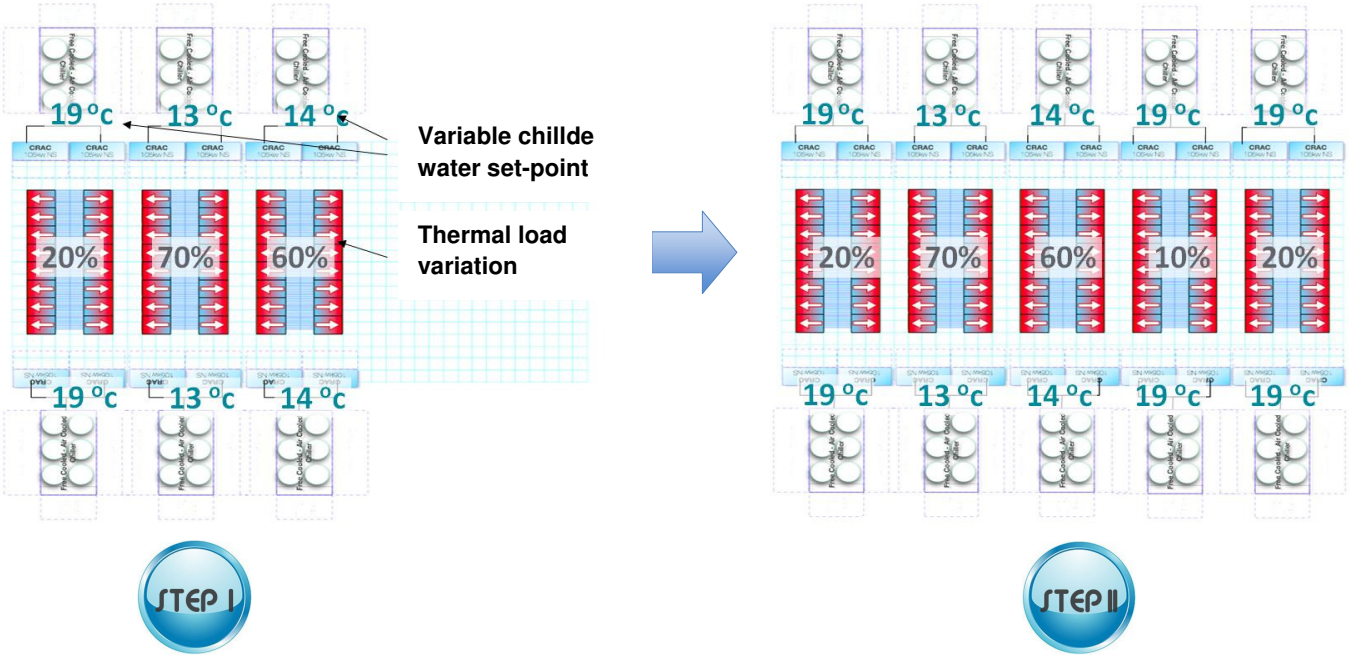
The operators then examined a different approach, based on the division of the data center into sub-areas served by conditioners and chillers connected in a local network and controlled using *Optimized Management* logic.

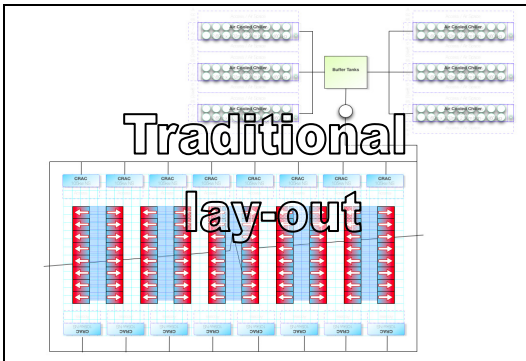
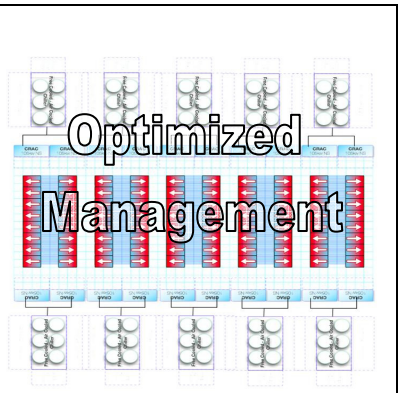
The preliminary analysis identified major benefits and led to this approach being adopted. The decision was later validated by the results obtained.

The chosen solution offers major benefits in terms of

energy saving and investment spread: additional conditioners and chillers can be installed as the data center expands.

Each individual area operates at the ideal set-point for the conditions current in it at any time, thus ensuring maximum energy efficiency.



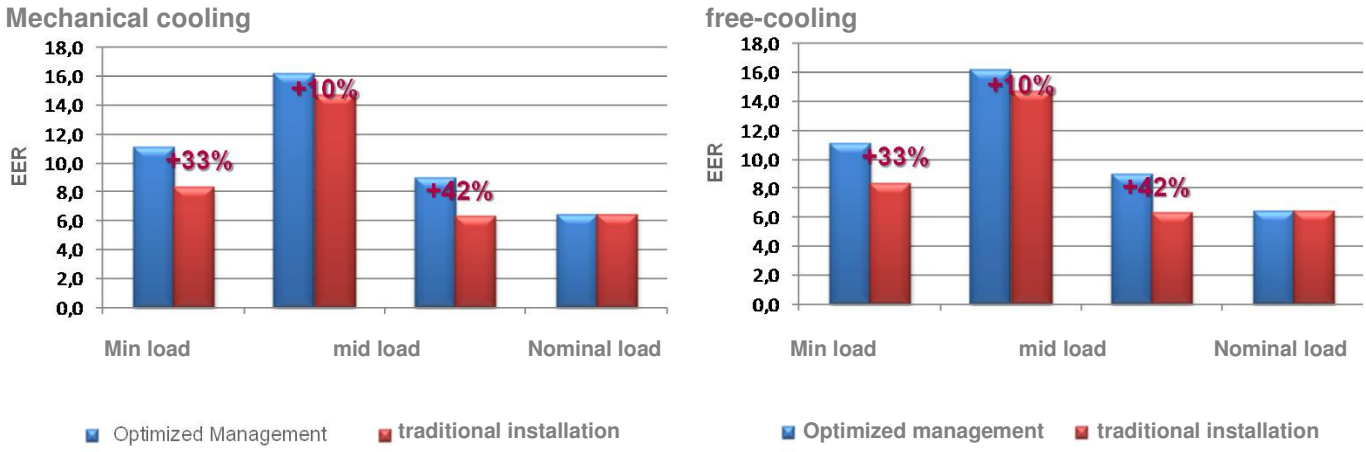
		
Areas dedicated to mechanical plant	60 – 100%*	30%*
Potential water leakage	150.000 -200.000 Litri	1.500 Litri
Reliability	Fault tolerant (with double hydraulic lin	Fault tolerant (distributed system)
Cost		up to 50% less

* % of white space

An analysis of the *Optimized Management* system installed showed that, given an excursion in thermal load per area of between 100 and 250 kW, and constant outdoor temperature, modulation of the chiller to suit actual load conditions gave savings of up to 30% over the conventional system.

The same considerations apply when outdoor temperatures are low enough to permit free-cooling.

Given an outdoor temperature of 10°C and the same variation in thermal load (100-250 kW) *Optimized Management* maximizes energy efficiency and gives EER values even 40% better than those for a conventional system.



Conclusions

The design of any individual installation obviously depends on a number of factors, from site-specific requirements like local climate and geographic area, to data center operating conditions. Energy efficiency, however, must be the primary motive driving design choices throughout the development stage.

Optimized Management maximizes energy efficiency simply and effectively by generating only the cooling power the data center actually needs. In addition to reducing energy consumption compared to traditional systems, Optimized Management therefore reduces CO_2 emissions too, protecting the environment and limiting the greenhouse effect.

SELECTION GUIDE

Medium-low load density installations (up to 5 kW/rack)

kW / module	Installation	Chiller	Air conditioning unit	Description
50	Medium or large data center comprising one room divided into a number of medium/low cooling power areas	 Modulating chillers with or without free-cooling (ISAC/F) 40 -110 kW	 TDCV chilled water conditioners	One ISA* Series chiller (and one in stand-by) for every conditioner (1+1)
100			 … TDCV chilled water conditioners	One ISA* Series chiller (and one in stand-by) connected to the conditioners (with N+1 logic), installed in the same room
200	Medium or large data center comprising one room divided into a number of medium cooling power areas	 Multiscroll chillers with or without free-cooling (ARAC/F) 120 - 260 kW	 … TDCV chilled water conditioners	One ARA* Series chiller (and one in stand-by) connected to the conditioners (with N+1 logic), installed in the same room
>500	Large data center comprising a number of rooms divided into a number of medium cooling power areas	 Chillers with or without free-cooling (BREC/F) 400 - 1200 kW	 … TDCV chilled water conditioners connected to Master Control	Chillers connected to conditioners installed in the data center via the Master Control module.

High load density installations (over 5 kW/rack)

kW / module	Installation	Chiller	Air conditioning unit	Active floor	kW / module
50	Medium or large data center comprising one room divided into a number of medium/low cooling power areas	 Modulating chillers with or without free-cooling (ISAC/F) 40 -110 kW	 TDCV chilled water conditioners		One ISA* Series chiller (and one in stand-by) for every conditioner (1+1) One Active Floor module for each high load density rack
100			 …  TDCV chilled water conditioners		One ISA* Series chiller (and one in stand-by) connected to the conditioners (with N+1 logic), installed in the same room. One Active Floor module for each high load density rack
200	Medium or large data center comprising one room divided into a number of medium cooling power areas	 Multiscroll chillers with or without free-cooling (ARAC/F) 120 - 260 kW	 …  TDCV chilled water conditioners		One ARA* Series chiller (and one in stand-by) connected to the conditioners (with N+1 logic), installed in the same room One Active Floor module for each high load density rack
>500	Large data center comprising a number of rooms divided into a number of medium cooling power areas	 Chillers with or without free-cooling (BREC/F) 400 - 1200 kW	 …  TDCV chilled water conditioners connected to Master Control		Chillers connected to conditioners installed in the data center via the Master Control module. One Active Floor module for each high density rack

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