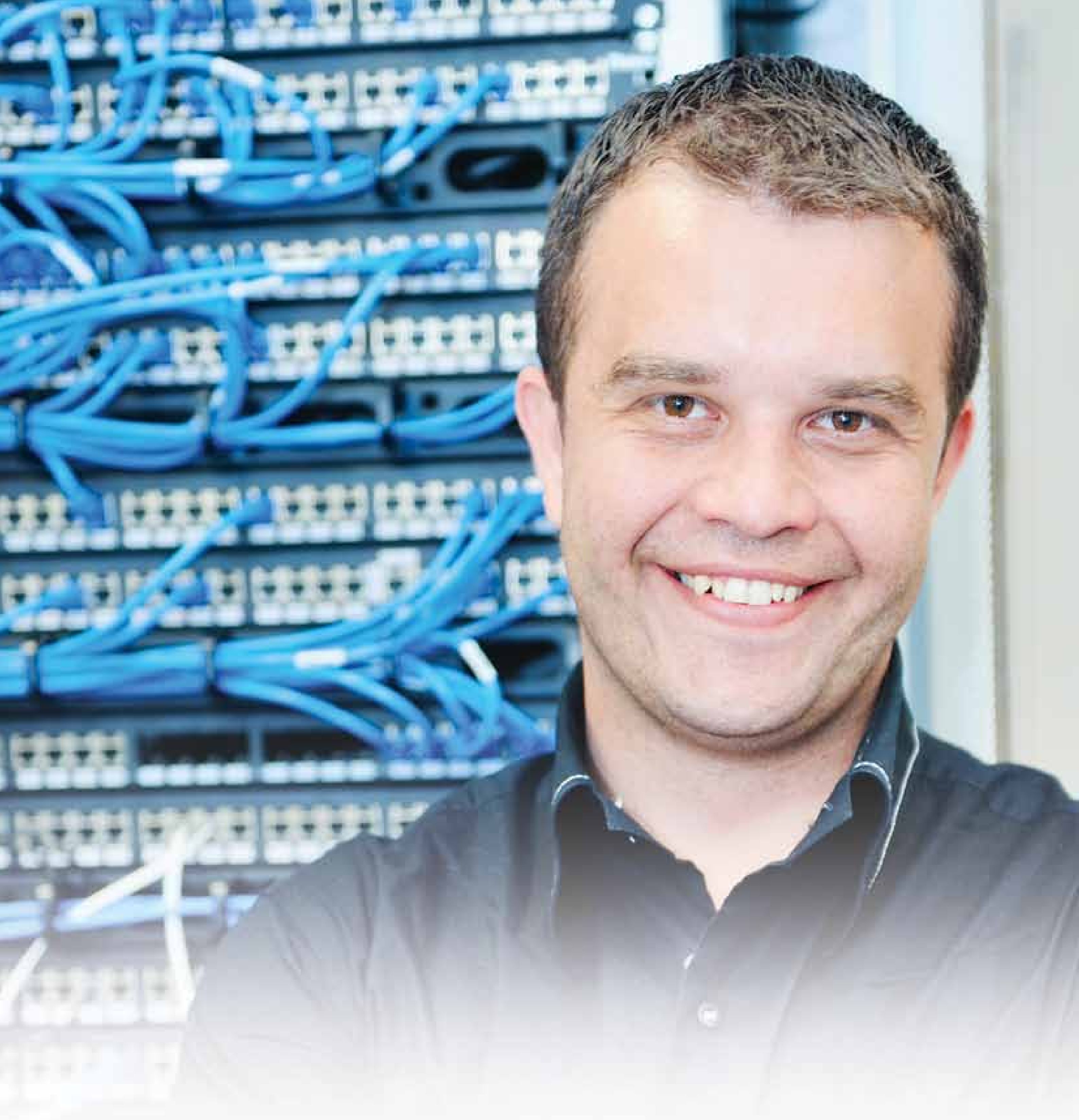
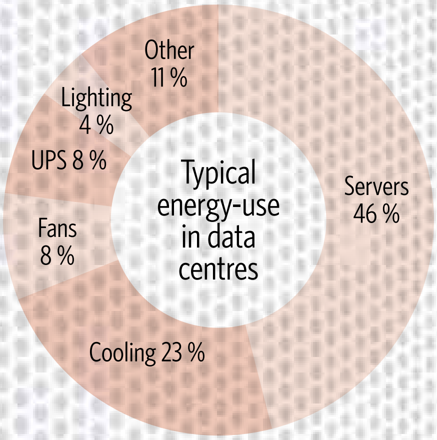


Energy-efficient Data Centre

The promised land of data centres?

Due to a number of reasons, Finland is an interesting country for the international data centre business. Compared with Europe in general, electricity is inexpensive and there is no lack of technical expertise. Data security issues are well taken care of and the power distribution network is reliable. Thanks to the cold climate, free cooling can be used for more than half of the year, and there is no shortage of waterways to run the free cooling systems. Finland has a stable climate and geology, and politically the country is a peaceful welfare state. Therefore, a number of high-class data centre companies are already setting foot in Finland. This phenomenon may also generate new business for Finnish companies.



SOURCE: HEWLETT-PACKARD

Improving energy efficiency in data centres

The number of data centres and the energy consumption in them are rapidly increasing, which increases costs and represents climate loading. Hence, energy efficiency has become a new competitive factor in this field.

Services are being transferred into the cloud and companies are outsourcing server operations. Increasing amounts of digital content are being transferred via the Internet, and most of it must be stored. Such development means enormous growth for the IT sector, but it also means drastically growing energy consumption in data centres.

Energy consumption in Finnish data centres doubled between 2005 and 2010. The growth of energy consumption is hardly this rapid in any other industrial field, and there are no signs of this growth becoming slower. It has been estimated that data centres consume from 0.5 to 1.5 per cent of the entire electricity consumption in Finland.

In 2010 the market value of the entire ICT branch in Finland was roughly EUR 8.8 billion. Of this amount, data centre-related business is about 35 per cent (about EUR 3 billion), which means that data centre business can be considered as an important industrial field of its own. (Source: Market-Visio).

The carbon dioxide emissions in the IT field are approximately two per cent of the global emissions. The proportion is about the same as emissions due to air traffic. It has been estimated that data centre emissions will quadruple over the period of 2010–2020, which is a big challenge for the entire field. At the same time, the price of electricity will go up, increasing the proportion of energy in data centre maintenance costs. Even now the energy bill for an individual server's entire life span equals the purchase price of a server. As much as 75 per cent of a data centre's operational costs are spent on energy.

Improved energy usage can reduce the annual energy invoice as much as 50%.

Means to reduce electricity consumption

- Optimising the cooling system
- Choosing energy-efficient devices
- Heat recovery for reuse
- Optimising and virtualising the use of servers
- Optimising UPS devices
- Rationalising the air humidifier system
- Renewing lighting and its control system

What is a data centre?

The term "data centre" refers to a space reserved for IT devices and their backup or redundant power supplies and security systems. IT equipment consists of servers, data storage systems and data communication devices. IT equipment is normally meant for services relating to data communications connections, back-up and storage capacity. Small facilities are often called server rooms and large ones are data centres.

Data centre equipment can be dedicated to one operator alone, or a commercial service provider can lease capacity to several customers. The concept of cloud services means that a data centre enterprise plans its services from the very beginning to serve several customers.

Servers must work reliably on a 24/7 basis, which is possible only in stable conditions, under constant monitoring and good security systems. Security systems increase energy consumption in data centres.

Rewards from energy efficiency

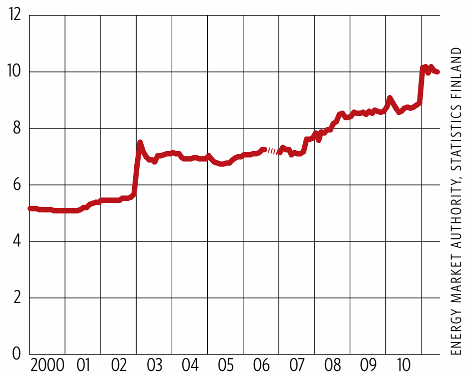
Increased energy efficiency reduces costs and emissions. It improves the company image and the credibility of the entire business. The advantages have been recognised by, for example, The Green Grid consortium, in which 175 IT companies around the world develop innovative solutions to improve energy efficiency in data centres. Energy efficiency has rapidly become part of the normal cost and brand control, and the leading companies compete by trying to demonstrate the lowest energy consumption.

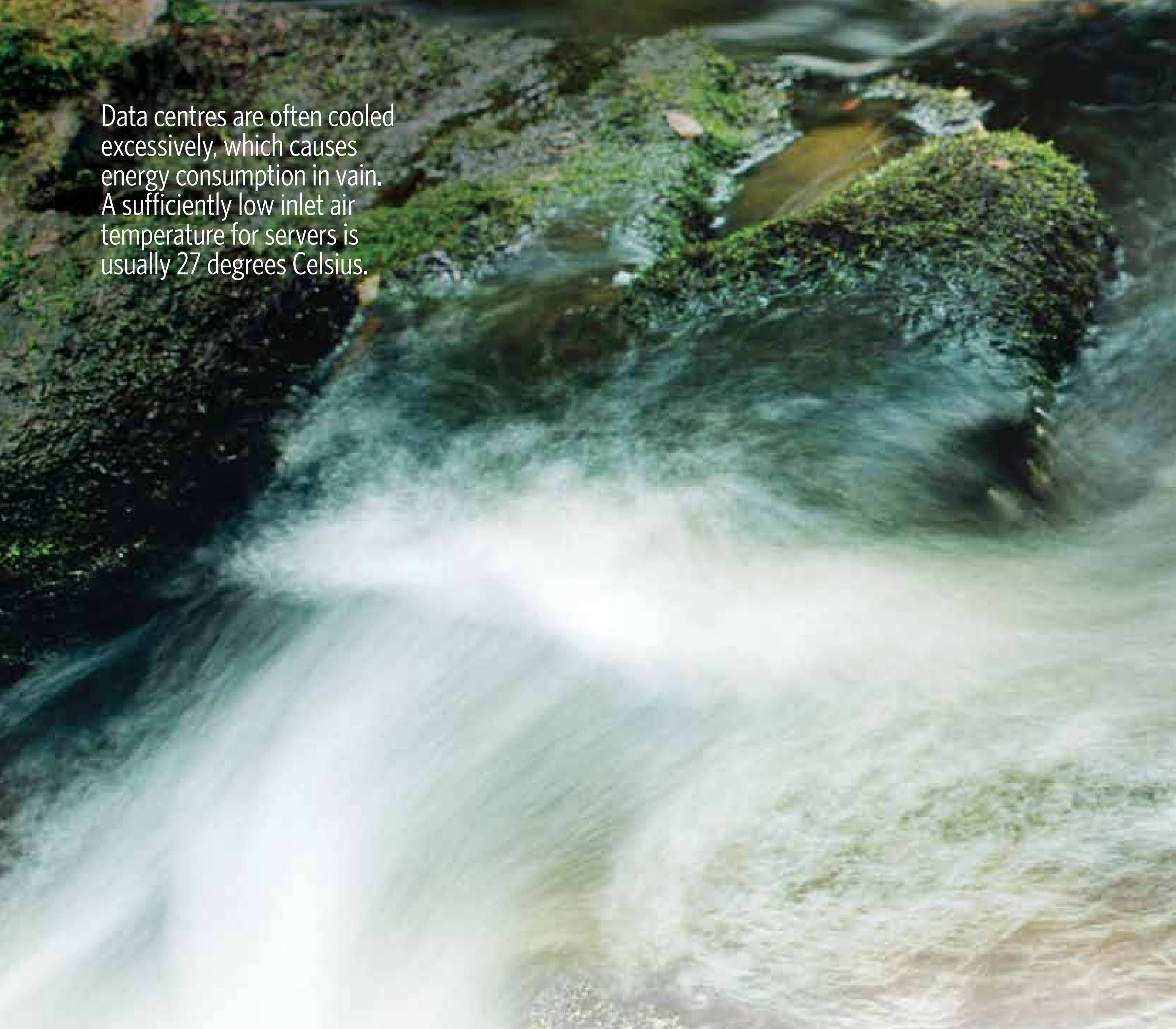
Most of the energy consumed in data centres is used on IT equipment and their cooling. The biggest savings are usually attained by virtualising servers and optimising cooling. Depending on the data centre's initial situation, it is possible to save up to 40 to 50 per cent in annual operating costs by improving energy efficiency.

Big savings can often be accumulated by taking a number of relatively small measures. Saving does not always necessitate investments – for example, by removing obstructions from free air flow can cut off tens of per cent from the energy consumption of cooling. Data centres are different when it comes to, for example, age, location and equipment. Which energy-saving activities to use depends on the particular data centre.

Electricity price has increased considerably

Increase in electricity price for operators consuming annually 2,000 – 19,999 MWh per year. The price includes electric power, power transmission and electricity tax (class 2). Eurocents per kWh





Data centres are often cooled excessively, which causes energy consumption in vain. A sufficiently low inlet air temperature for servers is usually 27 degrees Celsius.

Cooling

Cooling typically represents approximately 30–50 per cent of a data centre's total electricity consumption. The biggest potential for saving in energy consumption can usually be found in cooling.

Continuous cooling takes large amounts of energy

Server devices produce a lot of heat, so most data centres do not need a heating system. On the contrary, server rooms must be cooled practically all year round. Cooling is a continuous operation in data centres, so special attention should be paid to its optimisation. Major modifications to the cooling system are usually performed in conjunction with renewing of the data centre, but smaller measures can also save surprisingly large amounts.

The most common way of cooling is air cooling. The cooling device expels warm air from the room and delivers cool air for servers. Cool air is delivered to server cabinets via perforated floor tiles. The piping of the cooling system is hidden under a raised floor system.

Simple means

Perhaps the most important observation relating to cooling is that it is often overdone. The temperature in data centres is kept unnecessarily cool, for example, at 21–24 degrees Celsius. Ambient coolness is assumed to lengthen the life span of servers. Furthermore, a low operating temperature has been a conventional prerequisite in manufacturers' warranty clauses. However, in reality, servers' life span is so short that it is not affected by temperatures. Hence the inlet air led to servers can be increased close to 27 degrees Celsius, which is the maximum temperature recommended by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

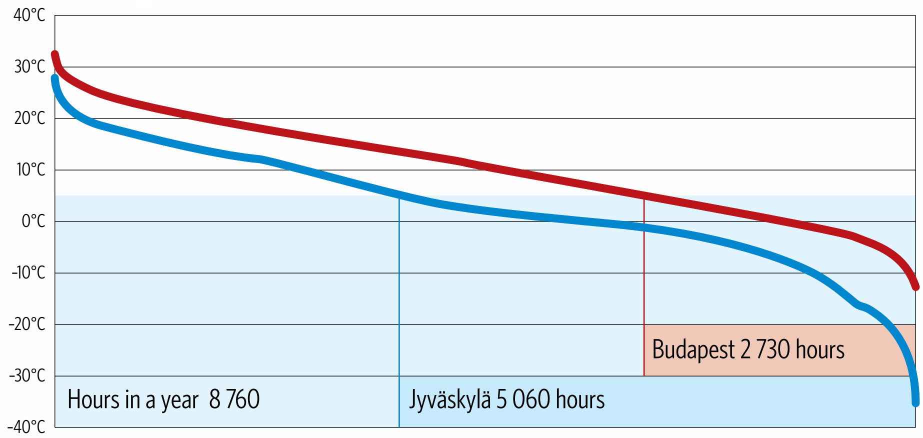
Raising the temperature of the inlet air blown to servers is a simple and effective energy efficiency measure that can easily be implemented in most data centres. In

water-cooled systems a corresponding measure is to raise the temperature of the cooling water. In many data centres cooling water is at 10 degrees although it could be closer to 20 degrees Celsius. The difference is quite significant from the point of view of energy consumption. Raising the water temperature also requires adjustment to the flow rate of water.

A dynamic, flexibly adjustable cooling system is a rational means to use energy. At best, the system actively controls itself: it delivers the biggest cooling effect to servers that produce large heat loads and less cooling for components that produce only little heat. Smart cooling control is worth the effort in all data centres.

Geographical location does matter

Finland has excellent provisions to utilise the coldness of air, water or ground for data centre cooling. For example, 58 % of the total hours in a year in Jyväskylä (Finland) are colder than +5 °C, whereas in Budapest (Hungary) the corresponding figure is only 31 %.



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FINNISH METEOROLOGICAL INSTITUTE

As much as 50 % of the cooling power can be wasted, if cold and hot airflows are mixed.

Free cooling

The most common method to cool a data centre is to use a combination of a compressor-driven cooling device and free cooling. In free cooling, cold from the outside air, water or ground is transferred inside, usually via cooling water. Electricity is needed only for circulating the cooling water and no physical air conditioners are needed. This makes free cooling very energy-efficient.

Cooling can also be implemented through direct free cooling by direct utilisation of filtered external ambient air. Fresh air-based free cooling is switched on when the outside air temperature drops below a certain level, such as 15 °C. The cooling effect of waterways can be utilised throughout the year. If the water temperature is not always sufficiently low, a compressor-driven heat pump can be used as an auxiliary device.

Frequently the temperatures for the outside air at which free cooling is turned on are set at unnecessarily low levels. It is recommendable to raise the threshold as high as the cooling water and air temperatures allow. When the temperature threshold is raised, the proportion of free cooling is increased and that of mechanical cooling is reduced – and energy is saved. Raising the temperature also requires raising the flow rate of the inlet air to servers and that of the cooling water. This means that the equipment's output and suitability for the new settings must be re-checked.

Finland's cold climate and abundant waterways provide good possibilities for free cooling, so it is a practical choice for cooling. The emphasis on geographical location is likely to increase in the future. Large data centres are already being built in the vicinity of waterways.

Placement of servers

From the point of view of optimised air cooling, it is crucial to pay attention to the placement of servers within the data centre. The aim of sensible placement is, first and foremost, to prevent cold and hot air from mixing.

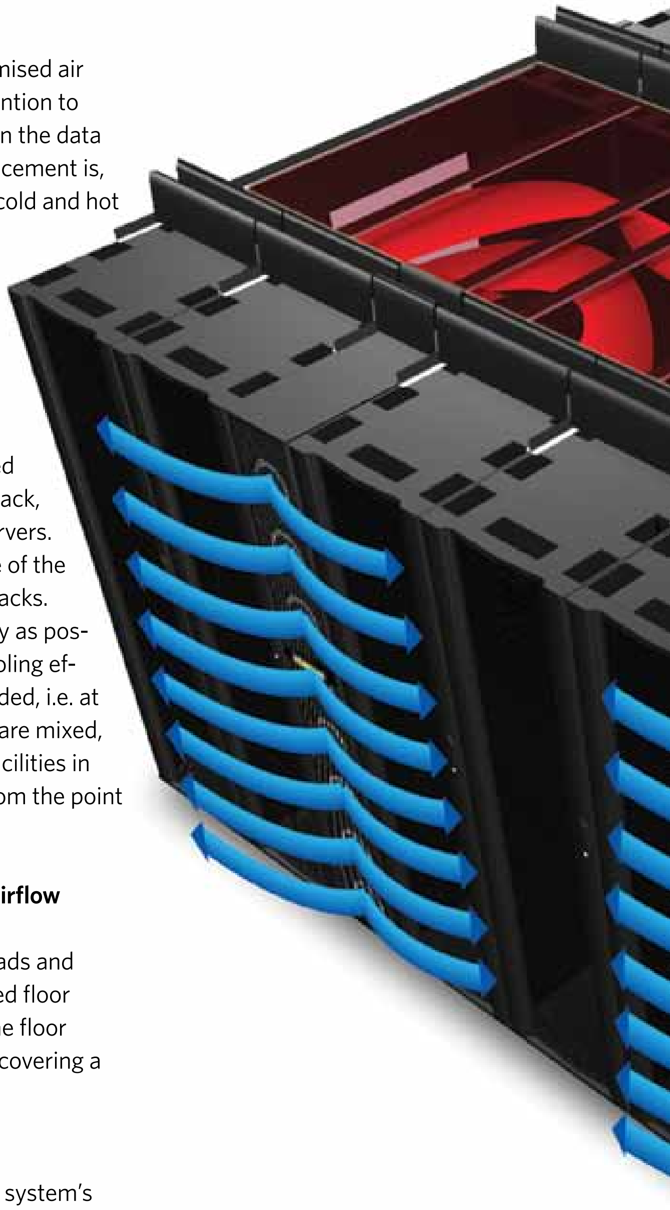
Ideally, server racks are equally high, placed in solid rows with no empty spaces between the racks. This helps to build distinct hot and cold aisles.

Usually cold air is delivered to the front side of the server rack, where the staff operate the servers. The hot aisle is at the rear side of the servers between two rows of racks. Hot air is expelled as efficiently as possible. This ensures that the cooling effect is targeted where it is needed, i.e. at the servers. If hot and cold air are mixed, the cooling affects more the facilities in general, which is ineffective from the point of view of energy usage.

The following means help in airflow management:

- Enclosing or removing the leads and pipes that are under the raised floor
- Blocking air leakage below the floor
- Enclosing server cabinets or covering a hot or cold aisle
- Well-defined cabling

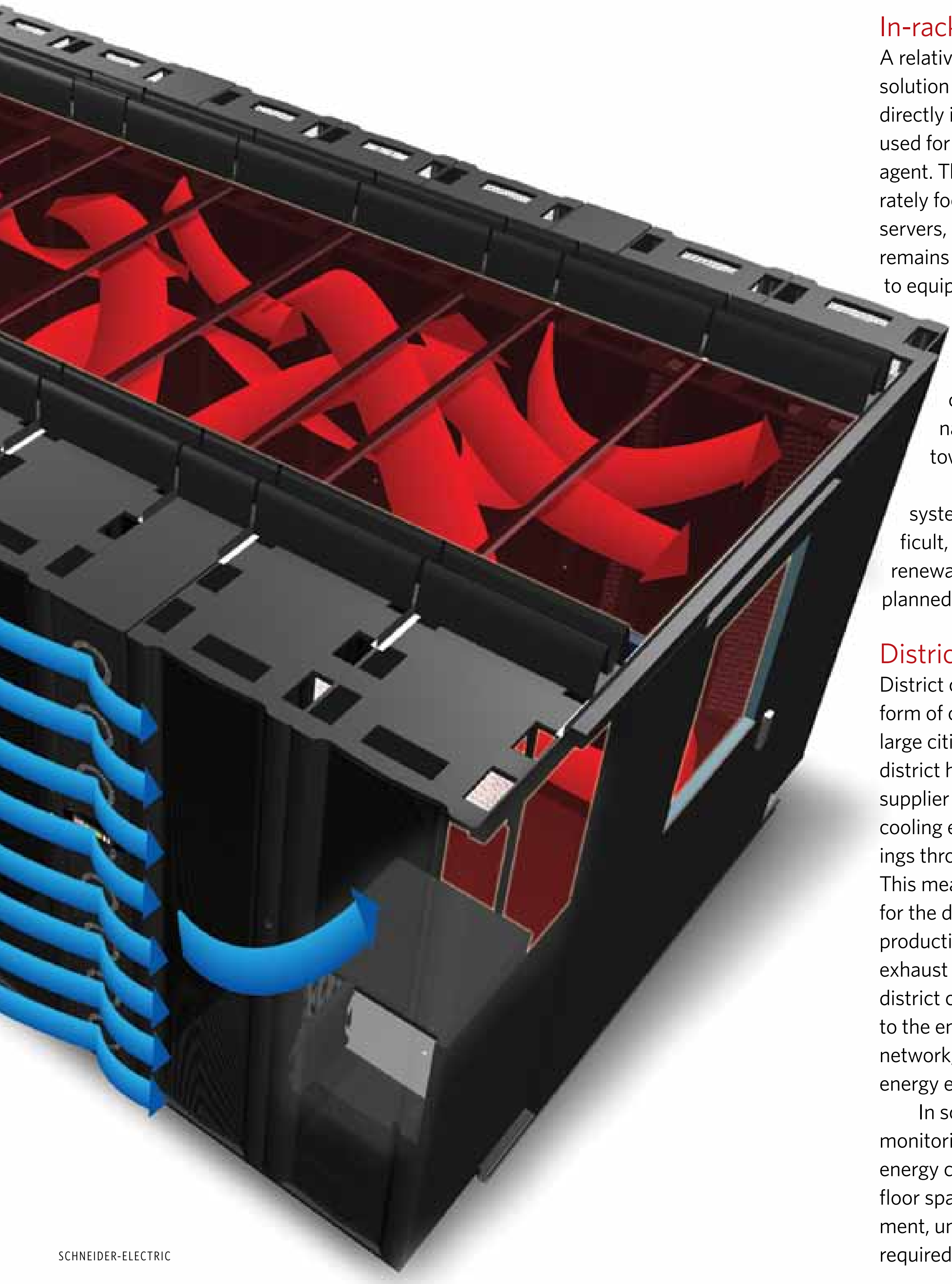
As much as half of the cooling system's power can be wasted when appropriate air circulation is prevented.



Separate cold and hot air aisles

For the sake of energy efficiency, it is important to keep the cold air flow led to the servers from mixing with the heat produced by the servers. Ideally, server racks are equally high, placed in solid rows with no empty spaces between the racks. This helps to direct cooling.

The main thing about cooling is to direct the cooling effect as precisely as possible to places where heat is generated, i.e. to the servers. Overall facility cooling is inefficient.



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In-rack cooling system

A relatively new, energy-efficient cooling solution is to place liquid cooling devices directly into server racks. The medium used for cooling is either water or cooling agent. This way the cooling affect is accurately focused on the actual target, i.e. the servers, and unnecessary facility cooling remains minimal. Liquid cooling delivered to equipment racks facilitates building cold and hot aisles. Both air cooling and water-based racks can be used in the same data centre. The solution changes the nature of cooling from office facility towards process cooling.

Installation of an in-rack cooling system in existing facilities can be difficult, but it is worth investigating when renewal of facility technology is being planned.

District cooling

District cooling is an energy-efficient form of cooling; it is becoming common in large cities. The principle is the same as in district heating, only reversed: an energy supplier company centrally produces the cooling energy and delivers it to buildings through an extensive piping network. This means that the floor space intended for the data centre's own cooling energy production is left free for other use. The exhaust heat from data centres utilising district cooling can often be transferred to the energy company's district heating network, which increases the data centre's energy efficiency.

In some cases the cooling system's monitoring can be outsourced to an energy company. District cooling releases floor space required by cooling equipment, unless separate cooling devices are required to allow for fault tolerance.

Looking for a compromise

Increasing back-up capability always increases energy consumption. To minimise energy losses, it is important to choose the correct level of redundancy. A suitable level is a compromise between the reliability requirements and economic efficiency.

It is possible to save significantly if, instead of doubling up every power supply system, the number of back-up systems is less than the number of actual systems. For example, two back-up systems can replace any of the ten main systems. This does not weaken fault tolerance, because the back-up systems are still available for all main systems.

Power distribution & UPS devices

Secured power distribution must be ensured in data centres, which requires energy-consuming back-up systems. There are many ways to improve the energy efficiency of power distribution.

Power distribution to servers must be guaranteed under all conditions. This can be achieved by using dual-feed power supplies and by maintaining back-up systems. For the main servers, power distribution is doubled up as far as the server device. These types of device have dual power inlets, doubled distribution panels and doubled uninterruptible power supply (UPS) units.

Dual feed increases energy consumption, because the back-up unit constantly draws partial power. It is common to use device- or rack-specific AC power supplies. It is possible to reduce energy consumption by using high-efficiency power supplies. This also reduces the cooling needed for the power supply units, because high efficiency means a smaller heat load.

Energy efficiency may be increased if a data centre's power distribution is changed from alternating to direct current. DC-based systems are more straightforward and provide better efficiency than AC-based systems. Adopting DC power feed requires that all servers have readiness for DC operation, which sets limits to its deployment in currently existing data centres.

Back-up systems and redundancy

The back-up levels of servers and facility technology are described by Tier classification and terms defining redundancy. On the four-step Tier scale, the highest fault tolerance class is Tier IV, which guarantees continuous data centre operations even during major power outage in distribution or faults in power supply units.

Secure data transfer without disruptions is important for our modern society, where information is more and more transferred electronically.

Redundancy refers to the degree of overlap in facility technology. Replication of power supplies and power distribution are described by the terms N, N+1, 2N, 2N+1, etc. The number in front of the letter N refers to the number of the actively used power distribution feeds and supply units, and the number after the letter N refers to the number of auxiliary feeds and units. Cooling, power distribution and UPS power can all have different levels of redundancy.

UPS devices

Uninterruptible power supplies (UPS devices) are used in all data centres to ensure continuous power distribution. The UPS devices maintain power during an outage or other power failure. The cooling system's function must also be secured, so the total power consumption of the UPS equipment may be much higher than that of the servers. UPS devices are constantly on standby mode consuming electricity. Many data centres have a dual-powered UPS configuration to backup for distribution outages and it can still be independently dual-powered.

The energy efficiency of the UPS devices is essential from the perspective of energy consumption. In new systems the efficiency is approximately 90–97 per cent. Some devices have energy saving settings that enable raising the efficiency to 98 per cent. The settings concern the normal situation when the UPS feed is on standby mode. Redundancy levels can be automated and power losses can be minimised by using UPS equipment with static bypass during normal power feed.

Several UPS devices working on partial load typically cause energy consumption. Losses are substantial when the load is small compared with the nominal load. Modular UPS architecture helps to reduce losses. Due to modularity, only the necessary UPS devices are in active mode.

Heat recovery for reuse

The exhaust heat from servers can be utilised as free facility heating. It is worth taking advantage of this.

Server equipment produces much heat. It is often led directly out of the data centre, but its utilisation is becoming more common. There are several opportunities for this, depending on the location, facilities and cooling solution of the data centre. District-cooled data centres can sell the expelled heat for an energy company for reuse in their district heating network to heat buildings and service water. For example, part of the thermal energy in the district heating network serving the cities Helsinki and Espoo in Finland comes from servers in data centres.

In individual properties exhaust heat can be utilised mostly for pre-heating the facility's inlet air. This needs a heat recovery ventilator. Facilities where this could be deployed include:

- technical facilities
- parking halls
- stairways
- staff facilities
- storage facilities

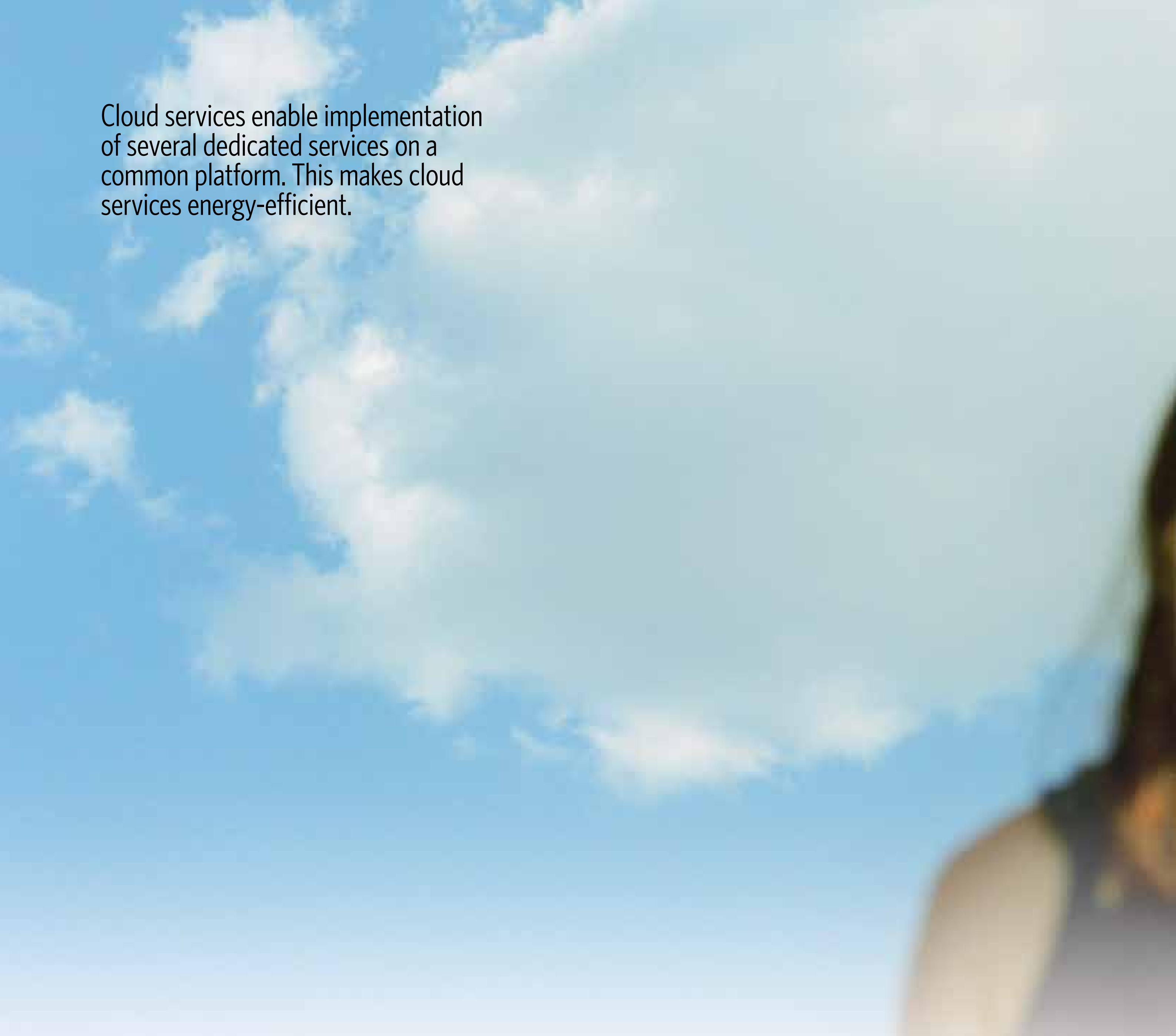
The district heating networks of the cities of Helsinki and Espoo in Finland utilise more and more the waste heat from data centres. In 2011 the waste heat from data centres was utilised for district heating for the amount corresponding the heating needs of thousands of detached houses in the Finnish metropolitan area.

If liquid cooling is being used, it can be considered whether return water could be utilised for heating by installing a heat pump. In itself, water at around 20 degrees is not sufficiently hot for heating, but it can be sufficiently heated by a heat pump to heat the facilities in question. Heat transport is arranged either by radiators, underfloor heating, or ventilation. One possible target is defrost heating for outdoor areas.

In existing data centres, the installation of heat recovery systems and heat pumps is feasible mainly in conjunction with the renewal of air conditioning systems. Waste heat can sometimes be reused also for buildings adjacent to the data centre. In Finland it has successfully been used for, for example, in heating a swimming pool in an adjacent property.

A data centre in Espoo, Finland, produces annually 30 GWh of exhaust thermal energy, which reduces carbon dioxide emissions by 10,000 tons. The same amount of emissions could be produced by driving a passenger car 1,650 times round the world.

Cloud services enable implementation of several dedicated services on a common platform. This makes cloud services energy-efficient.



Other activities to improve energy efficiency

New technologies help to save in capital expenses. Server virtualisation and energy-efficient equipment and lighting solutions reduce electricity consumption in data centres.

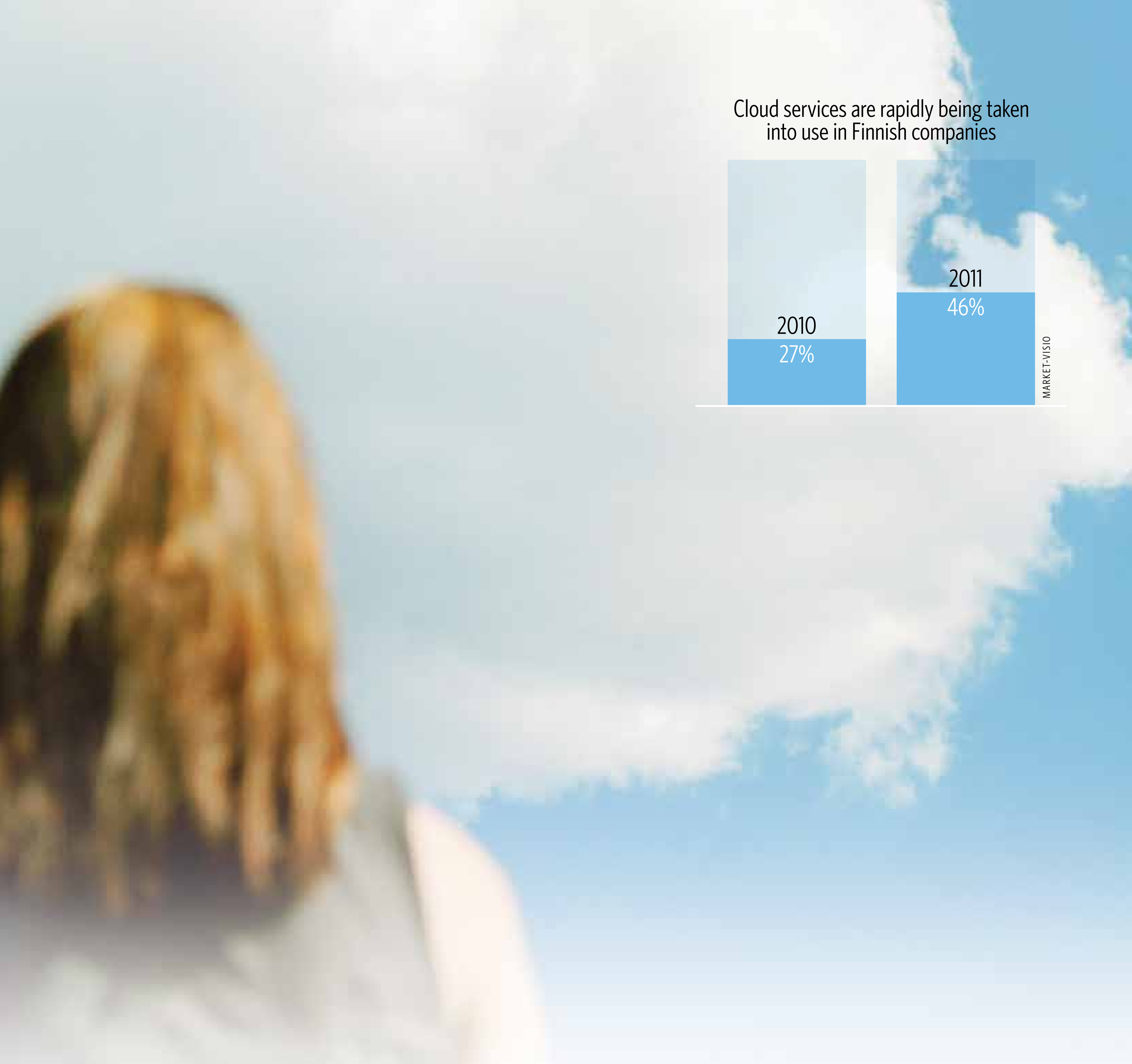
Server virtualisation

Virtualisation is already one of the most important means to improve energy efficiency in data centres and its role will continue to increase. Virtualisation refers to an architecture, in which several server systems are centralised on one configuration. When one set of equipment handles the work of several servers, it increases the utilisation rate of the servers. Normally the utilisation rate is quite low, only a few per cent of the full capacity. When operations are being centralised, servers' energy consumption can drop by several tens of per cent.

Virtualisation is also part of the basic technology in cloud computing – after all, it enables implementation of several dedicated services on a common platform. This makes cloud services relatively energy-efficient.

Energy-efficient devices

When new equipment is being procured, it is important to consider energy consumption and favour Energy Star-marked products. Types of servers known as blade servers are more energy-efficient than conventional rack servers. Their benefit is based on centralised power supply units, with one unit distributing power to several devices. Centralisation also reduces the number of cables needed and hence, it improves air circulation and reduces energy consumption on cooling. Blade servers have also energy saving settings that can



Brand-specific information is available on the energy consumption of servers and other IT equipment: www.eu-energystar.org | www.epeat.net

help to save in the power consumption of an individual server.

Power distribution systems are also different. For example, when replacing UPS equipment, it is best to look for devices with good efficiency and energy saving settings.

Air humidity and drying

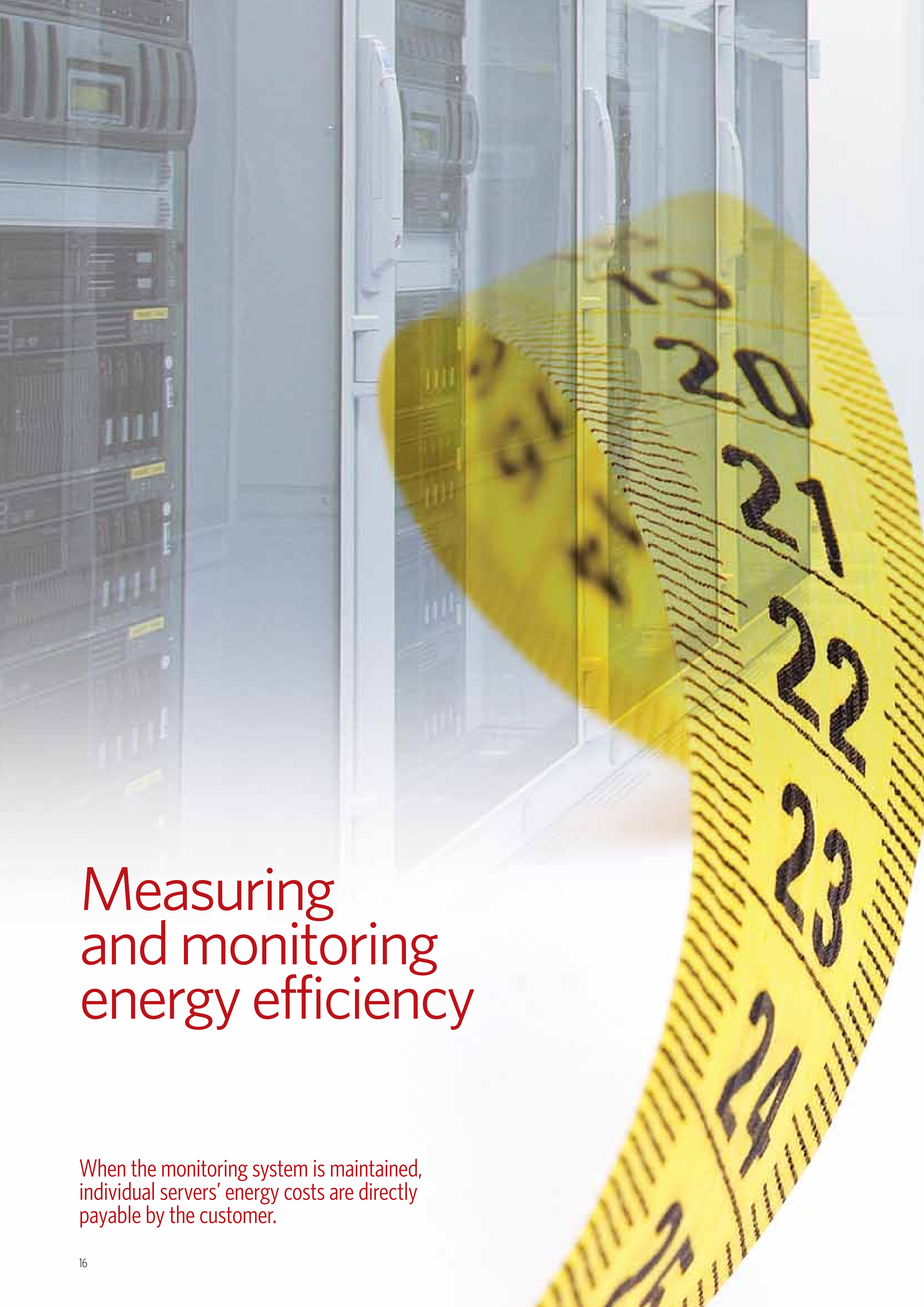
Excessive air humidity can cause condensation and excessively dry air can cause static electricity. In principle, both can cause disruptions in servers. Therefore, some data centres have air humidifiers and driers. However, in the Finnish climate such devices have been little used in practice. In cold winter weather it is possible that humidity decreases below the recommended set points, but dry air has not caused disruption. Similarly, there is not much use for air drying.

If humidifiers and driers are being used, attention should be paid to ensuring that they are not used simultaneously. Energy efficiency can also be improved by renewing humidifiers and driers.

Lighting

Data centre facilities are usually not occupied by staff, so the need for lighting is small. The energy bill for lighting can be reduced by using LED lights that consume only a fraction of the energy associated with conventional lights. Additionally, the thermal load produced by LEDs compared with the light intensity is very small, which reduces the need for cooling.

Lighting should be planned so that light is available when and where needed in operational situations. Unnecessary use of lights can be reduced by timers, and motion and presence detectors.



Measuring and monitoring energy efficiency

When the monitoring system is maintained, individual servers' energy costs are directly payable by the customer.

Several useful benchmarks have been developed to measure data centre energy efficiency. The most commonly used is the PUE value (PUE comes from power usage effectiveness).

Continuous measuring of data centre energy usage and monitoring of the measurement data are essential to improve energy efficiency. The recommended best practice is to measure at least the total consumption of the servers, in addition to the mains line consumption. This allows calculating the PUE value, which is the most common benchmarking standard for energy efficiency. Ideally, the consumption of servers, redundant systems, cooling and other facility technology can all be separately measured and monitored.

An essential part of monitoring is a system that describes the servers' intended use and level of use. Monitoring helps to eliminate unnecessary consumption due to various reasons. For example, a data centre may have servers, the intended use of which nobody knows. Monitoring at the server level allows a data centre enterprise to focus its energy costs more precisely, for example, directly on an individual customer. The possibilities of a data centre enterprise to conduct monitoring depend, amongst other things on whether the servers are owned by the company or the customer.

It is also essential to be able to identify and remove redundant servers with zero loads. The power draw at a zero load can be as much as 70 per cent of full load consumption. These servers are often run only "to be on the safe side". Removing them is an easy way to save energy.

The basic metrics express the energy consumption used by the devices and systems in kilowatt-hours and the used power as kilowatts. In addition to these, several alternative theoretical benchmarks have been developed to determine energy efficiency of data centres. For example, the measured benchmarks can be power density per unit of floor space, energy efficiency of the infrastructure, or the ratio of computing power to the used power load.

The key benchmarks are presented on the following double page. Which benchmarks are the most useful depend on the organisation's targets.

The PUE value has four classes, depending on how accurately the data centre's energy usage is being measured. In the best class every server has its own electricity meter.

Energy density

Power density or energy density is the ratio between the total power consumed and the floor space of the data centre. Normally it is roughly 0.5–1 kW/m². Energy density provides an overall description on how densely the data centre is equipped with servers. It is not exactly a meaningful benchmark to measure energy efficiency of the servers or facility technology.

PUE – Power Usage Effectiveiness

The PUE value is the most commonly used benchmark. Adopting it is a good starting point for metering energy efficiency. The PUE value describes the energy consumptions ratio of Total Data Centre Power (Ptot) to IT Power (Pit). The lower the PUE value, the higher the energy efficiency of the facility technology.

$$PUE = P_{tot} / P_{it}$$

P_{tot}: Total Data Centre Power
P_{it}: IT Power

In a typical data centre, facility technology and equipment each consume roughly 50 per cent of the energy. Then PUE=2. The higher energy efficiency the lower the PUE value. In the best case, the PUE value can be less than 1.2. Usually, the PUE value is higher in old buildings than in new ones, due to aged facility technology.

Measuring the PUE value can be defined according to accuracy into four categories.

The PUE value varies depending on temperature, humidity and occupancy level of the room. Therefore, a one-time measurement is not sufficient; ongoing monitoring is needed.

The PUE value measures only the energy efficiency of facility technology. It says nothing about servers' energy efficiency and it does not take into account, for example, the possibility of reusing exhaust heat outside the data centre facility. The PUE value was developed by an international IT consortium, the Green Grid.

	PUE CATEGORY 0	PUE CATEGORY 1	PUE CATEGORY 2	PUE CATEGORY 3
IT energy measurement location	UPS output	UPS output	PDU output	IT equipment input
Definition of IT energy	Peak IT electric demand	IT annual energy	IT annual energy	IT annual energy
Definition of total energy	Peak total electric demand	Total annual energy	Total annual energy	Total annual energy

The NPUE value describes data centre energy efficiency better than the PUE value when reuse of waste heat is deployed.

NPUE – Net Power Usage Effectiveness

The NPUE value is a more sophisticated version of the PUE value. The calculation takes into account also the energy expelled from the data centre. Usually it refers to utilising waste heat.

$$NPUE = E_{net} / E_{it} = (E_{in} - E_{out}) / E_{it}$$

E_{in}: Total energy input
E_{out}: Total energy output
E_{it}: IT equipment electric demand

The formula is valid for data centres that do not use district cooling. If district cooling is used, the following formula is applied:

$$NPUE = E_{it} / (E_{in} - E_{out})$$

The NPUE value describes data centre energy efficiency better than the PUE value when reuse of waste heat is deployed. The NPUE value was determined in 2010 by the KTH Royal Institute of Technology, Stockholm, Sweden.

CADE – Corporate Average Data Centre Efficiency

The CADE value is a more versatile benchmark of energy efficiency. It separately accounts for the utilisation rate of, for example, information technology and infrastructure:

$$CADE = AU_{fac} \times EE_{fac} \times AU_{IT} \times EE_{IT}$$

AU_{fac}: The utilisation rate of the data centre infrastructure (facility asset utilisation)
EE_{fac}: The energy efficiency of the data centre infrastructure (the ratio of the IT load to the facility's total load)
AU_{IT}: The utilisation rate of the servers (IT asset utilisation)
EE_{IT}: The energy efficiency of the information and communication technologies

The components in the formula are calculated separately. The final result is a percentage that describes the data centre's energy efficiency. The higher the CADE value the better the energy efficiency. Based on the results, data centres are rated at five levels, in which level 1 is 0-5 per cent and level 5 is higher than 40 per cent. Most of the current data centres meet only level 1.

The CADE value is relatively straightforward and provides a total picture of the energy usage of the data centre. The weak point in it is that the servers' utilisation rate is given as estimated values. The CADE value was defined by the consulting firm, McKinsey & Company in 2008.

CUPS – Computer Units per Second

The CUPS value refers to servers' normalised computing output divided by watts consumed. The unit is CUPS/W. The actual computing output of the equipment is not measured but instead, it is estimated based on the year of manufacture. Hence, an inventory is taken of servers' manufacture years. Then, servers of different age receive corresponding MCUPS coefficients (see a given table) that are multiplied by the server output. Multiply the result by server utilisation rate and the number of servers to calculate the total computing output of servers in CUPS. The result is divided by the data centre's Total Energy Consumption in kilowatts, which produces Data Centre Efficiency (CUPS/W).

CUPS gives an approximate idea of the data centre's energy efficiency. Compared with PUE, its advantage is the fact that it takes into account the servers' utilisation rate. The bad thing is that the computing output depends on an estimate based on the year of manufacture, rather than a direct measurement. The CUPS value was introduced by PDU supplier Emerson Network Power.

Many investments rapidly return the expenditure as reduced energy costs.

Energy audits of data centres

Energy audits and analyses help to identify the most profitable saving targets and concrete means, with which it is possible to improve energy efficiency and reduce costs. They produce valuable information to guide operations in continuous improvement of energy efficiency.

Energy audits and analyses are exhaustive and holistic reviews of energy and water usage within a facility or production process, and possibilities to improve the efficiency of use.

The reviews are conducted by a qualified energy-auditor in cooperation with the commissioning company. The results include reliable information about the distribution of energy consumption and means to reduce energy consumption and its costs.

Energy audits and analyses create a basis for long-term and target-oriented energy consumption tracking and active improvement in energy efficiency. The company or the community benefits from its energy efficiency activities that strive for systematically improved performance.

Valuable information that stimulates action-taking

As a result of the work, the customer receives an audit report that contains information on energy consumption and its distribution. The report contains suggestions for improvement methods suitable for reducing energy consumption and investments needed. It also specifies a table of the saving effects on energy consumption, as well the costs and repayment period of the actions. Once the energy audit or analysis is ready, the customer decides on further activities and makes a preliminary engagement to realise them.

Savings even without investments

Energy audits are an efficient way to reveal possible means to reduce energy expenses.

Cost savings are often gained even without investments. For example, in the service field a third of the recommendations from this kind of review can be implemented merely by adjusting devices and systems and changing operating procedures.

Many investments rapidly return the expenditure as reduced energy costs, some already during the first year.

The collaboration between the auditor and the customer will generate reliable information about the targets of energy consumption and how to reduce the consumption.

Special features about data centre energy auditing

Compared with auditing targets in the service sector or industry, data centres are essentially different. Typically, a data centre's electricity consumption per floor space is considerable and the areal power demand is more than 1000 W/m^2. The most significant energy saving measures can most often be found from cooling and power distribution solutions.

When data centre energy audits are being planned, it is important that the users and persons responsible for production participate actively in the planning process. The best or at least good end results can only be achieved when the special features of the target are discussed with the user and the solutions made during the audit are agreed together. Among the most significant of boundary conditions concerning an individual data centre include the redundancy level required from the systems, other security requirements, and the ambient conditions requirements concerning each device. Furthermore, the placement of the devices and naturally, also the energy efficiency of the IT equipment plays a major role.

The guidelines on industrial energy auditing should be applied to data centres, following the requirement for thorough review of the "production process" and sufficient dialogue with the user.

Government supports energy efficiency

In Finland it is possible to apply for state subsidy for the implementation of energy audits and analyses. Subsidies can also be applied for execution of the measures proposed in the audits. Discretionary subsidy for energy efficiency investments on ordinary technology is granted only for enterprises and municipalities that have signed up to the Energy Efficiency Agreement.

The Government provides financial support especially for implementation of new technology. New technology refers to technical and other such solutions that have not yet been commercially applied in Finland.

The amount of energy subsidy to be granted for energy audits and analyses is annually resolved. Subsidies can be applied from the local Centres for Economic Development, Transport and the Environment ("ELY-centre") throughout the year, and financing is granted within the limits of funds.

ENERGY EFFICIENCY
agreements

The aim of the Energy Efficiency Agreement for Industries is to improve energy efficiency in accordance with the EU Energy Services Directive with voluntary measures.

Energy efficiency agreements

Why is it important to improve energy efficiency?

Improving energy usage in a company is rational management of finances, for smaller energy consumption will be visible in operating costs. Energy efficiency is part of responsible company management.

Energy efficiency should always be regarded as a starting point also in data centres when developing their services, creating procedural instructions, providing induction training for new staff or deciding on equipment procurement.

The Energy Efficiency Agreements play a crucial role in Finland's effort to meet its energy efficiency targets. They also help to curb climate change, by voluntary means and without legislation. In Finland, the agreement scheme is the primary tool in the implementation of the EU Energy Services Directive.

Energy Efficiency Agreements back up international agreements

- Agreements signed by the Finnish Ministry of Employment and the Economy with the Confederation of Finnish Industries EK and the municipal sector aim at realising the EU Energy Services Directive with voluntary measures over the period of 2008–2016.
- An enterprise, municipality or a group of municipalities participating in the agreement scheme can apply for energy auditing and investment subsidies.

Additional information:
www.energyefficiencyagreements.fi
www.motiva.fi

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This guide was produced by Motiva to promote energy saving in data centres. The guide was created as part of the “Energy-Efficient Data Centre” project.

This guide is primarily meant for improving energy efficiency in the currently existing data centres, but it is also useful when a new data centre is being planned.

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