Existing Office Carbon

A fast track guide to reducing the carbon impact of existing offices

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BDP.

Energy savings in existing offices

In most existing offices there are opportunities to reduce energy consumption considerably through the implementation of a number of low-cost adjustments. BDP have analysed the energy performance of a large number of existing
offices and have noted a common pattern of opportunities to reduce energy demand. The purpose of this document is to highlight the potential to achieve low-cost energy savings and to enable office managers to take direct action where possible to reduce energy bills while retaining the benefits of the savings produced. The document also assists energy managers in planning the building's journey towards a zero carbon future.

The document is divided into two sections. The first covers simple, low-cost opportunities and the second covers opportunities that are more complex or involve higher capital costs.

Energy consultants vs direct action

Most of the advice within this document can be applied directly by a building manager but in some circumstances, it is beneficial to employ a consultant to assist with tracking down opportunities to generate savings and assist in implementing them.

A consultant will typically produce advice for a fixed fee and the building manager can then achieve the full benefit of the resulting savings over the building's future.

Some energy services companies offer to reduce energy bills with no initial cost and to share the savings produced. While this option can seem like an attractive proposal due to the absence of up-front costs, these options sometimes seem too good to be true for a reason. They will typically result in lower long-term cost savings relative to agreeing a fixed sum and taking the full benefit of the energy savings produced.

Claims of special techniques such as the use of advanced AI, secretive energy saving technologies, or patented technologies to produce savings should be treated with caution. Such claims are normally marketing gimmicks and the most significant energy savings in an office are normally achieved through the logical methods described within this guide.

Contracts that are based on shared cost savings also require care to ensure that comfort and air quality are not compromised in the interest of achieving savings. It is also important that the measures implemented do not simply shift costs to other building users or increase maintenance costs.

Top Tips — Simple Changes

Increase the chilled water temperature.

Reduce fresh air supply temperatures.

Reduce the volume of hot water stored.

Adjust time schedules.

Turn off heating when not required.

Reduce the flow temperature of boilers.

Adjust internal air temperature set points seasonally.

Increase the chilled water temperature

In most offices that use chilled water systems, the chilled water temperature is set to 6°C. This temperature is often used as a result of tradition rather than necessity and in a typical office, adequate cooling can often be provided with chilled water at a much higher temperature.

Increasing the chiller flow temperature is the easiest way to reduce cooling energy usage by at least 12% with no capital costs.

Raising the temperature will typically improve the chiller efficiency by at least 2% for every 1°C that the temperature is raised. There are also indirect efficiency improvements because chilled water at 6°C will cause moisture to be removed from the air unnecessarily and there is a significant energy penalty associated with unintended moisture removal.

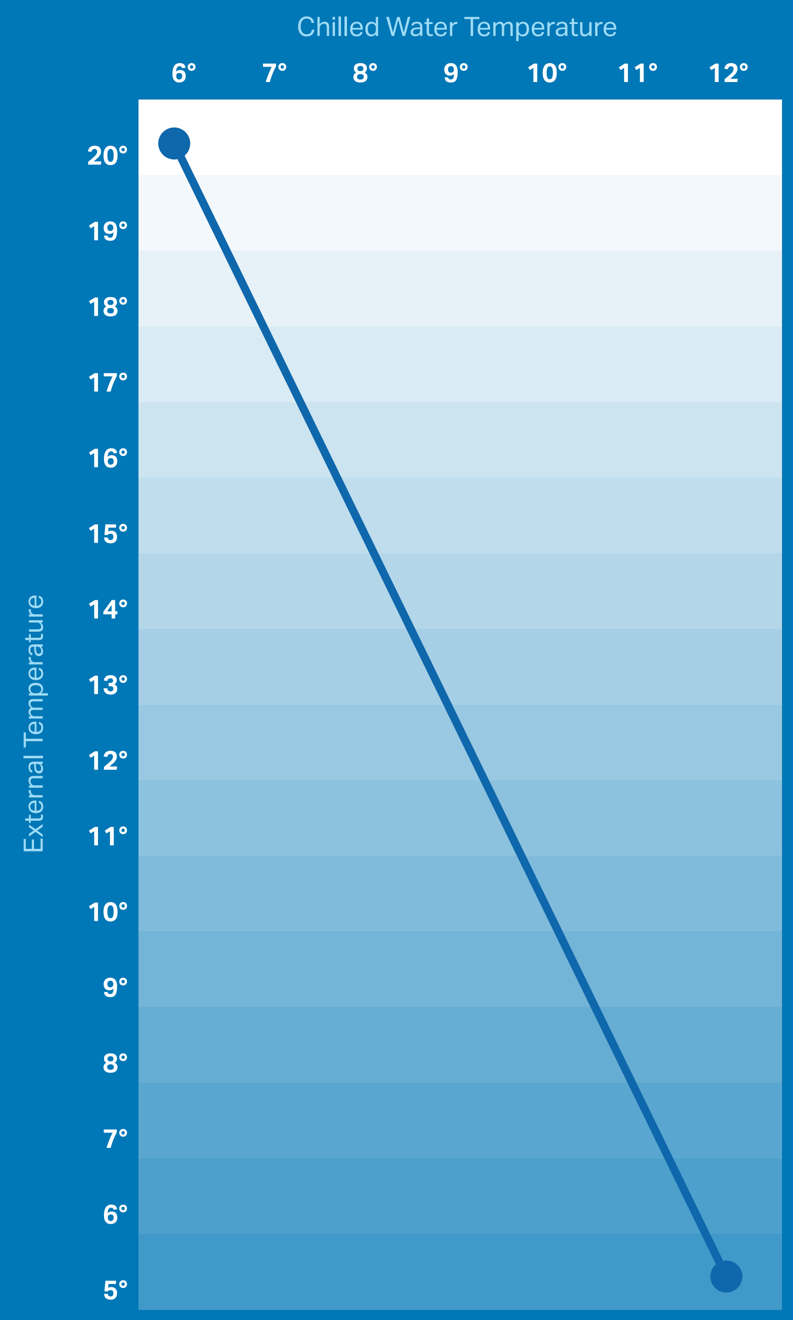
If the temperature is raised too high then there can be side effects such as inadequate chilled water flow or if fan coils are used with variable speed controls, it can force the fan energy to increase. Increasing temperatures to roughly 12°C will however generate a net saving in most buildings.

The change can normally be made directly on the chiller control panel.

As a more advanced feature, it is possible to control the chilled water flow temperature on the BMS and to increase this temperature as the outside temperature reduces.

For example, the controls could be set up as follows:

When the external temperature is above 20°C the chilled water flow temperature shall be 6°C. When the external temperature is below 5°C, the chilled water flow temperature shall be 12°C. Between these temperatures the chilled water shall change in proportion to the external temperature.



Chilled water temperature of **6°C** results from tradition. Increasing the temperatures to at least **12°C** can result in dramatic savings.

Reduce fresh air supply temperatures

Fresh air is typically supplied to offices at a constant temperature all year round. This means that fresh air is often heated before being supplied to an office and is then cooled within the office by the fan coils.

This not only wastes energy heating the fresh air but also misses out on a significant opportunity to provide free cooling from the fresh air supplied.

Simply reducing the fresh air supply temperature is likely to reduce cooling energy demand for most of the year. If the fresh air system is provided with heat recovery, then reducing the temperature in cold weather may result in a loss of heat recovery so it is important to return the temperature to around 19°C in colder weather.

With a small change to the BMS, it can be set to gradually reduce the supply temperature as the external temperature increases or to increase cooling when there is a net cooling load in the building.

It is important though not to actively cool the fresh air unnecessarily, the controls can also be set not to activate any air handling cooling coils if the outside temperature is below 20°C.

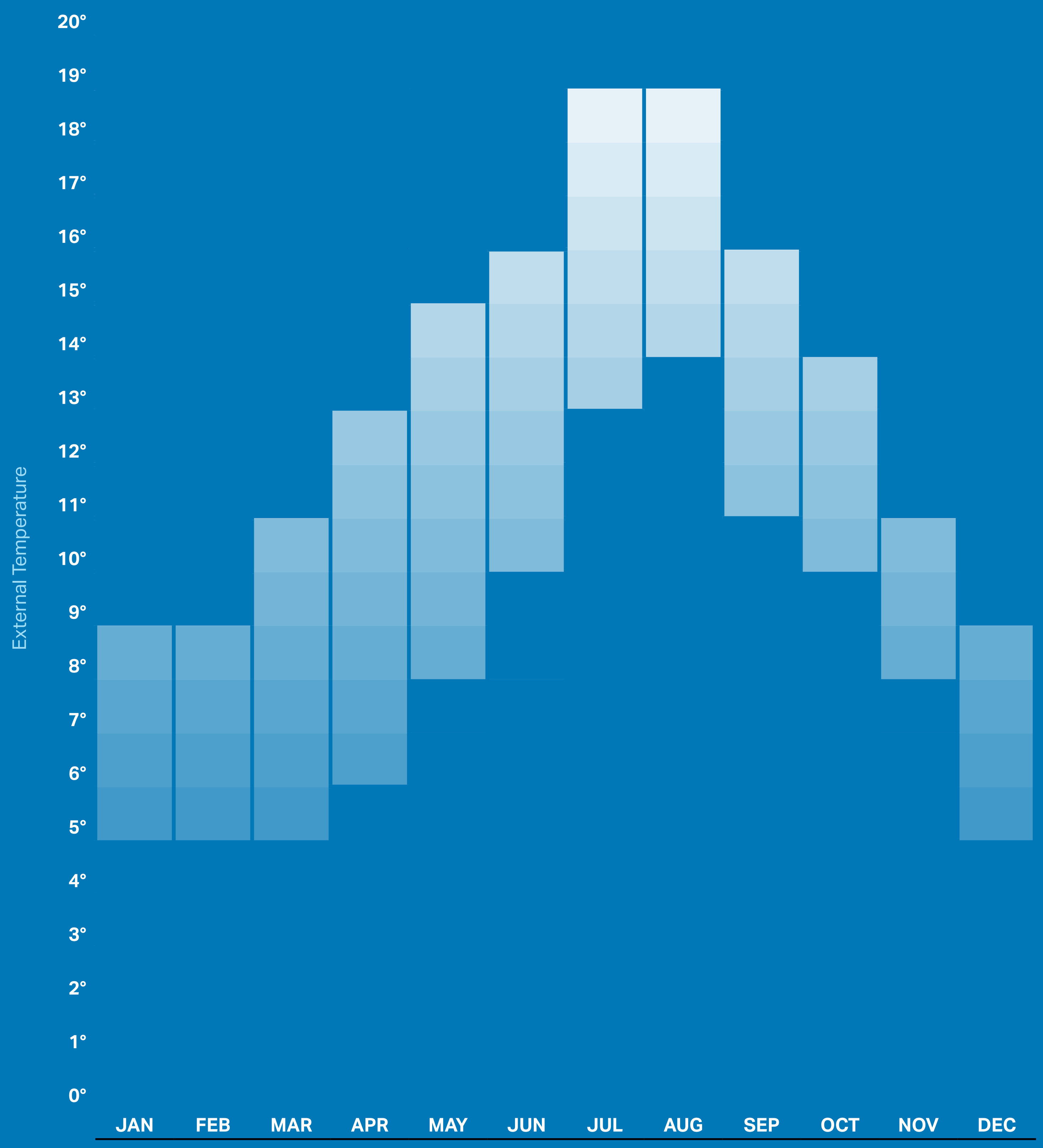
Care is required if the supply air ductwork is not insulated as supplying air at too low a temperature can cause condensation on uninsulated duct surfaces. Delivering air at less than 12°C may also cause draughts if the fresh air is not always delivered to the back of fan coils (where it would be mixed with room air).

Fresh air can also be delivered at external temperatures for a few hours prior to the building being occupied to increase free cooling. If run before 8am, and at reduced fan speeds, the fan energy costs will be very low compared to the pre-cooling benefits.

Domestic hot water

In many offices, domestic hot water storage is oversized dramatically. It is often stored in a number of cylinders, and it is often possible to manually isolate one or more of the cylinders with no affect on the ability to meet the demand. This reduces standing losses from the cylinders.

Average outside temperatures may be below the required room temperature, all year, offering free cooling



Boiler temperatures

If the building is heated with a condensing boiler, then reducing the boiler flow temperature can improve energy efficiency significantly both by improving efficiency of heat generation and by reducing heat losses from pipework etc.

Often boilers are set to generate hot water at 80°C if they also feed domestic hot water systems, but such systems are often oversized and can still operate at lower temperatures.

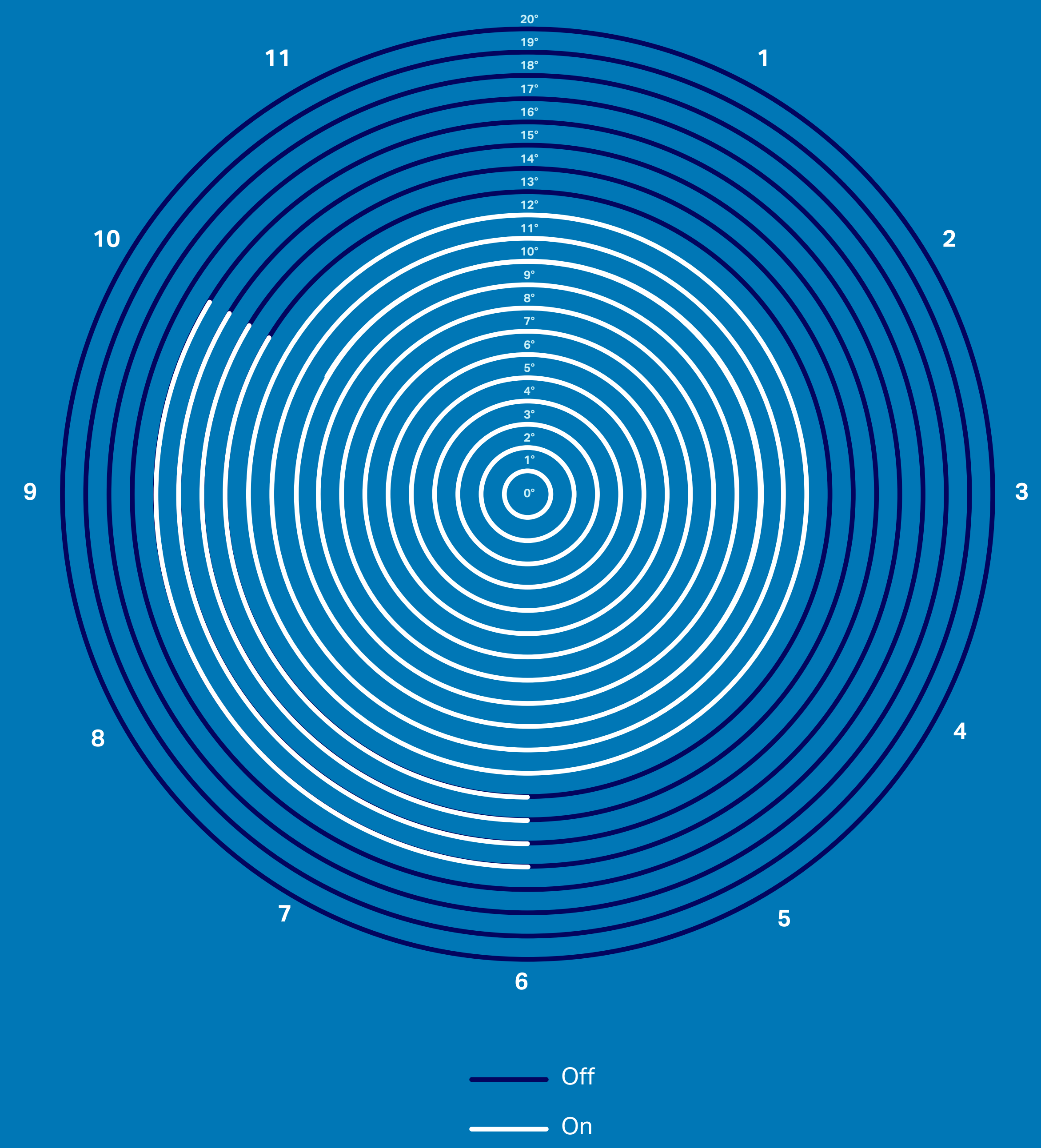
Ideally the BMS would be set to adjust the boiler flow temperature based on the external temperature, so when it is warmer outside, the flow temperature is lower. Where domestic hot water is served by the same boiler, the BMS can be set to prioritise the hot water heating and then revert to the lower temperature required.

Turn off heating when not required

The building heating system and associated pumps should be set to turn off completely during warmer weather. This can be set automatically on the BMS when the external temperature rises above typically 14°C.

Generally, an office may still need heating early in the morning in warmer weather but not later in the day and the BMS can be set with a slightly lower cut off temperature to kick in later in the day. For example:
If the external temperature is above 14°C before 10am or above 13°C after 1pm then turn the heating off.

The outside temperature at which the heating ***'hold off'*** activates can be lower after the initial building heat up period.



Adjust time schedules

Time schedules are often incorrectly set and can call for systems to turn on when not required, e.g., during evenings, nights or weekends. It is important to check what the actual operating hours are and adjust to suit. Some systems like domestic hot water can be turned off a little before the office is vacated as they will continue to provide hot water reliably for some time.

Adjust internal air temperature set points

Offices are often controlled to a set temperature of 21°C. In summer months this can be uncomfortably cool and raising the set point by a few degrees can dramatically reduce the cooling energy required while improving comfort. Ideally the heating controls should contain a "dead band" that heats spaces to 20°C and cools them to 24°C. This use of a dead band also avoids potential scenarios of simultaneous heating and cooling.

Simultaneous heating and cooling can occur if two fan coils within one space are controlled by different temperature sensors and both are trying to control to a precise set point.

Top tips — Advanced Changes

When replacing chillers and pumps, use smaller plant.

Turn on variable speed control for fan coils.

Add VAV to fresh air units.

Add heat recovery to air systems.

Reduce kitchen fan flow rates.

Turn off CHP units.

Introduce natural ventilation.

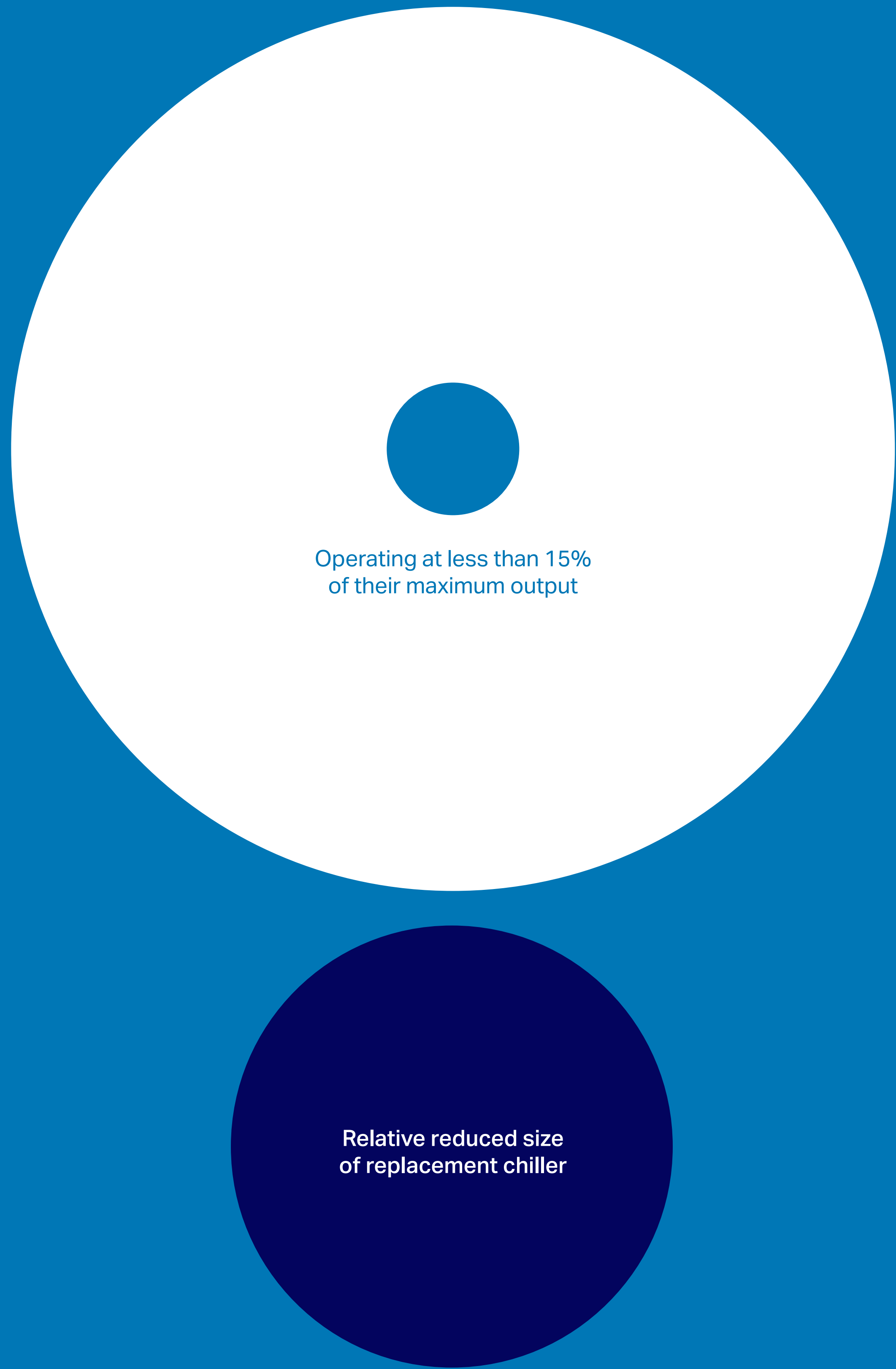
Replacing chillers

When reviewing chillers in existing offices, we regularly note that the chillers are oversized, often by a factor of over 100%. A chiller has a typical life span of 20 years and is often then replaced on a like for like basis. However, in most cases the chiller could be replaced with a much smaller unit and the pumps associated with the chiller could also be replaced with much smaller pumps.

While a slightly oversized chiller can operate more efficiently, most chillers spend the majority of their operational time operating at less than 15% of their maximum output and are very inefficient at that level. The chiller primary pumps are rarely designed to operate at less than 100% of their peak load so there can be significant pump energy wasted through over sizing.

The duty of an existing chiller can be checked in a number of ways on a warm day. Measuring the electrical power into the chiller or measuring the water temperature difference across the chiller over a warm day will give a good indication of the output. The output can also be checked by dividing the capacity of the chiller by the area of the building served. If an output of more than $60W/m^2$ is provided, then it is very likely that the chiller is dramatically oversized.

Often chillers are oversized by a factor of 100%



Enable variable speed control of fan coils

While variable speed fan coils are installed in most offices where fan coils have been installed within the last 15 years, they are almost always set up to operate at a constant speed, missing out on their energy saving potential.

Changing the fan coils to automatically adjust their speed to meet the actual load reduces fan energy and also reduces the noise produced by fan coils. The complexity of enabling variable speed control will vary depending on the installation but most controls suppliers should be able to make the change.

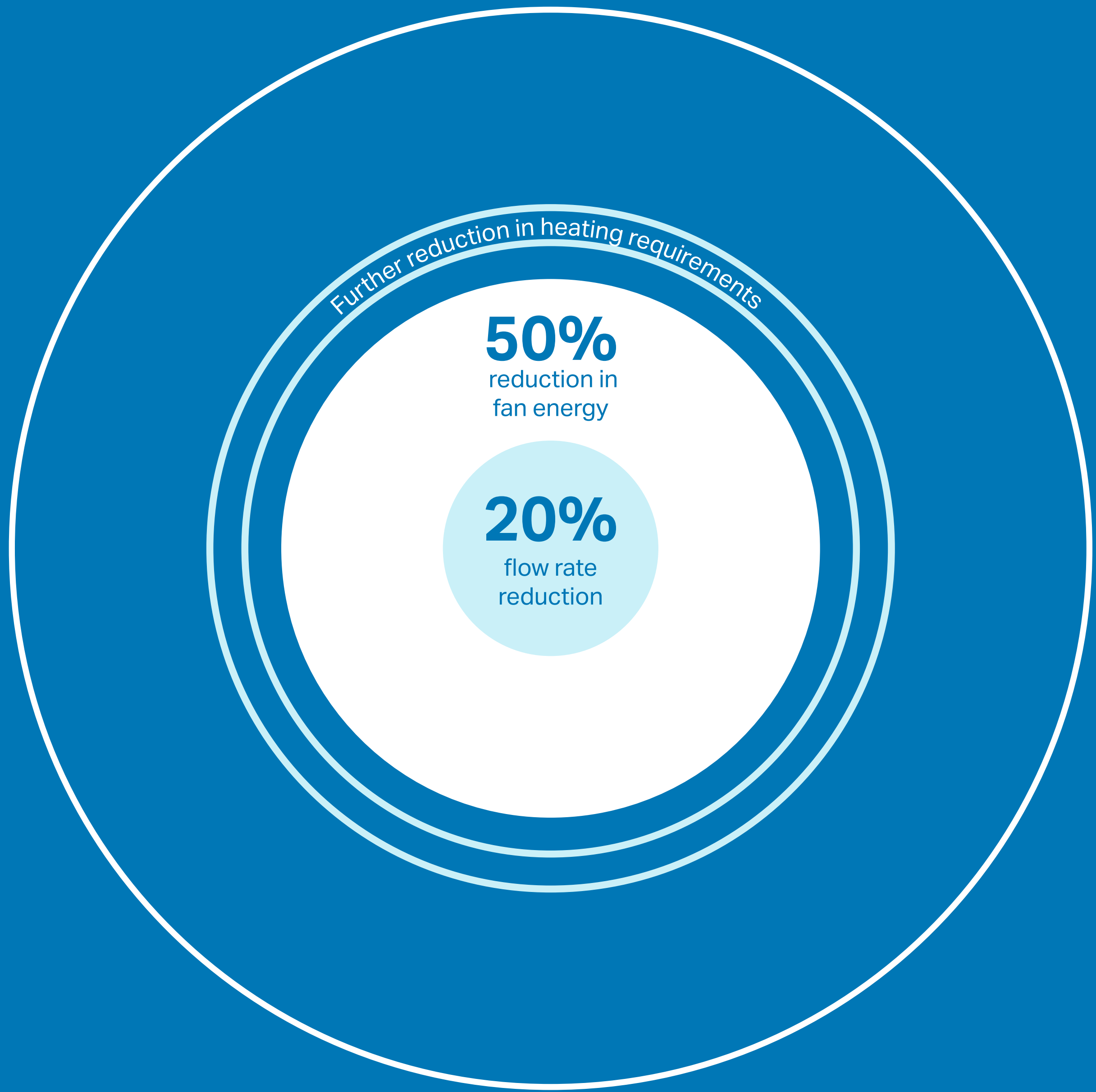
Add Variable Air Volume (VAV) control to fresh air handling units

Where large fresh air handling units are installed, reducing the air flow rates by a small amount can generate significant savings. For example, reducing the air flow rate by 20% can result in a 50% reduction in fan energy in addition to reducing heating requirements. In some offices the amount of air provided is more than required and a simple adjustment can be made.

If the fresh air delivered is more than 10 l/s per person, then it may be possible to reduce the fan speed.

It is possible to install dynamic systems that adjust the air flow rate depending on the number of people in the building, but it can be complex to install such systems in buildings that have not been designed to take advantage of this solution. In particular, care is required if fresh air is delivered directly to meeting rooms, as reducing fresh air volumes centrally could compromise the air volumes delivered to meeting rooms.

Variable Air Volume (VAV) Control



Add heat recovery to air systems

If supply and extract systems are located at the same level and in close proximity, it can be practical to install heat recovery on air systems. If they are separated, for example if the supply is at basement and the extract is at roof level, then it may not be practical, even by using a run-around coil system.

If air handling units contain unnecessary components such as frost coils, it is worth considering removing them to reduce air resistance.

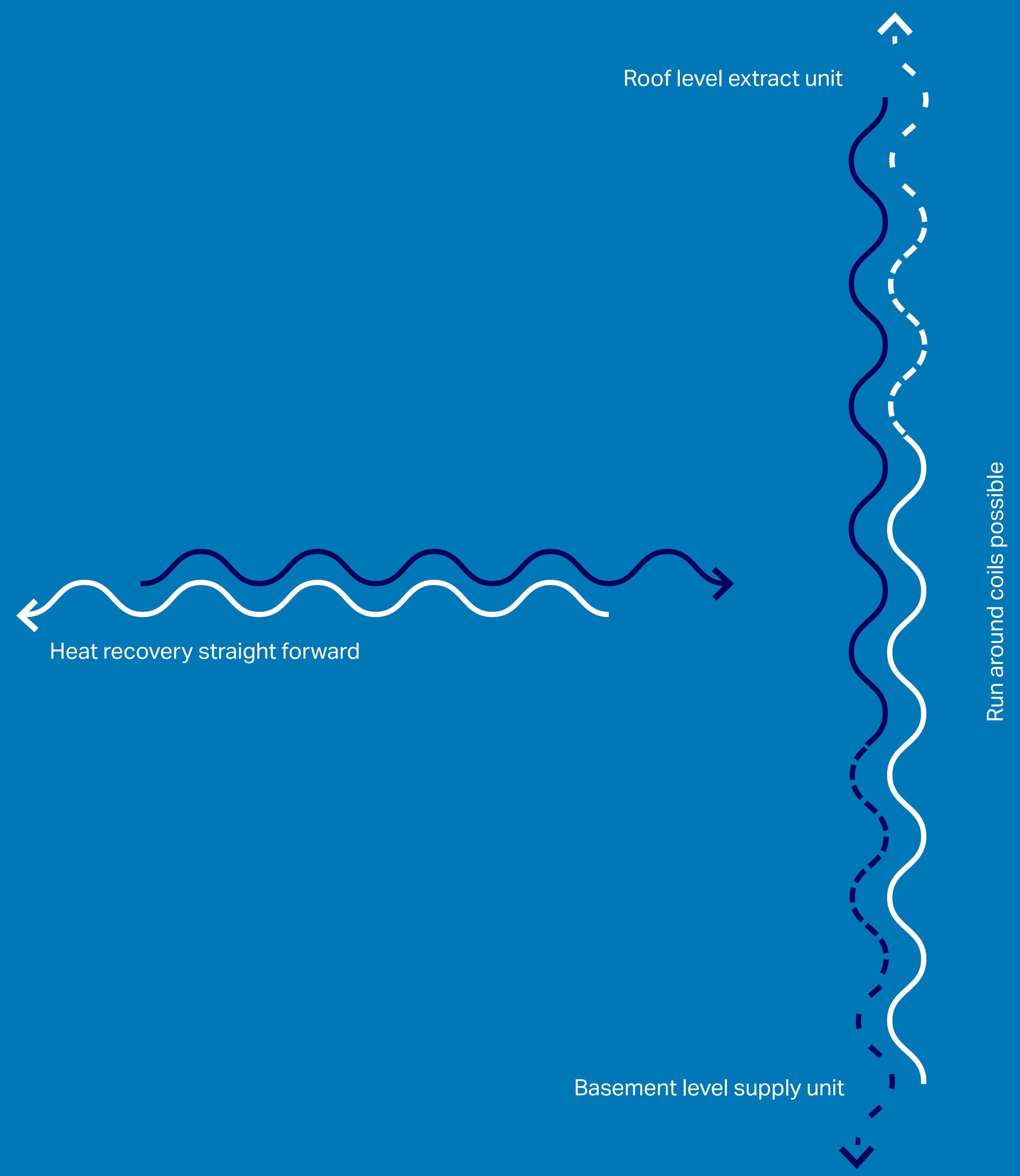
Reduce kitchen ventilation flow rates

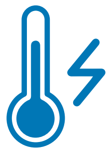
Many commercial kitchen ventilation systems are oversized. In addition to wasting fan energy, considerable energy wastage can occur in heating the air supplied to the kitchen to make up for the high levels of extract.

The calculation method in DW172 can be used to accurately calculate the actual level of extract air flow required based on the kitchen equipment under the canopy. Often engineers simply multiply the area of the canopy by a fixed factor to size it which results in oversized fans.

Reducing flow rates by 20% can reduce fan energy by roughly 50% and will also reduce heating energy required.

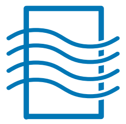
Make sure that the heating system doesn't overheat the supply air to kitchens. Kitchens often benefit from the supply of cool air and lowering temperature set points can significantly reduce the heating energy required.





Turn off CHP units

In the rare case where an office is fitted with a CHP (combined heat and power) unit then simply turning it off is likely to result in environmental and cost savings. CHP units rarely produce savings in office buildings, particularly for countries that have an national electrical grid with a low carbon intensity.



Introduce natural ventilation

In some buildings there are opportunities to introduce free cooling through atrium vents or other openings that can be easily added, for example at the top of stairwells.

These vents can be set to open when temperatures are warm enough not to cause draughts and cool enough to provide free cooling.

This can reduce the load on chillers and can also improve air quality by introducing additional fresh air into the building.

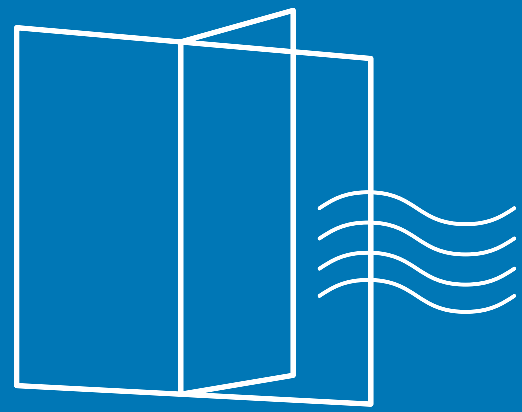
Next steps

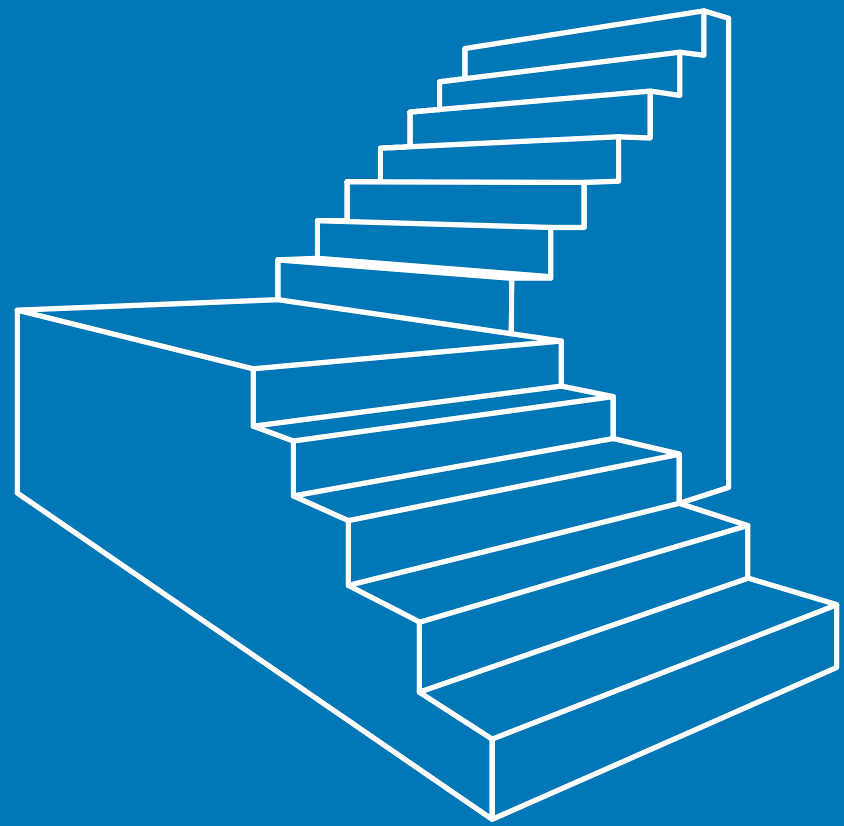
Adding photovoltaic to available roof spaces will normally produce an excellent rate of return but will typically only reduce carbon emissions by less than 10% and often by a much smaller proportion in most offices.

The addressing of energy loads that occur out of hours and the implementation of an environmental IT procurement strategy are important next steps in reducing the carbon impact of offices.

The de-carbonisation of heat by switching from gas or oil boilers to heat pumps is unlikely to result in running cost savings but can significantly reduce the building's carbon emissions.

With the exception of adding photovoltaic panels, these "next step" techniques can introduce complexities, the discussion of which is beyond the scope of this document.





Conclusion:

Implementing a number of these changes can often reduce office system energy usage by over 30% with payback periods of less than a year.

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