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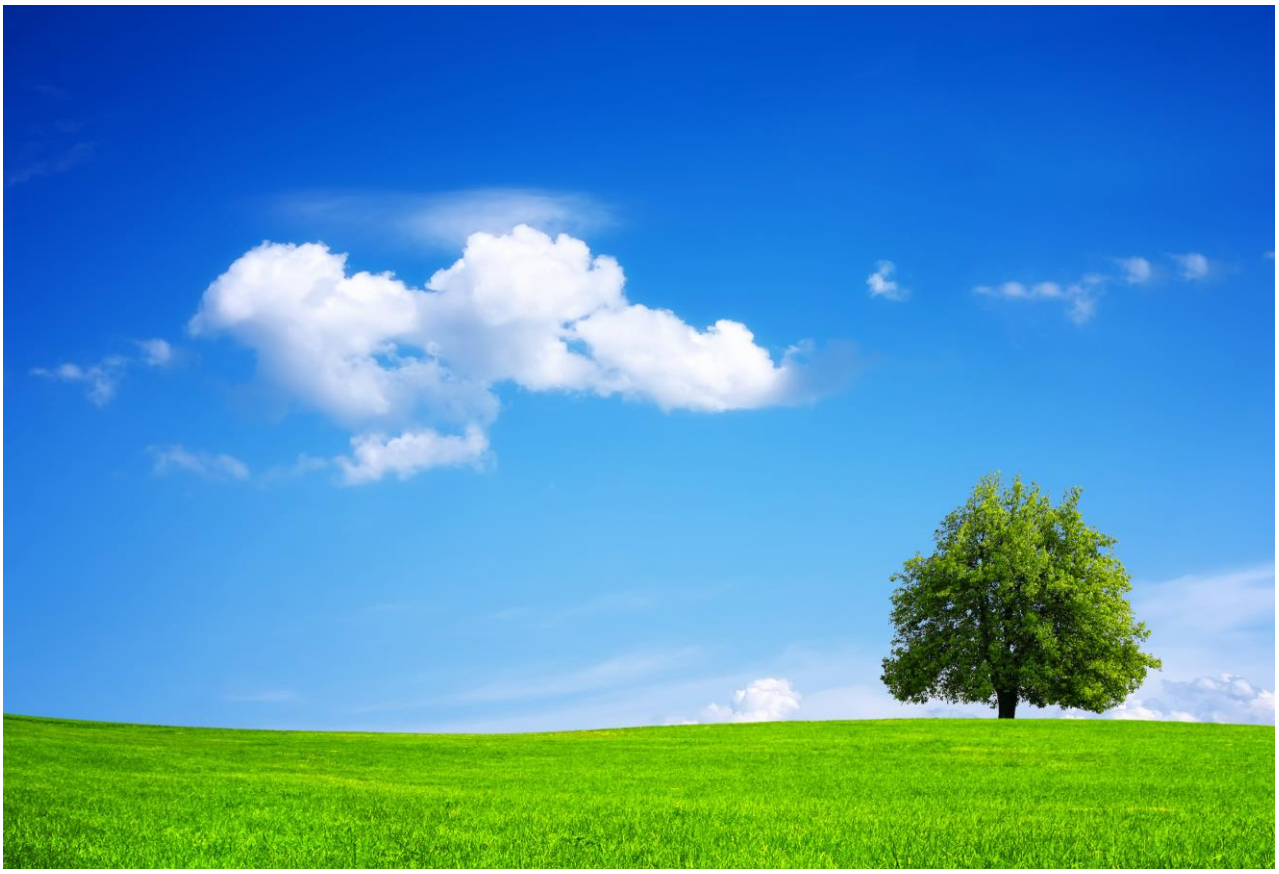
Protecting the climate and reducing costs

A guide to energy efficiency in commercial kitchens



An information sheet of HKI Industrieverband Haus-, Heiz- und Küchentechnik e.V.• Lyoner Str. 9
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Published by:

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Heating and Kitchen Technology e.V.

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Status: April 2019

Introduction

In commercial kitchens, food preparation is an energy-intensive process. This includes cooking methods such as frying, roasting, stewing, steaming or preparation in the microwave. Essentially, it involves exposing food to a certain temperature for a certain amount of time.

The cooking of food is closely followed by the cleaning of dishes, cutlery and glasses. Other main processes are the cooling of food, ventilating and deaerating the kitchen, keeping dishes and food warm and preparing coffee specialties.

In commercial kitchens, thermal, refrigeration and dishwashing equipment as well as ventilation and extraction systems are used for this purpose.

In general, when buying a new appliance, the connected load and the energy consumption over the entire service life must be taken into account in addition to the product price. The operating costs over the product life cycle exceed the purchase price by far.

A prudent use of energy helps to secure the future of the company and protect the environment at the same time. An overview is given of how energy can be used efficiently as well as how energy can be saved while maintaining the same quality level.

The guide "Protecting the climate and reducing costs" focuses on eight areas of energy efficiency in commercial kitchens:

1 Thermal Equipment

The simplest way to save energy in a commercial kitchen is to switch on electrical and gas appliances only when they are actually needed and switch them off again when not in use. In general, energy-intensive standby operation should be avoided. Commercial kitchen equipment should only be preheated when really necessary. The heat output of the appliances should be regulated in good time.

To avoid too long preheating, information about the preheating time can be attached to each appliance. This reduces the user's uncertainty and the appliances are heated up in time, but not too early.

Intelligent energy optimisation systems enable a targeted time-controlled locking and unlocking of appliances with time specifications.

If available on appliances, the use of intelligent and optimised cooking processes with simple programmes, manual operation or continuous operation is to be preferred.

For all appliances that use water (e.g. steamers, combi steamers), make sure that the water does not cause limescale deposits in the appliance. Limescale deposits affect heat transfer and have an impact on heating and cooking times, energy consumption, especially in gas-operated appliances, and the service life of the appliance. Therefore, to avoid limescale deposits, suitable water treatment for hard water should be carried out.

Comparative values
The standard DIN 18873 *Methods for measuring the energy consumption of commercial kitchen appliances* defines energy consumption value measurements. This makes it possible to compare the energy consumption of different appliance groups from different manufacturers under defined test conditions.
Information on this can be found at http://www.grosskuechen.cert.hki-online.de/en.

1.1 Ranges

Pot detection
Modern appliances are equipped with a pot detection system. The cooking zone is switched off or put into standby mode when it is not under load. This reduces unnecessary energy consumption. Pot detection is found on induction hobs and specially equipped glass ceramic stove tops that use radiant heating elements. Pot detection is rarely used with gas hobs. This technology is practically non-existent on large hobs, earth hobs and hotplates.

Hot water
For cooking, water from the hot water tank should be used instead of cold water. Small amounts of water can also be heated with a kettle instead of the cooker. This is not only faster, but also requires only about half the energy compared to the mass hotplate.

Cookware
The size of the cookware must match the respective cooking zone. If pots and pans are smaller than the cooking zone, heat and energy will be wasted. The right choice of cookware for the amount of food to be cooked is also very important. It must always be as big as necessary. To avoid further energy loss, the cookware should always have flat bottoms. Cookware with uneven bottoms should be repaired or replaced, as they consume up to 30 % more electricity. Low-quality

cookware in particular deforms easily and heat energy is lost. Chrome steel pans are more energy-efficient than cast-iron pans because they radiate less heat.

Lids
Always use suitable lids for the cookware and adjust the heat output accordingly. Energy savings of up to 25 % can be achieved. Without a suitable lid, about three times as much energy is needed to keep a product cooking.

1.1.1 Cookers with induction hobs

Precise control
With induction hobs, the heat can be adjusted far more precisely. The heat storage capacity is very low with this technology. When the power is changed with the rotary switch, the heat in the food being cooked immediately adjusts to the new power level. Power mode functions are offered for household appliances or appliances with consumer electronics (low-end and low-price products) that are not designed for high continuous output.

Fast heat-up phase
Compared to a glass ceramic hob with a radiant heating element, the heat-up phase is three times faster. Induction hobs offer the best possible energy utilisation. A strong alternating magnetic field is generated under the glass ceramic cooking zone, which enables direct energy transfer in suitable pots and pans. Thus, the heat is generated directly in the bottom of the cookware. There is a direct energy conversion in the bottom of the cookware, which makes the cooking process faster and more controllable. If no cookware is placed on the hob, no energy is consumed when the cooker is switched on, apart from a low standby power consumption. There is a low thermal load at the workstation, which has a positive effect on the room temperature.

Cookware
Induction cookware must have ferromagnetic properties. Aluminium-steel compound bottoms cannot convert the full power due to the principle. Compound bottoms should have at least 70 % steel in the surface area. The power that can be converted corresponds to the proportion of steel in the bottom surface. Ideal are pots with a continuous and unperforated steel inlay that covers the entire bottom.

1.1.2 Cookers with glass ceramic hobs

Place cookware on hob correctly
A radiant heating element is located under the glass ceramic hob. Through an electrical resistor, heat is transferred by radiation and conduction via the cooking zones on the glass ceramic hob to the bottom of the cookware. The prerequisite is that the cookware is one hundred percent seated on the hob. (see 1.1 Cookers, section Cookware).

1.1.3 Cookers with mass hotplates

Switch on when cookware is on the hob
The heating coil is insulated with ceramic. The heat is transferred to the bottom of the pot by electrical resistance and heat conduction. No temperature control is possible due to a step switch with power control. Long heat-up and stand-by phases and heat radiation result in high energy

consumption. The appliance should therefore only be switched on when the cookware is on the hob. Unsuitable cookware and incorrect handling lead to high energy consumption.

1.1.4 Cookers with gas hobs

Immediate, stepless combustion control
Heat is supplied directly from the gas flame. It is available very quickly at full power. The food gets hot quickly. The combustion is regulated steplessly. It must be taken into account that combustion products are released into the exhaust air. The heat source can be switched off quickly. The reaction time is much faster compared to glass ceramic hobs and mass hob tops. Care must be taken that the pot size clearly covers the flame pattern.

1.1.5 Glow plate cookers and commercial hobs

With commercial hobs and glow plate cookers, it is generally not possible to achieve a good ratio between the heated surface and the cookware surface. This is why their energy efficiency is significantly worse than that of mass hobs, glass ceramic and induction hobs. Due to the high thermal inertia, energy-intensive standby operation can hardly be avoided. If such appliances are used, an independent heating zone setting and temperature control are advantageous.

1.2 Ovens

Adapt work processes
Depending on the product, frozen food can be defrosted before baking or preheating can be omitted. The residual heat can be used by switching off the appliances beforehand. If possible, the oven door should not be opened during the baking process.

Viewing window
The viewing window should be equipped with a heat-reflecting coating or double glazing.

1.3 Microwave ovens

Regenerating small quantities
For regenerating smaller quantities of cooked food, a microwave oven is very energy-efficient. The energy is transferred directly into the food. There is hardly any heating loss.

1.4 Convection steamers

Different cooking methods and optimized utilisation
The appliances are multifunctional as they allow different cooking methods such as baking, broiling, roasting, steaming and grilling. They are also equipped with additional innovative technologies. Among other things, they can be programmed to prepare food using the less expensive off-peak electricity. For example, non-programmable and non-multifunctional tilting fry pans and cooking kettles that are not equipped with innovation technology can be partially replaced. If the menu is well thought out, different foods can be cooked at the same time and the appliance fully loaded. Odour/taste transfer can be avoided in the process. Optimal and continuous loading of the appliance consumes less energy.

Modern convection steamers have a clear advantage in energy consumption over conventional cooking appliances such as cookers, combi ovens, tilting fry pans or kettles due to their high energy efficiency and the different cooking methods. By replacing individual other appliances, the convection steamer also saves space, which has a positive effect on investment and operating costs.

Convection steamers are not only characterised by minimal heat emission in the kitchen, but also use almost all the energy for food preparation due to optimal insulation. Thanks to their precise measuring and control technology, they are able to supply only as much energy as is actually needed for the respective cooking state. Appliances with adaptive cooking processes are preferable here, as they always determine the ideal cooking process for the current state and optimise it even while the process is running. This not only ensures the best food quality, but also minimises energy consumption. Thanks to the programmability of the convection steamers, food can also be cooked gently overnight. The price advantage of the night-time electricity used for this saves further energy costs.

High efficiency, short heat-up times, low emission values of gas appliances
Appliances with forced draught gas burner technology can be many times more efficient than conventional gas appliances. The short heat-up times and low emission values are also positive from an energy perspective. Most of the energy is used exclusively for food preparation. This means that heating and air conditioning equipment (range hoods, room-conditioning systems) can be dimensioned much smaller. The investment and operating costs for space cooling are significantly lower.

Connection requirements
For temperature-controlled appliances, such as combi steamers, the connected load cannot be used to determine the energy consumption. I.e. low/high connected loads do not necessarily lead to low/high energy costs.

Prevent limescale
Limescale deposits insulate heating elements/heat exchangers, thus impairing heat transfer and increasing energy consumption in gas-operated appliances. Furthermore, limescale deposits often lead to premature malfunctions and failures of appliances. Limescale can be combated with appropriate water treatment or integrated system cleaning.

Suitable appliance size
If a large convection steamer is is not always used to its full potential, it is advisable to consider buying two smaller appliances instead, which can significantly increase flexibility. Appropriate combination options are available on the market for both electric and gas appliances.

Using the right accessories helps to save energy
The right accessories can not only make food preparation easier and more efficient, but also increase flexibility and save energy.

Special coatings are available for oven racks such as trays, grids or food containers, which increase the service life and shorten the cooking process due to their very high thermal conductivity, thus reducing energy consumption. Often it is not even necessary to preheat the oven rack.

With accessories specific to the food being cooked (e.g. chicken rack, plate rack trolley), the capacity utilisation can also be increased and thus the energy consumption reduced.

A condensation hood or a condensation breaker can significantly improve the general conditions for the design of the ventilation system and thus reduce its energy consumption.

1.5 Tilting fry pans

Tilting fry pans are available with both stainless steel and cast iron pans and offer the possibility of frying, boiling and steaming a wide variety of foods and dishes conventionally. Stainless steel pans are available with a surface treatment (without coating) with non-stick properties.

For gas-powered tilting fry pans, energy efficiency can be improved by using forced draught gas burner technology.

Connection requirements
For temperature-controlled appliances, such as tilting fry pans, the connected load does not indicate the energy consumption. I.e. low/high connected loads do not necessarily lead to low/high energy costs.

1.6 Multifunctional contact cookers - combination of tilting fry pans, (pressure) water boilers and deep fryers

Different cooking methods
The appliances are multifunctional as they allow different cooking methods such as boiling, frying, steaming, pressure cooking, deep frying.

Heating technology
The heating technology should be designed to be as efficient as possible with minimised losses in heat transfer.

Optimum temperature control
Appliances with temperature control that is as precise and consistent as possible are also preferable, as only as much heat as necessary is generated.

Covering the cooking container
Covering the cooking container with an insulated lid during cooking increases energy efficiency considerably. The energy dissipation into the room is significantly reduced. If possible, dishes with longer cooking times are cooked under pressure. This shortens cooking times with relatively low energy input.

Technology
Multifunctional cooking appliances equipped with innovative technology that work automatically or can be programmed can be used, for example, to produce food with cheaper night-time electricity. Easy to clean cookware also saves resources such as water, chemicals and time. Because of the power and flexibility of these appliances, the same or a larger quantity can be produced with fewer appliances.

For energy-efficient cooking, when purchasing new appliances, attention should be paid to the design and, above all, to the overall system of heating, the surfaces to be heated and the connected load. A high connected load combined with a low mass and precise temperature control is energy efficient.

It should be taken into account that higher peak loads can lead to higher electricity costs. Load management systems can reduce energy efficiency in peak load situations.

Connection requirements
For temperature-controlled appliances, such as multifunctional cooking appliances, the connected load cannot be used to determine the energy consumption. I.e. low/high connection values do not necessarily lead to low/high energy costs.

Heating fat by direct heating in the fat basin is very energy-efficient and advantageous for a short heat-up and reheating time. A large surface area of the heating system in the fat basin and a cool fat zone (cold zone) below the heating elements additionally increase the useful life of deep-frying fats.

During short breaks in operation, the basins should be covered with the help of a lid and/or the temperature should be automatically regulated down. Modern deep fryers regulate down automatically.

1.7 Boiling pans

The steam required for the cooking process should be generated separately from the pressure vessel. Due to the smaller volume of service water to be heated, less energy is required than for direct steam generation in a large-volume double jacket boiler. In order to keep the energy in the food to be cooked, boiling pans should be equipped with double-jacketed lids.

For gas heated boiling pans, systems with forced draught burner technology are preferable to atmospheric burners because the energy efficiency is significantly higher.

1.8 Salamander broilers

The appliances are mostly used for short periods of time to gratinate food. Therefore, it makes sense to use appliances with plate detection to request the energy only when needed. The heating elements must then provide the radiant heat very quickly (e.g. infrared radiators). A zone circuit is also energetically advantageous in order to heat individual or small portions as needed.

1.9 Griddles and roasting pans

Take into account material properties
Stainless steel, steel, cast iron or hard chrome plates griddles with anti-radiation coating) are heated over a large area. This leads to high energy consumption through heat radiation and standby. Hard chrome plates or stainless steel surfaces are more energetically positive than cast iron plates. Regular cleaning is a prerequisite.

1.10 Steam ovens

Food is cooked just below boiling point with steam and less energy loss than in a cooking pot. If possible, foods with longer cooking times are cooked under pressure. This shortens cooking times with relatively low energy input and minimises energy dissipation (load dissipation) to the room.

1.11 Bain-Maries (double boilers)

Ensure correct use

Double boilers are frequently used in the catering industry. For economic use, it is necessary to ensure that no open spaces are created during operation. For this reason, unused sections should be covered with a flat container so that no water steam escapes. In addition to energy loss, the escape of water steam would cause increased humidity, which would adversely affect the kitchen climate and promote the growth of mould.

1.12 Plate dispensers

Set temperature as required and pay attention to insulation

Static or forced convection-heated plate dispensers have an infinitely variable thermostatic temperature control. The desired temperature should be set as needed. The appliances should be sufficiently insulated.

1.13 Food transport trolleys

Food transport trolleys are used for two purposes. Firstly, to keep already cooked food warm after the cooking process until all components are ready. Secondly, to keep the food warm up to and during serving.

Filling with hot water

If the food transport trolley is filled with hot water instead of cold water, the heating time can be shortened and time and energy for tempering the water can be saved. In addition, the hot water can be provided via a central water heating system with significantly less energy and costs than with electric food transport trolleys. The heating phase required for the use of hot water can also be easily determined in the commercial kitchen without the need for complex measuring devices: To do this, the warming trolley is switched on five minutes later each day and it is empirically checked at which time the trolley must be switched on so that it has reached the desired temperature in time for serving the food.

Ensure consistent covering

An easily implemented measure is the consistent use of cover plates. Due to their design, some food transport trolleys have a fixed cover, others have a separate cover. The latter are often left open during their heating phase so that the water evaporates. In addition to energy losses, this mishandling leads to increased humidity, which pollutes the kitchen climate and promotes mould growth. By consistently covering the food transport trolleys with the cover plates provided for this purpose, electricity can be saved and the kitchen climate improved. At the same time, the performance or operating time of the exhaust air system in the kitchen can be reduced.

Make sure that the food transport containers sit flat on the top cover. In addition, the food transport containers must be covered.

If, in addition to covering the food transport trolleys, the heating time is also reduced to about 80 minutes, annual energy savings of about 1,000 kWh are possible for a food transport trolley with an output of about 2.1 kW.

2 Refrigeration equipment

View investment and operating costs together
When buying a new refrigeration unit, energy consumption, good thermal insulation and an efficient refrigerating machine must be taken into account. Investment and operating costs must always be considered together. Internally, it is important to think through the size and type of the new refrigeration equipment. The production system of the company and the level of convenience must be considered first. The requirements for the refrigeration process vary, depending on whether the goods to be refrigerated are raw, packaged, semi-finished or ready-prepared, and whether they are at room temperature, pre- or deep-frozen or hot from cooking.

Carry out checks on the cooling temperatures
The cooling temperature should only be as low as necessary; regular temperature checks can ensure this. Temperatures that are too low lead to considerable additional energy consumption. For every 1 °C too low cooling temperature, approx. 4 - 6 % more energy is required. Often the set temperatures are not checked or are set too low in order to prevent an increase in the interior temperature due to frequent opening of the door. Defective thermostats can also be the cause. Note: DIN 10508 *Food Hygiene, Temperatures requirements for foodstuffs* specifies maximum temperatures for deep-frozen, frozen food and food to be refrigerated. These should not be exceeded, as food that has spoiled and therefore has to be disposed of has a significant influence on the profitability of a business.

Open refrigeration appliances for the minimal amount of time necessary
If the doors are opened for a long time and frequently, not only does cold air escape, but warm and humid air also enters the cooling area within a short time. This leads to rapid icing of the evaporators and to a deterioration of the cold transmission. In addition, defrosting has to be done more frequently, which increases electricity costs. Refrigerator doors should be closed as soon as possible.

Demand-led defrosting by means of electronic controls regulated by microprocessors can save up to 10 % energy, e.g. with timer operation. The aim is to achieve short defrosting times, e.g. in the case of plug-in appliances by means of hot gas defrosting in approx. 15 minutes instead of electrical defrosting with heating elements of up to 30 minutes - with high power consumption. When defrosting according to factory-set parameters, the operator should ensure that the evaporators of the refrigerator or freezer are free of any ice build-up after each defrosting process. If the appliance is constantly iced up, it must be defrosted manually or the defrosting time must be extended.

Refrigerators with glass doors generally consume more electricity due to the required product lighting and the poorer insulating properties of the glass doors - in the case of freezers with additional heating of the glass surfaces to prevent fogging - compared to insulated solid doors. These appliances are mainly used as self-service cabinets in supermarkets and as beverage dispensers. However, because of the better overview of goods and the resulting faster removal of goods, they are also used at various stations in restaurant kitchens, in the preparation of cold food and at dessert and patisserie stations. They are only useful as beverage refrigerators for self-service by the guest.

Upright freezers are more space-saving than chest freezers, but are less energy-efficient due to the cold losses that occur when the door is opened. The prerequisite is that the refrigerated

cabinets are not overstocked (only up to the stack mark). However, these appliances offer less clarity and require more space than upright freezers.

Employees must be informed that the doors of refrigeration units are only to be opened for a short period of time. Prominent information signs can help with this. Self-closing doors can also be activated.

If refrigerators, cold rooms and freezer rooms are opened frequently, the use of transparent doors or strip curtains or so-called air curtain systems is recommended. Energy savings of up to 10 % can be achieved in cold storage and deep-freeze rooms.

Cleaning the air vents, cooling fins and refrigerant condenser
The ventilation grilles must not be blocked or obstructed. In refrigerators and freezers, this leads to an increase in energy consumption of up to 10 %.

Soiling in the floor area can be considerable. For example, aggregates can be covered with dust. This greatly hinders heat dissipation. The appliances take longer to run or may even overheat under certain circumstances. Equipment failures with subsequent consequences for the production process are the result. Even before a breakdown, power consumption increases due to extended running times. A hand brush should be used to remove heavy soiling, followed by a vacuum cleaner. Using compressed air only spreads dirt. Regular cleaning of the evaporator and condensers (at least twice a year) leads to energy savings of 5 to 10 %. Refrigeration units, e.g. plug-in refrigeration units in grease- or vapour-laden kitchen areas, should be cleaned at shorter intervals (every two to three months). When installing refrigerators or freezers, it is advisable to use models that are equipped with casters or adjustable feet or that can be fitted with these as an option. This allows for easier cleaning even underneath the appliances.

Use refrigeration equipment to its full capacity
Only put cooled and properly packaged food into the refrigerator. This prevents the formation of frost in refrigerators and freezers, which leads to additional energy consumption. Products stored in a refrigerator can be grouped together (consider HACCP). Refrigeration appliances should be used to capacity because when the door is opened, there is less warm outside air that can flow in, leading to higher energy consumption.

Up to 20 % more usable space can be achieved by evaporator systems located outside the interior of refrigerators and freezers and divided into insulated compartments in the machine compartment. In addition, when the doors are opened, the incoming warm air does not directly hit the evaporator surfaces (thus less ice formation, shorter or reduced defrosting times and lower electricity consumption). Door contact switches built into the appliances should also prevent the evaporator fans from continuing to run when the doors are opened, thereby drawing in additional warm air from the kitchens from the evaporator.

Doors should not be left open for long periods. This can be helped if food is put away according to a certain system. Labelling on the doors or signs directly at the storage areas can help.

Unnecessary packaging and empty containers must be removed. Energy savings of up to 20 % are possible. Units that are not needed should be switched off. After switching off, clean the interior of the appliance and leave it open a crack to prevent mould growth.

If larger quantities of food are removed from a freezer or deep-freeze unit, they can be defrosted in the refrigerator or cold room. With clever planning, this can save cooling energy in the refrigerator or cold room.

Switching off refrigerated storage cabinets
If possible, open refrigerated storage cabinets should be closed with glazed doors or glass covers. This has the advantage that they do not need to be defrosted as often and less heat is released into the room air.

Open refrigeration units, such as refrigerated storage cabinets, which are in the shop area or similar, can be covered with roller blinds or foils during sales-free periods and the temperature setpoint can be raised. Consistent covering can save up to a quarter of the energy.

If no goods are to be cooled during non-sales periods, the refrigeration system must be switched off, the interior cleaned and the door left ajar to prevent mould growth.

Adapt cold room lighting to requirements
Lighting in cold rooms and other refrigerated units increases electricity consumption partly through the consumption of the lamp and partly through the heat emitted by the lighting in the refrigerated area, which increases the need for refrigeration. The number of lamps installed should be kept to a minimum. Energy-saving LED lamps are to be used. The lights are operated via a door contact switch that activates when the door is opened.

The light switch at the cold store entrance should indicate the status (light on/off). Even better is an automatic contact that can be switched off when the cold room is entered frequently during peak production. During the rest of the time, the light switches on and off automatically when the door is opened.

Select a convenient location for the condenser
Refrigeration appliances should be placed well away from thermal appliances or other sources of heat. Very often they are found in room niches or warm adjoining rooms due to limited space.

An adequate air supply, preferably cool, and a dust-free environment will ensure the optimal functioning of the condenser. High dust loads in the vicinity of the appliances should be avoided. Lowering the condensing temperature by one degree already achieves energy savings of up to 4 %.

For refrigerators and freezers, adequate heat extraction must be ensured. Separately installed condensers are particularly recommended for centrally cooled appliances and can be located on the shady north side of the building, for example. If generously dimensioned, this achieves additional subcooling of the refrigerant after it leaves the condenser.

If the appliances are located in the basement or in an extension, ventilation elements can provide the necessary air supply. The ventilation elements should be arranged in a location that is as cool as possible and has as little flow as possible (low room temperature). Ventilation elements are e.g. external wall outlets (ventilation slots, louvre windows, door slots) or electric fans with low power. (Observe Ecodesign Directive 2014/1253 for power > 30 W).

Pay attention to defective door seals etc.
Cold losses also occur due to defective thermal insulation, leaky, porous or damaged door seals, floor elements and condensate pipes without a siphon. Leaks also lead to increased icing. Door

frame seals should be replaced if they are brittle or cracked. An increase in power consumption of up to 40 % of the appliances concerned may be possible.

Door seals should be as wide as possible. Grooveless PVC magnetic frame seals prevent thermal bridging and condensation on the door frames and ensure a perfect seal against heat entry, thereby reducing energy consumption.

Examine possibilities for heat recovery

The waste heat given off by the fans to the room air can reach the amount of energy supplied to the compressor by electricity. This waste heat from a cooling unit is suitable, for example, for preheating hot water via a heat exchanger. For each kW of compressor power, about 2.5 kW of heat output can be calculated.

Energy efficiency classes

Since July 2016, there has been a uniform label for commercial refrigerators and freezers. The label makes it possible to compare the useful contents and the climate classes in order to be able to select the optimal appliance for the respective use.

3 Dishwashing technology

Just as the capacity and utilisation of thermal and refrigeration equipment play a decisive role in energy-saving food preparation, general conditions should also be taken into account for dish-washing equipment. In order to avoid energy losses at a later stage, when selecting a commercial dishwasher it is important to take into account the degree of utilisation, operational requirements, number, type and turnover frequency of items to be washed, type of return of items to be washed, planned washing time of the machine and capacity reserve. Attention should also be paid to a high level of intelligence in terms of control and automation process.

Correct equipment selection / purchase

When buying new appliances, pay attention to energy values, water consumption and standby power consumption values. As a rule, appliances that consume less water also require less energy. Fresh-water appliances are preferable for infrequent dishwashing, as they have no standby consumption. In addition, more energy and water can be saved here, as with these appliances only rough pre-washing of the dishes is necessary.

Installation

If possible, connect appliances to the central hot water supply. Do not lower room temperatures excessively by air supply condition. The lower the room temperature and the stronger the air movement or air circulation, the higher the energy consumption. Higher temperatures in turn lead to increased ventilation energy consumption (supply air heating). The temperature specifications of the workplace directive must be observed.

Water quality

In the case of dishwashing appliances, make sure that the water does not cause limescale to build up in the appliance. Limescale deposits impair heat transfer and increase energy consumption. Therefore, if the tap water is hard, suitable water treatment must be carried out to prevent limescale precipitation.

Optimum capacity utilisation of the appliance

The appliance should be optimally utilised by only operating it when it is full. Take into account the storage space for the amount of dishes and the basket systems for the dishes.

Doing a pre-rinse

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The water temperature should not exceed 35 °C during manual pre-rinsing. A good manual pre-rinse avoids multiple rinses and can lead to unnecessary energy consumption even before the rinse cycle in the machine.

Rinse programme selection

Select the rinse programme according to the degree of soiling of the dishes. Especially for lightly soiled dishes, economy programmes or programmes with lower temperatures can be selected. These can result in energy savings of up to 30 %. Always keep the doors of dishwashers closed, especially tank dishwashers, and only open them briefly to avoid energy loss and to prevent food residues from drying.

Clean strainers as often as possible. Appliances, especially tank dishwashers, should be switched off if they are not needed for a longer period of time (e.g. overnight).

Optimise machine settings
Adjust the detergent dosage optimally, follow the manufacturer's dosage recommendation. Especially with low water hardness, the amount of detergent can often be reduced. Reducing the rinse temperatures by approx. 5 K can save 5 - 10 % energy. If necessary, reduce the amount of rinse water in tank dishwashers; this saves energy as well as water and chemicals.

Hot water connection and integrated waste water heat recovery
Dishwashers with low resource consumption can additionally save energy. This is achieved by connecting the dishwasher to the hot water supply and additionally to an integrated waste water heat recovery system. Built-in heat pumps extract heat from the waste air and the room air, which is used to heat the tank. Without a hot-water connection, the appliance requires a higher connected load, as an electric heater must heat the cold water from 10 °C to a rinse temperature of 60 °C.

Energy efficiency classes
For commercial dishwashers, there is currently no classification into energy efficiency classes, as is required for household dishwashers.

4 Commercial beverage equipment

4.1 Coffee machines

The challenge in the coffee machine category is to meet customer requirements in terms of availability of beverage output with optimal energy efficiency.

A significant proportion of energy losses from coffee machines is caused by heat losses from the heating and storage systems in standby operation and by losses from cup or jug heating surfaces.

The larger and more powerful these systems are, and the longer the service readiness must be maintained without beverage preparation, the greater the energy losses.

When planning the demand for a coffee machine, the aim should therefore be to ensure that the performance of the coffee machines is dimensioned according to demand (also taking into account the energy losses) for the respective application in order to avoid both undercapacities and overcapacities.

The appliances should also be kept on standby by the operator only when necessary, according to the respective requirement profile.

Many coffee machines have timer-standby functions and energy-saving modes, with which the coffee machines can be switched off automatically at the end of operation and switched on in good time at the start of operation, in order to avoid unnecessary heat loss.

These functions support the optimisation of energy consumption, taking into account the customer's operating requirements.

It is also important to ensure that the water does not cause limescale to build up in the appliance. Limescale deposits impair heat transfer and increase energy consumption. Therefore, if the tap water is hard, suitable water treatment must be carried out to prevent this.

4.2 Milk coolers

For milk coolers, the recommendations in the section "Refrigeration equipment" apply. Care should be taken to ensure that pre-cooled milk is generally poured in.

4.3 Cup warmer

When using cup warmers, it is also advisable to use timers or time-controlled switchgear. These can be switched off half an hour before the end of operation.

5 Ventilation systems

Ensure maintenance
To ensure that the performance is not reduced by dirty filters, the filters should be cleaned regularly. Filters, heat exchangers, ventilation grilles and air ducts should be serviced regularly (at least twice a year) or at least their condition checked.

Adapt time control
The operating times of the ventilation and the various ventilation stages should always be tailored to the actual demand.

Ventilation systems are controlled by weekly timers, among other things, which may have been running with the same programme since commissioning. In general, the programming should be checked regularly. If technically possible, a presence switch should be installed for short-term commissioning.

Adjust setting
The ventilation system should only supply as much air as is actually needed. Reducing the air volume by 20 % halves the fan output. If less air is needed in the long term, it is much better to let the fan run more slowly than to throttle the air volume. Since 01.01.2016, the use of energy-optimised fans with EC technology has been mandatory, which enable power adjustment through the possibility of control with 0-10 V and thus additionally save electricity.

In existing systems, this can be done by adjusting the pulley diameter on the fan drive, which involves a certain financial expense, but saves energy in the long term and also reduces the noise level.

Cooling at night
In summer, the kitchen spaces can be cooled by operating the ventilation during the night hours, using the storage potential of the enveloping surfaces as a buffer.

Demand-oriented ventilation system
In case of inconsistent usage times, the division of the ventilation system into individual zones should be provided for, which allows for a reduction of the volume flow or full shut-off as needed. Ventilation systems that are not needed should be switched off.

Speed control
The adjustment of the required air volume can be achieved via the fan speed with a frequency inverter or directly with EC fans. In contrast to the usual control via throttle valves, considerable energy savings are possible.

Demand-oriented air volume control
On the market, control systems for kitchen ventilation systems are offered that recognise active emission sources in kitchens and automatically adjust the air volume depending on temperature, humidity and other released particles.
Compared to continuous operation at nominal speed, energy savings of more than 40% are quite feasible.

Using heat recovery
In kitchens, a considerable amount of energy is released all year round via the exhaust air system and emitted into the environment. The waste heat from the cooking process is also available in summer, so energy recovery could also be used to heat domestic hot water. A heat exchanger can recover up to 70 % of the heat.

Note: according to Ecodesign 2014/1253, heat recovery is mandatory for new buildings and renovations.

Use fans with a high degree of efficiency
The Ecodesign Directive 2014/1253/EU stipulates energy-optimised fans. Fans with EC technology are currently common.

Fan walls
In larger ventilation units, belt-driven fans can be ideally replaced by fan walls with a modular array of several small EC fans.

Optimise air duct cross-section
The larger the duct cross-section, the lower the pressure loss and thus also the required fan power.

6 Lighting

Replace lighting products
Replace faulty or older lamps with LED technology. LED replacements are available for most standard light sources without having to replace the socket or luminaire. 1 W LED replaces 5 - 7 W conventional incandescent lamp.

Motion-activated light switches
Rooms and areas that are often frequented only for a short period of time (cold storage rooms, staff toilets) should have an automatic light switch (motion detector) (available from 8 €). In terms of energy, it is worth switching off after just one second. In addition, a motion detector creates ergonomic advantages for the staff.

Daylight adjustment
In areas with daylight, it is often forgotten to switch off the artificial light in the morning. On the one hand, the lamps should be grouped in rows parallel to the window frontage and, on the other hand, it should be possible to switch or dim them manually or automatically according to the lighting conditions. Automatic lighting control for new installations pays off after 3 years, for existing installations much later.

Using daylight
In a new building, the use of daylight must be given due consideration. In existing buildings, windows are often covered because of overheating in summer. With special blinds or cleverly arranged canopies, daylight can be used without the summer heat.

In rooms with dark ceilings and walls, a light coat of paint significantly improves the effect of daylight and artificial light.

Setting up group switching
In a commercial kitchen, it should be possible to switch lighting on and off individually in groups according to use.

Ensure maintenance
Since every light source shows a decline in luminous efficacy (lm/W) over the years, this effect should not be amplified by dirt. Lamps and luminaires should be regularly cleaned for this reason.

Adjust light
If there is too much light for a room or area, individual lamps should be removed. If a lot of light is needed at a seperated workplace, the necessary luminaires should be placed as close as possible.

7 Performance optimisation

In an electricity tariff with power metering, the annual maximum power or the monthly maximum power account for a significant share of the electricity costs. In billing, this is referred to as the power price, stated in €/kW.
The energy supplier measures the 1/4 average values here with a remotely readable meter and charges the consumption in kWh and the highest peak in kW, depending on the tariff. It is essential to avoid unnecessary electricity peaks caused by the simultaneous start-up of large electricity users such as dishwashers, combi steamers and laundry room appliances. This reduces the peak load and thus also the electricity bill.

Take organisational measures
Electricity consumption can be reduced by purely organisational measures. For certain largescale kitchen appliances, operating times are set that prevent bigger electrical consumers from being switched on at the same time. The maximum power peak is used as the basis for assessment if there is a deviation from this regulation even once a year or month.
Interfaces enable the individual appliances to be networked to form a „comprehensive commercial kitchen system". Almost every manufacturer of commercial kitchen technology equips its appliances with an optimisation interface according to DIN 18875 *Equipment for commercial kitchens - Interface for power optimization*, if required.

This enables the use of an energy management system that reduces power peaks and can significantly lower electricity costs without neglecting aspects of hygiene and food safety.
The use of an intelligent load management system does not require any special knowledge about the characteristics and requirements of the electrical catering equipment used in the production process. The manufacturer of such systems takes the thermal properties into account and sets the system to the correct control parameters.
There is no priority list for the switching sequences. The system automatically determines the necessary priorities as required.
A unit list with details of the unit type, number of thermostats/heating circuits and their outputs in kW serves as the basis for this planning.
If required, the ventilation ceiling segments can be linked to the switch-on message of kitchen appliances.
Thanks to targeted further developments, systems are now available with which induction cookers can also be included in the optimisation. This was not possible until now.

The purchase of an energy optimisation system should already be considered when planning a commercial kitchen, as the commercial kitchen equipment must be suitable for it. Retrofitting can make a valuable contribution to reducing energy consumption.

An entry into optimisation technology also makes it possible to purchase an inherently performance-optimised rangeset. Depending on the chosen configuration, the optimisation system can be extended to the entire kitchen.

Not only kitchen technology can be controlled in an energy-optimised way, but also all electrical laundry appliances such as washing machines and dryers, as well as all sauna ovens in the wellness area. Savings of 30 - 50% of the electricity price are possible here.

8 Energy management

Through systematic energy management, the energy flows in the company are constantly controlled and improved.

In the long term, this leads to:
- *Continuous improvement of energy efficiency*
- *Reduction of energy costs*
- *Improving economic efficiency*
- *Ensuring the security of energy supply*
- *Sustainable reduction of CO2 emissions*
- *Raising awareness among employees*
- *Increase data transparency*

ISO 50001 Energy management systems - Requirements with guidance for use defines international standards for an energy management system. The general objective of the standard is to support organisations in setting up systems and processes to improve their energy efficiency. The globally valid standard describes the requirements for an energy management system that enables the operational organisation to continuously improve its energy performance through a systematic approach. At the same time, legal requirements are met and all the organisation's obligations are taken into account.

The goal of energy management is to economically and ecologically optimise the input of energy into the utility energy; from the purchase to the delivery of energy. It comprises the sum of all measures that are planned and implemented to ensure minimum energy use and thus minimum costs for the required use.

8.1 Detect potential energy savings

Savings without investment
Part of the energy-saving potential can be tapped without any investment simply through the conduct of operational staff and decision-makers (e.g. switching off appliances and machines during breaks in operation). Good results can already be achieved by forming "energy teams". These are working groups made up of employees from various departments. This allows energy issues and actions to be coordinated across the company.

Suggestions for energy saving, e.g. within the framework of the in-house employee suggestion system, must receive explicit recognition. In this way, employees develop a high level of awareness for energy efficiency and energy saving.

Energy controlling
The aim of energy controlling is to reduce the energy costs of a business by detecting and eliminating weak points and irregularities in the energy supply.
The basis is the continuous recording of a company's consumption as well as the simultaneous recording of the main parameters influencing energy consumption.

Recommendation for action:
1. Compilation of information on the organisation and technical equipment of the operation.

2. Analyses of the collected consumption data with corresponding known energy indicators in order to establish assessment benchmarks for consumption.
3. Continuous consumption recording and monitoring based on the developed assessment benchmarks.

8.2 Measures for the sustainable reduction of energy costs

Load curve analysis
In the case of power price-dependent electricity contracts, it makes sense to have an analysis of the electrical load profile carried out, which should be repeated as soon as a significant change in the demand structure is suspected (e.g. changes in production). It is advisable to record daily, weekly and, if necessary, monthly load profiles in times of usual production cycles. In most cases, this service is offered by the energy supplier free of charge or at low cost.

A load curve analysis makes it possible to identify short-term electrical power peaks according to size and time. It also illustrates the power consumption outside of operating hours (base load). This also makes it possible to detect electrical consumers that could actually be switched off.

The presentation of the performance data should be in the form of a graph for one day or one week.

Energy purchasing
In addition to measures for rational energy use, efficient energy purchasing is a way to reduce energy costs. Comparisons show that there are sometimes significant price differences for the same purchase quantity and similar load profiles. Furthermore, cost savings can also be realised through the choice of energy source.
Due to the liberalisation of the markets for electricity and natural gas, every company has the freedom to choose its energy supplier. The search for a suitable and reasonably priced supplier as well as the drafting of the contract can be done by the company itself or transferred to third parties.

Should the tender be carried out in-house, the large interconnected companies, most municipal utilities and new providers are eligible as suppliers.

Energy contracting
Energy contracting, or more precisely energy savings contracting, is a contractual agreement for the pre-financing of energy saving measures. It is concluded between an energy user, e.g. a production company, and an energy service provider. The range of tasks of energy contracting includes the planning and construction of energy generation and distribution plants, of systems of measurement and control technology, financing and operation of the plants as well as the delivery and billing of the finished end products (heat, cooling, electricity, compressed air).

The energy service provider makes the investments in energy supply or energy efficiency and allocates the depreciation to the price of the energy supplies. After the contract expires, the energy user benefits entirely from the savings achieved through the investment.

Advantages for the energy user are the saving of upfront financing of sometimes considerable investments, the competence brought in for efficient energy use and the relief from tasks that do not necessarily belong to the user's core competence. Energy contracting is particularly appropriate when the energy user lacks the know-how and financial resources for worthwhile investments.

Load management
In addition to the energy price for the energy used, the company also pays the energy supply company a demand charge for the maximum power used. High power peaks cause the energy costs to rise particularly sharply.

An automatic load management or load shedding system ensures that a predefined consumption within a measuring period - usually 15 minutes - is precisely adhered to and not exceeded under any circumstances. With the help of an optimisation computer, negative influences on the operating process can be prevented. For this purpose, constantly operated consumption devices are briefly switched off and on again at peak load times.

For this purpose, equipment must be available whose use can be shifted from peak load times to times with lower power demand.

Load management has no effect on energy consumption, but serves solely to reduce costs.

8.3 Measures for improved energy use

Heat recovery
With every energy conversion (e.g. electricity to heat), there are losses in the form of waste heat. However, this waste heat has a potential that can be used to save energy. By intelligently combining processes, the necessary supply of primary energy can be reduced.

Heat recovery is possible in many areas, e.g. in refrigeration and ventilation systems. An interesting field is the use of waste heat from production processes. Possible uses include the preheating of combustion air, heat recovery from thermal exhaust air purification processes, refrigeration and the use of waste heat to generate electricity.

Combined heat and power
The principle of combined heat and power appliances is based on the simultaneous generation and use of electricity and heat. With this technology, the fuel used is utilised more effectively than with separate generation. This range of topics is related to building technology.