



A summary of the “Climate friendly buildings and offices: a practical guide” report

What is a climate friendly building or office?

To be climate friendly, a building or office must seek to measure and reduce emissions created through:

- The **energy supply and distribution** (giving consideration to suppliers e.g. is there potential for on-site supply, lease agreements or metering?);
- The **operation** of the building (controlling peak energy demands, challenging equipment start-up times, understanding energy bills and behaviour issues such as thermal comfort levels);
- **Lighting strategies** (optimising lighting levels, carrying out lighting upgrades and making full use of daylight and exterior lighting);
- **Heating, ventilation, air conditioning and refrigeration** (making effective use of air distribution, chillers and cooling, water distribution, boilers and hot water, motors and insulation);
- The **building envelope** (give consideration draught-proofing doors and external entrances, window enhancements, solar shading, use of high reflectance materials on the exterior, insulation and green roofs);
- **Office equipment** (the use of energy efficient equipment, centralising resources and computer/server rooms); and
- **Refrigerants** (ensuring their management and replacement).

What are the first steps in tackling greenhouse gas emissions?

- 1) An individual should be assigned responsibility for managing and leading any initiative. They must have the support of a senior manager.
- 2) Define the organisation’s current position (an example energy matrix is provided in the full report).¹

- 3) Establish a baseline of energy use by identifying where energy is currently being used and what levels of consumption are. Identify areas for possible savings, ensuring legal requirements e.g. health and safety have been taken into consideration. The UN have produced a Greenhouse Gas Calculator at www.greeningtheblue.org to help in compiling greenhouse gas inventories.
- 4) A system for benchmarking should be established
- 5) Set targets for reducing emissions. All targets must have a baseline year, defined baseline value and a defined period over which the target is to be achieved.

Where are the opportunities for reducing greenhouse gas emissions?

Opportunities for greenhouse gas emission reductions fall into eight main areas:

1. Quick wins
2. Energy supply and distribution
3. Operations and behaviour
4. Lighting
5. Heating, ventilation, air conditioning and refrigeration
6. Building envelope
7. Office equipment
8. Greenhouse gas compounds and refrigerants

Which energy and supply distribution issues should be considered?

- The lease structure with the landlord and options for pursuing a green lease which creates a partnership between the landlord and tenant aimed at reducing the building’s emissions;
- The provision of both mains metering and sub metering to fully understand energy consumption within the building;
- External energy supply which looks at energy tariffs, green power options and rebate programmes; and

¹http://www.greeningtheblue.org/sites/default/files/climate-friendly-buildings-final_0.pdf

- On-site energy supply including combined cycle energy options and renewable energy solutions.

What operational and behavioural changes can facilities managers implement?

- Understanding and close monitoring of energy bills will ensure accuracy. Potentially also leading to costs savings which can be used to fund other measures.
- Finding the optimal temperature for the office will ensure the comfort of those in the building as well as avoiding unnecessary energy use.
- Optimising the use of equipment by minimising start-up load peaking and only running equipment for as long as it is needed.

How can savings be achieved through the provision and use of lighting?

A number of measures can be used to reduce energy usage used for lighting:

- Keep light fittings clean in order to maximise effectiveness,
- Install automatic lighting or ensuring lights can be easily switched off when areas are not in use,
- Maximise day light,
- Reduce excessive lighting; ensuring that the level of lighting is appropriate to the area is covers, and
- Upgrade to low energy light fittings each time it becomes necessary to change bulbs.

What about heating, ventilation, air conditioning and refrigeration?

The main point to consider with most appliances in this category is that they must be well maintained and correctly programmed. This is true of water chillers, boilers, heating systems, thermostats, building management systems (BMS) and motors. Ensuring good air distribution will help to achieve even temperatures throughout the office. Air economisers can also be useful in reducing the start-up energy needed for heating and cooling systems.

What areas should be considered when trying to make savings from the building envelope?

Doors and windows should be well insulated to retain cool air in warm climates and prevent heat loss in colder ones. Window films which allow in sunlight but reduce heat gain can be useful in warmer climates. Make full use of natural

ventilation and external building envelope treatments such as solar reflective surfaces.

How can office equipment be used more sustainably?

Sustainable use of office equipment can be achieved by ensuring that equipment is powered down when not in use. Centralising and networking equipment reduces the number of items needed. Using energy efficient equipment and taking measures to ensure server rooms and data centres are as efficient as possible will all make equipment operate more sustainably.

How should greenhouse gas compounds and refrigerants be managed?

Maintaining correct refrigerant charge levels is important to ensure equipment runs effectively with the lowest energy use necessary. Replacing inefficient refrigeration equipment can contribute to energy efficiency and greenhouse gas emission reductions.

What about the fact that UN buildings are so diverse?

The ideas covered in this summary provide a guide to the types of measures which are available. With so many diverse buildings making up the UN, facilities managers are advised to reference the full report which provides a guide as to which measures to consider and prioritise based on office type, location and occupation. See figure 4.2 - Decision Matrix for Selection of Applicable Measures.

What needs to be considered before greenhouse gas reduction measures can be implemented?

The identified improvement measures will need to be prioritised against the respective UN organization's criteria such as cost, greenhouse gas reduction potential, overall environmental improvement and practicality. The 'no cost' items can be implemented immediately, however many of the other measures will involve some form of investment. Also give consideration to:

- Legal compliance with health and safety
- Financial evaluation
- In what order the measures should be prioritised
- Are there any barriers presented by tenancy agreements?

For further information please read the full report: [Climate friendly buildings and offices - a practical guide.](#)

Action Checklists

TOP 10 QUICK WINS	<input checked="" type="checkbox"/>
1) Turn off lights when rooms are unoccupied or daylight levels are good;	
2) Activate screensavers on all computing equipment	
3) Maximise day lighting in the office whilst providing the ability to control glare and heating e.g. the use of blinds	
4) Turn off electrical items at the plug socket and eliminate phantom electricity consumption due to stand-by modes	
5) Change the current thermostat settings—consider increasing the temperature by 1oC in summer and reducing by 1oC in winter	
6) Eliminate draughts from windows and doors	
7) Ensure equipment and systems are not operating during periods of non activity e.g. night time and weekends;	
8) Establish procurement policies to only purchase energy efficient equipment	
9) Ensure vents, grilles and radiators are not blocked or obstructed	
10) Ensure regular and routine maintenance and inspections are undertaken	

ENERGY SUPPLY AND DISTRIBUTION - LEASE NEGOTIATIONS	<input checked="" type="checkbox"/>
Meet with landlord to review the UN's carbon neutral aspirations and the intent of this Guide. Compile relevant information and data for discussion with the landlord including the current office lease, utility bills of the last 12 – 24 months and any energy audit findings (such as the results of implementing this Guide).	
With this information, negotiations can be started with the landlord about the existing lease and opportunities for collaborating on energy efficiency and low carbon measures.	
More information on green leases can be found in Section 4.3 of http://www.greeningtheblue.org/sites/default/files/climate-friendly-buildings-final_0.pdf	
When searching for new offices to lease if moving or opening a new office, specify from the outset that an energy efficient building is a top priority for the UN. Enquire about the energy efficiency measures that have been carried out to the building already and gather historical energy use for comparison. Discuss green lease options with prospective landlords from the beginning.	

ENERGY SUPPLY AND DISTRIBUTION - MAIN OFFICE METERING	<input checked="" type="checkbox"/>
Investigate existing lease arrangements in terms of energy bill payment, and also whether a dedicated energy meter for the UN office exists.	
Where the energy costs are all directly covered by the landlord, engage with the landlord with a view allowing the UN to be directly responsible for these bills, and where no meters exists, engage with the landlord to get appropriate main metering installed. Either scenario may mean the lease may need to be renegotiated.	
Where new metering is needed, or existing meters can be replaced, consider smart meters, which allow consumption to be measured automatically and at different times of the day.	
For UN offices that do receive and pay their own energy bills, find out from the landlord whether these bills include for the provision of heated/cooled air. For many office buildings, this item is not covered by tenancy metering and is typically under the landlord's control.	
If heated/cooled air is not separately metered, discuss with the landlord how this data specific to the UN office's consumption may be generated or extrapolated.	

ENERGY SUPPLY AND DISTRIBUTION - SUB-METERING	<input checked="" type="checkbox"/>
An office energy audit and feasibility study should be undertaken before a metering system is designed to identify the main priority areas for installing meters. This will allow the compilation of key energy consuming systems and items.	

Preliminary energy data may be obtained if necessary to support the activities in point 1 above through the use of hand-held portable instruments.	
Once key energy consuming systems and areas have been identified, an energy sub-metering plan should be developed. The local utility company or an energy consultant could be used to support in this.	
The more frequent the meter measures and collects data, the better the analysis of the data, therefore smart energy meters with on-board data logging capability, which are automated and can measure at different times of the day, should be considered.	
Typical office features to be considered for sub-metering include individual floors, as well as the heating/cooling system, lighting, IT and data centre rooms and hot water heating systems.	

ENERGY SUPPLY AND DISTRIBUTION - ENERGY TARIFFS	<input checked="" type="checkbox"/>
Determine if this measure is applicable by researching the local energy markets to determine if they are deregulated.	
Compile energy bills for a minimum of the prior two years for benchmarking purposes.	
Determine from bills or existing supplier the night-time and off-peak consumption, and peak level consumption. If this information is not readily available, take meter readings at the end of the day and first thing the following morning to determine the night-time consumption.	
Assess forecasts of energy consumption and costs for the coming year using benchmarking data.	
Obtain quotes from existing and competitor energy suppliers - this can be done quickly by consulting price comparison sites, or going to the websites of alternative energy suppliers. Energy consultants can also be engaged to support if appropriate.	
If a cheaper deal can be found elsewhere, switch supplier as soon as possible subject to existing contractual obligations. Existing contracts can often only be finished early with the payment of a penalty charge and this needs taking into consideration.	

ENERGY SUPPLY AND DISTRIBUTION - GREEN POWER	<input checked="" type="checkbox"/>
Determine if this measure is applicable by researching the local energy markets to determine if they are deregulated and energy providers offer green power options.	
Compile energy bills for the last two years and generate energy consumption figures.	
Assess forecasts of energy consumption and costs for the coming year.	
Select the amount of green power to be purchased (as a percentage of total consumption), and if important to the UN organisation, select the energy source of preference (e.g. wind, solar etc).	
Research green power providers and ensure their credibility and robustness can be verified.	
Obtain quotations for green power options, and select green power provider.	

ENERGY SUPPLY AND DISTRIBUTION - UTILITY REBATE PROGRAMMES	<input checked="" type="checkbox"/>
Research of local Government, regional/federal and utility supplier programmes and eligibility of the UN organisation. To find out what incentives are available, contact the local energy and utility providers, as well as Government departments.	
The types of programmes that could be considered include: <ul style="list-style-type: none"> • Investment subsidies: the authorities refund part of the cost of installation of the system. • Feed-in tariffs/net metering: the electricity utility buys electricity from the producer (assuming the office has • An on-site energy source) under a multiyear contract at a guaranteed rate. • Renewable Energy Certificates (RECs): a green energy provider is credited with one REC for every 1,000 • kWh or 1 MWh of electricity it produces. • Smart meters: an economical way of measuring this information, allowing price setting agencies to introduce different prices for consumption based on the time of day and the season. 	

If a suitable scheme is identified, and the eligibility of the UN is confirmed, make a relevant application.	
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ENERGY SUPPLY AND DISTRIBUTION - CO-GENERATION	<input checked="" type="checkbox"/>
Evaluate the current generator together with fuel availability for potential for conversion or need for full replacement. Then establish demand and energy use profile and model the generator hour fuel and maintenance costs for running existing generators.	
Determine constraints that may exist relating to the longer use of equipment such as duty cycle, the need for parallel switching, the lack of ventilation or noise impacts.	
Determine detailed electricity consumption, electricity rate tariff and actual cost for the past two years, including peak and off-peak usage and power factor, and whether incentives are available from the local utility company.	
Analyse and model the demand patterns to quantify the electricity and heat that will be supplied by cogeneration cycle and the amount that will require topping up from grid power or other sources.	
Develop the co-generation cycle business case.	

ENERGY SUPPLY AND DISTRIBUTION - RENEWABLE ENERGY	<input checked="" type="checkbox"/>
Identify availability of space (e.g. roof areas) for potential renewables and determine whether any structural upgrades may be needed to support the renewables, as well as potential lease constraints.	
Research the office's climatic position and the weather profiles such as sun and wind that may support consideration of renewable energy options.	
Compile an inventory of energy loads for the office and current and historical electricity demand profiles, or hot water needs.	
Research of regional/national incentive or rebate programs for renewable energy generation on site.	
Research of renewable energy retailers and any leasing programs offered.	
Identify potential suppliers and develop business case model for installation.	

OPERATIONS AND BEHAVIOUR – UNDERSTANDING ENERGY BILLS	<input checked="" type="checkbox"/>
Ensure that the office has an energy meter in place and the UN is paying its own energy bills directly	
Begin taking actual meter readings for the office manually on at least a monthly basis.	
Clarify the energy tariffs that apply to the office	
Compare the manually recorded meter readings to the actual bills and check for accuracy and errors.	
It is recommended that an employee is designated to be the custodian of all energy data and to take meter readings for comparison with invoices.	

OPERATIONS AND BEHAVIOUR – THERMAL COMFORT SETTINGS	<input checked="" type="checkbox"/>
Confirm that the thermostats are working (see HVAC-01a) and that the set temperature (that set on the thermostat) and the ambient temperature (actual room temperature) are within 2-3 oC.	
Establish minimum agreed cooling temperatures and maximum space heating temperatures (see Rules of Thumb above). Local or international best practice standards could be used to help determine these levels e.g. ASHRAE standards.	
Once the acceptable temperature ranges are established, ensure that the office controls and performance can meet these standards.	
Ensure that a suitable 'dead band' of around 3oC is in place between systems operating in heating and then cooling mode to allow for opportunities for free air cooling (OPS-03c).	

Where individual zone or room thermostats are present, ensure that they are set to the same temperatures to prevent simultaneous heating and cooling in adjacent rooms.	
Ensure any changes to current operating practices are implemented slowly e.g. 0.5 oC at a time, to ensure occupant satisfaction.	

OPERATIONS AND BEHAVIOUR – MINIMISE LOAD PEAKING	<input checked="" type="checkbox"/>
Compile a list of the start-up procedures and equipment, and assess the starting currents.	
Obtain a copy of the tariff structure applicable to the office in order to recognise the peak and off-peak times and associated costs	
Stagger the start up schedule of equipment with large starting currents such as air conditioning, electric space heating and master lighting. If a building management system is available, utilise this to schedule the start ups.	
Reduce the use of master lighting during peak energy demand hours, as these peak hours normally occur when daylight can be most effectively utilised.	
Investigate the potential for shedding other loads during peak demand hours and shift it to off-peak hours if needed.	
Install alarms/triggers to notify when the current demand is close to maximum demand.	
An option may be to stagger shifts or using flexible work schedules to empty offices during energy peaks.	

OPERATIONS AND BEHAVIOUR – EQUIPMENT OPERATION TIMES	<input checked="" type="checkbox"/>
Compile an office use profile to understand when occupants start and finish, as well as different shifts and out-of-hours activities.	
Assess and review seasonal climatic conditions and how this will affect cooling, heating and lighting needs.	
With this information, a schedule can be established with daily, weekly, weekend and holiday operating times. This schedule should challenge the current equipment operating times.	
Once this has been established, it may then also be possible to adjust the schedule and further refine on and off times. For example the refinement could be based on assessing at the end of the day the timing for turning off the heating/cooling system but allowing the fans to continue operating to see how long it takes to become uncomfortable for occupants.	
Consider using after-hours manual override, where after-hours work is sometimes required.	
Challenge the operating hours in conjunction with the operating temperatures through the use of thermostat controls	
Consider free cooling in order to take advantage of external temperatures.	

LIGHTING – REFLECTANCE	<input checked="" type="checkbox"/>
Obtain specification documents for the existing light fixtures from the manufacturer or supplier, and before cleaning the light fixtures, consult the manufacturer's data sheet.	
Establish a good maintenance and cleaning schedule for the lighting system and implement before undertaking any of the other lighting measures.	
The cleaning regime should comprise frequent dusting and regular fixture cleaning by removing the bulbs from their fixtures and wiping using a lint-free cloth. Tubes and fittings should be handled with care as they can be quite brittle.	
Replace darkened light fixture diffusers and old yellow fittings, which waste a large fraction of lighting energy, with reflector (mirrored) fittings.	
When replacing lamps, select lamps that do not collect dirt rapidly and can be cleaned easily.	
To further maximise light distribution, consideration should also be given to painting walls in light colours to maximise reflectance.	
Obtain specification documents for the existing light fixtures from the manufacturer or supplier, and before cleaning the light fixtures, consult the manufacturer's data sheet.	

LIGHTING – REDUCE EXCESSIVE LIGHTING	<input checked="" type="checkbox"/>
<p>Prepare a summary of occupancy by area of the office and lighting expectations. This is important as lighting should be task-focussed. A uniformly lit room may not be appropriately lit for individual tasks being performed within. If necessary, research the required levels of illumination required per task, area and occupancy level.</p>	
<p>In parallel, prepare an inventory of the number and type of current lighting fixtures per room/area (include details on the type of lamps, ballasts and wiring configurations). Also determine the associated lighting levels(using a light meter) to identify areas which are over-illuminated.</p>	
<p>Develop a reduced lighting plan focussing on removing unnecessary light fittings in over-illuminated areas such as near windows or where minimal light is needed such as non-critical or non-occupied areas. Fluorescent bulbs should always be removed in pairs. In four-tube fixtures, remove either the outer pair or the inner pair. If all the tubes are removed from one fluorescent fixture, disconnect the ballast as well because, if switched on, it will continue to use electricity even if the sockets are empty.</p>	
<p>Where necessary, consider lowering background lighting levels and providing local task lighting as required for individual desks. Task lighting has the benefit of only being used when the occupant is in the office, and that large areas do not need to be illuminated.</p>	

LIGHTING – LIGHTING CONTROLS	<input checked="" type="checkbox"/>
<p>Compile an inventory of current methods of lighting control including master switches, rocker switches, dimmer switches, timers etc, and understand current lighting circuits.</p>	
<p>Compile data on light usage per room based upon average occupancy, activities performed and the timings of occupancy (overlaps with requirements of LIG-01b). This information should be used for lighting zoning patterns which will then form the basis for the installation of sensors.</p>	
<p>Determine the form of lighting switch to be used for different zones such as occupancy sensors for areas of intermittent occupancy, timer switches for open plan offices, daylight sensors for day lit areas (see LIG-03) and push button switches for intermittent use areas. Note that some types of lighting are not well suited to controls e.g. occupancy sensors with HID (high intensity discharge) lighting.</p>	
<p>Timer switches are particularly effective in shared open plan spaces where it is difficult to assign individual responsibilities for switching off lights.</p>	

LIGHTING – DAYLIGHTING	<input checked="" type="checkbox"/>
<p>Compile an office layout defining windows, doors, atriums and other sources of incoming daylight.</p>	
<p>Based upon these layout plans, a daylighting strategy should be developed focussed on reducing artificial lighting in areas with available daylight through a combination of the following measures:</p> <ul style="list-style-type: none"> • The use of dimmer or dual level controls and photo-sensor switches. Re-wiring may be required. • Ensure blinds and curtains needed to shield from direct sunlight are open in the morning to avoid unnecessary • use of artificial lighting (see ENV-06). • Paint walls in light colours to maximise reflectance, and consider the use of light shelves for allowing light • Penetration further into the office space (light shelves should be located above eye level and have a highly • Reflective upper surface.) • Installation of skylights or sun pipes (sealed for summer). • Consider office layout changes to optimise the use of daylight and avoid glare from direct sunlight, and changing partition materials to transparent or glazed materials. 	

LIGHTING UPGRADES - LAMPS	<input checked="" type="checkbox"/>
Compile an inventory of current methods of lighting lamps and fixtures.	
Identify available replacement lamp options based on current ceiling grid pattern and associated costs. Develop a re-lamping strategy such as replacing T12 with T8 or replacing T8 with T5, or if maximum efficiency is desired, replace existing lamps with LED equivalents.	
When specifying a fluorescent lighting system, always specify electronic ballasts and retrofit all magnetic ballasts with electronic ballasts.	
When replacing existing fittings always ensure that automatic lighting level controls are installed based on occupancy and daylight levels	

LIGHTING UPGRADES - BALLASTS	<input checked="" type="checkbox"/>
Determine if the existing fluorescent lamps have low or high frequency ballasts. As a general rule, T12 lamps will typically be using magnetic ballasts and T8 and below will be using electronic ballasts. Note LED lamps do not require ballasts.	
Consider the selection of the ballast based upon an appropriate lamp-ballast system and the relative ballast factor.	
The aim should be that all occupied spaces with fluorescent lamps have high frequency electronic ballasts.	
Consideration should be given to a phasing programme of replacement.	

LIGHTING UPGRADES – EMERGENCY LIGHTING	<input checked="" type="checkbox"/>
Determine the location of all emergency and exit signs in the office.	
Compile an inventory of the types and ratings of lamps used in the current exit signs.	
Develop a replacement plan for substituting all lamps with LED equivalents.	
Factors to consider when purchasing new LED exit signs include: colour of sign (green or red), battery backup, location and placement, applicable state and local building codes, appropriate casing material for application, and number of faces (single or double).	

LIGHTING UPGRADES – DOWN-LIGHTING	<input checked="" type="checkbox"/>
Compile an inventory of recessed down-lights in the office and their function.	
Look at the options available for using CFLs or LEDs to replace incandescent lamps based upon their function and use.	
For applications requiring high-wattage incandescent or halogen lamps, consider metal halide down-lights, especially the new high colour quality ceramic metal halide lamps. There are also some LEDs that can meet these requirements.	
When replacing incandescent down lights, take note of the following: <ul style="list-style-type: none"> Go for a 3:1 wattage ratio. Lamp manufacturers publish a 4:1 ratio for replacing incandescent bulbs with CFLs (that is, a 25-W CFL can replace a 100-W incandescent lamp) but practice has shown that a 3:1 ratio is more appropriate (a 25-W CFL can replace a 75-W incandescent lamp). Due to the wide range of sizes and shapes, limit the range of CFL types used in the office and this will be useful to standardise and also to reduce stocking requirements and eliminate any confusion during re-lamping. 	

LIGHTING – EXTERIOR LIGHTING	<input checked="" type="checkbox"/>
Prepare an inventory of existing exterior lighting fixtures, current and required operational hours, and the areas of use.	
Undertake an exterior lighting survey and implement a re-lamping strategy for exterior lights.	
Control and manage the use of exterior lighting including the following:	

<ul style="list-style-type: none"> Automatically activate exterior lights precisely at sunset using timers or sensors (ensure lights are not operational in hours of daylight). Use stepped ballast and lamp systems for all exterior lighting applications, reducing light to the minimum necessary intensity to serve the function of the space it serves. Combine occupancy-based and photosensitive control when occupancy is detected and it is dark. Install panel-based astronomic clocks to turn exterior lighting on and off based on calculated seasonal sunrise/ sunset changes. Two types of energy-efficient high-intensity discharge lighting are widely available for exterior use: high-pressure sodium (HPS) lights and metal halide lights. LEDs are also emerging with some fixtures incorporating photo-voltaics and battery storage. 	
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CONTROLS – THERMOSTATS	<input checked="" type="checkbox"/>
Compile the layout of the office that shows the air duct design, location of coolers and exhaust systems. Compile data of the operational requirements of the office such as number of occupants, design data on air change rates, temperature and humidity requirements	
From this information and based on the office zoning, the requirement for thermostats in each functional zone can be determined.	
Select the appropriate type of thermostat required—examples include standard digital, programmable, remote controlled, heating and cooling anticipators and remote temperature sensors.	
When locating and positioning thermostats, the optimum location is on a partition wall approximately 1.5m from the floor in a location with freely circulating air. Avoid placing them where they can be influenced such as near to radiators, in direct sunlight or near to air discharge grills.	
Ensure the thermostats are appropriately linked to the systems they are intended to influence (so either direct to the AHU, or to the BMS).	
For existing thermostats, check and calibrate that they are working, including that the set temperature (that set on the thermostat) and ambient temperature (actual room temperature) are within 2-3 degrees.	

LIGHTING – BUILDING MANAGEMENT SYSTEMS (BMS)	<input checked="" type="checkbox"/>
As a general guide, the use of a BMS should only be considered for larger office space, and offices where the UN has full system control.	
Consult with a number of suppliers and/or an energy consultant to determine the type and scope of a BMS to be installed including which systems to be controlled.	
In reviewing BMS options, it is important to consider the three main BMS functions of monitoring, controlling and reporting.	
As a general guide, the use of a BMS should only be considered for larger office space, and offices where the UN has full system control.	
Consult with a number of suppliers and/or an energy consultant to determine the type and scope of a BMS to be installed including which systems to be controlled.	

AIR DISTRIBUTION – AIR BALENCING	<input checked="" type="checkbox"/>
It is recommended that the design requirements are established, and collated against actual performance data to verify that the design requirements are being met e.g. electricity, temperature, flow rates, HVAC commissioning records (such as design temperatures and flow rate) etc. From this exercise potential areas of concern could be identified.	
Simple air balance diagnostics can be performed by holding out a hand in office spaces to feel air flow and temperature and gain feedback from office users.	
For a fully tested air balance, a specialised HVAC contractor will be required to balance the airflow in an HVAC system, and to implement to changes identified as necessary. Modelling of	

the system on HVAC software may be required at times.

AIR DISTRIBUTION - OBSTRUCTIONS	<input checked="" type="checkbox"/>
The office as-built drawings should be studied in order to determine the location of all air outlets, diffusers and outlets.	
Inspect each of these identified locations and ensure there are no direct blockages or obstructions and that sufficient space exists to allow for air movement and flow.	
Temperature distribution monitoring might also assist in determining whether indoor air characteristics are as designed.	
Remove obstructions to ensure that air flow and distribution is not impeded.	

AIR BALENCING – FILTER CLEANING & UPGRADES	<input checked="" type="checkbox"/>
Identify and locate all main filters within the HVAC system.	
Consult equipment O&M manuals and supplier recommendations to ensure that the recommended inspection (at least monthly) cleaning and replacement cycles are being followed (typically filters are changed on pressure drop or based upon a prescribed schedule).	
Existing filters should be checked to ensure that they are the correct size and inspected for damage. The taking of differential pressure-drop readings can help in determining when a filter may need replacing.	
During maintenance and cleaning, check that the air filter fits properly and tightly.	
When replacing filters, look to upgrade with extended surface area filters which have a lower initial pressure drop and higher filter efficiency. It is recommended that all filters be replaced at the same time.	
Be aware of activities external to the office that may require that filters be changed more regularly (for example construction projects nearby creating dust in the vicinity of the office).	

AIR DISTRIBUTION – ELIMINATE DUCTWORK LEAKS	<input checked="" type="checkbox"/>
A routine ductwork inspection plan should be developed and implemented.	
As a first step, look for evidence of potential duct air losses such as higher than usual energy bills, difficulty in heating/cooling areas or stuffy/uncomfortable rooms.	
Review as-built HVAC drawings to identify ducting routes and dimensions, accessibility and potential problem areas. Areas with flex ducting should be a priority due to possible disconnection or damage. Also look at insulation integrity.	
The use of a professional contractor is recommended for identifying and eliminating HVAC ductwork leaks. The use of several different instruments could be used for leak detection, the operation of which will require a suitable level of proficiency.	
Ad hoc leak elimination can be performed by a technician or person with a reasonable understanding of the system operation, however this activity will only address obvious problems.	
Repair or replace damaged ducts or leaks. Air flow tests can be performed after sealing repairs.	

AIR BALENCING – HEAT EXCHANGE COILS	<input checked="" type="checkbox"/>
Identify all air-side heat exchange coil locations and maintenance and cleaning requirements from the O&M manuals, as well as any associated pressure-drop monitoring needs.	
Review the facility maintenance schedule to establish existing practices.	
Prepare visual inspection reports and then survey to establish the extent of fouling and scope for improvement.	
Implement required cleaning activities for fouled heat exchange coils, and examine route-cause of the fouling.	
The best strategy is to prevent coils from becoming dirty in the first place through regular maintenance and cleaning.	

AIR DISTRIBUTION – DAMPER BLADES AND LINKAGES	<input checked="" type="checkbox"/>
All louvers and dampers should be checked for freedom of movement. Shafts, bearings, pivot points, etc. should be cleaned and lubricated with a light spray oil.	
Blades should be checked in the closed position to ensure tight closure. Adjustments should be made at linkage to correct any misalignment.	
Blades should be checked for freedom of movement. Blades should be disconnected from their operators and manually checked. (Blades should move freely with no binding or twisting.)	
Pins, straps and bushings should be checked for wear, corrosion or rust. Replace or paint as required.	
Check louver or damper blade edge and seals (where applicable).	
Check all linkage, connecting bars and operator connections for proper alignment and fit.	
Check overall installation to ensure that the louver or damper was installed in a plumb and square position and proper clearance has been allowed for blade, linkage and operator movement.	

AIR DISTRIBUTION - FANS	<input checked="" type="checkbox"/>
With respect to maintenance, follow established preventative-maintenance protocols for cleaning housings and fan blades, lubricating and checking seals, adjusting belts, checking bearings and structural members and tracking vibrations.	
Vibration analysis is a good predictive maintenance practice on large fans. Vibration signatures are compared to previous readings for indications of component degradation such as worn bearings, shaft alignment or fan blade imbalance.	
For VAV systems, determine whether the existing fans have control, and if not investigate the possibility of implementing fan speed control through variable frequency drives (VFD).	

AIR DISTRIBUTION – SUPPLY AIR TEMPERATURE RESET	<input checked="" type="checkbox"/>
Establish the occupancy and operational schedule to determine where and when specific areas within the air-conditioned area are occupied. Establish the associated design and measured data (if available) of supply and ambient temperature of the office for the different zones.	
Establish what controls are already in place for the HVAC system and the viability of adding in the required supply air temperature reset controls, which require direct digital control (DDC) sensors in the discharge air and space sensors to provide space temperature feedback. The control algorithm will look for the warmest (or coolest) zone and adjust the supply-air temperature accordingly.	

AIR DISTRIBUTION – VARIABLE AIR VOLUME	<input checked="" type="checkbox"/>
Historical data relating to the operational requirements of the building occupants is required for zoning purposes, and to understand where the most demand exists.	
The changing of constant volume systems to VAV is a significant undertaking and therefore a thorough feasibility study of cost and design impacts must be considered.	
The VAV system must be designed so that it will deliver the required amount of outdoor air to each space it serves not only under the conditions that prevail on the cooling design day, but under the full range of weather and load conditions that can be expected, and under the range of space ventilation rates and system airflows that the system will deliver to meet those loads.	
The design should consider reducing the static pressure set point to the minimum required to deliver air to remote outlets.	

AIR ECONOMISER – FREE COOLING	<input checked="" type="checkbox"/>
Develop a building occupant schedule and associated weather and external temperature profile to determine when pre-cooling / pre-heating opportunities exist.	
Air Economiser / Free Cooling: Ensure the office has an economy cycle — a large fresh air intake, spill/relief air outlet and a damper.	
In the summer months, use cooler morning air prior to office start up times to reduce subsequent artificial cooling requirements. In addition, the building could be pre-cooled during off-peak hours using thermal storage e.g. ice storage to reduce the peak load on the chiller water plant.	
In winter months ensure the external damper is closed during morning warm-up to ensure warm air from internal heat gains is circulated prior to the commencement of space heating. Minimum fresh air will need to be brought in during occupied hours.	
This approach can also be applied during the daytime when the ambient air is at an appropriate temperature to mean that cooling or heating systems need not operate.	

CHILLERS AND COOLING – WATER SYSTEM MAINTAINANCE & TREATMENT	<input checked="" type="checkbox"/>
The office's HVAC water distributions systems should be understood and mapped through as-built drawings and O&M Manuals. Examples of such water systems include chilled, heating and condenser water.	
Routine maintenance must be undertaken following O&M Manual guidance, which as a minimum should include: <ul style="list-style-type: none"> • Adequate water treatment following supplier recommendations, and water filtering; • Inspection of insulation to eliminate energy losses; • Cleaning of condensers; • Valve inspections for noises which may suggest over-pressurisation and system imbalance; • Pump efficiency testing and associated differential pressure set-points; and • Leak inspections (which can be through meter readings). 	
The office's HVAC water distributions systems should be understood and mapped through as-built drawings and O&M Manuals. Examples of such water systems include chilled, heating and condenser water.	

CHILLERS AND COOLING – CHILLER MAINTAINANCE	<input checked="" type="checkbox"/>
Review existing O&M plan, manuals and logbooks of the chillers.	
Undertake required annual, monthly and weekly checks and maintenance tasks such as keeping logs of operating performance, checking starter and controls, operating pressures, refrigeration charges and compressor inspections.	
Follow manufacturer's guidelines for testing such as oil (for destructive acids), oil filter (for metal deposits) and the refrigerant (for moisture, acid or rust).	
The correct refrigerant charges should also be assessed.	
Where problems are identified, implement the recommended remedial measures as per the manufacturer's guidelines and the O&M manual.	

CHILLERS AND COOLING – WATER-SIDE ECONOMISERS	<input checked="" type="checkbox"/>
Determine the cooling energy load and with the daily, weekly and seasonal demand patterns and the operational hours of the office building.	
Undertake an audit to determine the current cooling infrastructure in place and the process used in the office.	
If it is identified that chilled water currently meets the cooling requirements for the office building, or the building has significant cooling limitations from air side economisers, undertake a feasibility study to identify potential benefits and savings that can be achieved from the installation of water-side economisers. A key issue with a water-based free-cooling system is	

calculating the peak cooling load and sizing.	
If water-side economisers are implemented to meet cooling requirements, ensure that the current O&M plans for the HVAC system reviewed to incorporate the O&M of the economisers.	

CHILLERS AND COOLING – CHILLED WATER RESET	<input checked="" type="checkbox"/>
Establish the occupancy and operational schedule and the associated loadings, as well as the external year round conditions such as temperature and humidity in order to identify opportune periods for implementation of this measure.	
The simplest and cheapest method is to reset the chilled water temperature manually at the chiller control panel. A table of chilled water settings will need to be developed and followed as this approach will require constant change and amendments of the temperature to suit occupancy and external conditions.	
The alternative to manually making the changes is to utilise a direct digital control (DDC) to automatically control the reset temperature.	
Establish the occupancy and operational schedule and the associated loadings, as well as the external year round conditions such as temperature and humidity in order to identify opportune periods for implementation of this measure.	

CHILLERS AND COOLING – COOLING TOWERS	<input checked="" type="checkbox"/>
Assess the cooling tower maintenance and inspection needs based upon the O&M Manuals.	
Ensure an appropriate maintenance strategy is implemented that considers issues such as: <ul style="list-style-type: none"> • Water treatment (for both biological growth control and avoidance of scaling); and • Nozzle cleaning and moving parts. 	
Consider and investigate the opportunities for a condenser water reset strategy—the aim would be to balance the water temperature at optimal levels, ideally the temperature set point of the water leaving the cooling tower being as low as possible.	
Where possible, cooling towers should be operated simultaneously to rely on natural draft (i.e. no use of fans) to reduce energy consumption.	
Fans should be checked for efficiency performance (see HVAC-02g for suitable guidance) and also be upgraded where required to optimise performance.	

CHILLERS AND COOLING – VARIABLE PRIMARY FLOW	<input checked="" type="checkbox"/>
Conversion of existing systems to primary variable flow requires specialist technical expertise to review viability of existing systems to be upgraded. Consideration would need to be given to a number of factors including: <ul style="list-style-type: none"> • Replacement of AHU valves to ensure tight closure; • Removal of balancing valves that do not serve as isolation or service valves; • Interlock primary pumps to run with chillers they serve; • Variable frequency drives on pumps; • Installation of a check valve in the decoupler connecting the chilled-water supply and return mains to prevent return water from mixing with supply water; • Revision of the chiller control panel including temperature reset points; and • Linkages to cooling tower fan operations. 	

CHILLERS AND COOLING – CHILLER RETROFIT	<input checked="" type="checkbox"/>
Chillers and Cooling — Chiller Retrofit: Chiller retrofit is a specialist field where chiller suppliers and manufacturers will need to be consulted. Some of the retrofit measures that could be considered (either collectively or in isolation) include: <ul style="list-style-type: none"> • The addition of variable speed drives to centrifugal chillers; • Modernise the controls and add automation to help manage issues such as the limitation 	

<p>of chiller demand, reset chilled water temperature (see HVAC-04d), time of day start/stop mechanism (OPS-03b), optimise load sequencing based on load conditions and identify maintenance needs based on chiller performance.</p> <ul style="list-style-type: none"> Retrofitting the chiller with a new compressor-motor driveline will maintain the current heat exchanger shells. 	
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BOILERS AND HEATING – DOMESTIC HOT WATER		<input checked="" type="checkbox"/>
<p>Assess the current office hot water needs in terms of:</p> <ul style="list-style-type: none"> The volume consumed; The temperature it is delivered at; and The availability of hot water during the day, and throughout the year. 		
<p>By assessing these, consideration should be given to options to reduce energy requirements including:</p> <ul style="list-style-type: none"> Not providing hot water in the Summer time to hand basins; Install water flow restrictors and aerators which can help reduce energy; Deliver water at lower temperatures (note that due to health risks such as <i>Legionella</i>, optimum temperatures for water storage tanks is 60-65oC, and for instantaneous hot water is 50oC); and Consideration of the time of day hot water is provided. 		
<p>In addition, the heating source of the hot water should be assessed, and where hot water is supplied by a main boiler and/or centralised plant, consider substitution with smaller dedicated water heaters or the use of solar water heaters</p>		
<p>The loss of heat through along the system should also be addressed through the proper use of insulation.</p>		

BOILERS AND HEATING – BOILER MAINTAINANCE		<input checked="" type="checkbox"/>
<p>Obtain boiler fuel consumption and demand over a 12 month period and observe performance trends for boiler usage.</p>		
<p>Obtain boiler O&M manuals and observe manufacturer/supplier maintenance procedures.</p>		
<p>Obtain boiler maintenance records and operating log sheets.</p>		
<p>Boiler maintenance should focus on optimising the combustion and boiler house efficiency through minimising excess air and burner tuning.</p>		
<p>The program developed should typically cover testing, inspection and maintenance of the boiler plant.</p>		

BOILERS AND HEATING – DEMAND NEEDS		<input checked="" type="checkbox"/>
<p>Determine the seasonal cycles relevant to the office’s location and identify periods where external temperatures and conditions where main space heating is not required.</p>		
<p>Identify during these periods what heating is required such as for domestic hot water or dehumidification.</p>		
<p>Look at the installation of controls such as TRV and ensure they are properly installed.</p>		
<p>Review and assess opportunities for alternative heating approaches during these periods including possible decentralisation.</p>		
<p>Assess the business case for installation.</p>		

BOILERS AND HEATING – HOT WATER RESET		<input checked="" type="checkbox"/>
<p>Determine the boiler and heating loads and map against the seasonal cycles relevant to the office’s location. The temperature requirements for the heating loads will vary considerably according to the outdoor temperature.</p>		
<p>A manually operated control programme can be installed where the boiler controls are manually</p>		

adjusted in response to environmental conditions.	
For greater savings, automatic controls can be installed which will ensure maximum energy savings. A reset control is a device that automatically controls the boiler water temperature according to a software program based on outdoor temperature.	
Installing a three-way mixing valve that is controlled by an outside temperature sensor is also an effective way to reset the hot water temperature. The valve mixes return water with the higher water temperatures to reach the desired hot water supply temperature.	

BOILERS AND HEATING – INSULATION	<input checked="" type="checkbox"/>
Undertake an insulation audit of the HVAC system to confirm that the “as built” drawings and identify where pipes, tanks and ducts require insulation. Where heat is noted emanating from equipment, this is typically a sign of inadequate insulation.	
All ductwork should be sealed before insulating it.	
Undertake an insulation strategy for the office and implement it.	

BOILERS AND HEATING – SHUT OFF FLUE DAMPER	<input checked="" type="checkbox"/>
Obtain boiler fuel and maintenance costs and operational schedule.	
Obtain the existing operational and maintenance manual and logbooks of the boilers	
Two common types of vent dampers available are electromechanical and thermo-mechanical. The electromechanical vent damper is coupled with the fuel valve while the thermo-mechanical vent dampers open and close according to the temperature rise and fall.	
Vent dampers are usually installed in the flue pipe between the heating unit and the stack and are also referred to as stack dampers.	
Select and install based upon advice from heating/boiler experts.	

BOILERS AND HEATING – OXYGEN TRIMMING	<input checked="" type="checkbox"/>
Compile an inventory of the number of boilers, their locations and their fuel costs.	
Review the existing operational and maintenance manual and logbooks of the boilers.	
Increased and unnecessary amounts of excess air can occur because of: <ul style="list-style-type: none"> • Control system defects; • Variations in boiler room temperature, pressure, and relative humidity; • Lack of burner maintenance; and • Variation in fuel composition. 	
Incorporate an oxygen trim system to optimise fuel to air ratio. These systems monitor excess oxygen in the flue gas stack and adjust the air intake to the burners accordingly.	
Liaise and work with the boiler manufacturer together with the installation of a gas analyser in the stack will optimise and monitor fuel-to-air ratio. Incorporation of a carbon monoxide trim loop together with the gas analyser will ensure that incomplete combustion does not take place due to a lack of air.	
Installation of a controller should be considered to monitor oxygen in exit gas to optimise excess air.	

BOILERS AND HEATING - ECONOMISER	<input checked="" type="checkbox"/>
Obtain boiler fuel and maintenance costs and operational schedule.	
Determine the existing operational and maintenance manual and logbooks of the boilers.	
Stack economisers recover some of the heat from the flue gases in the stack for pre-heating water.	
Stack economisers should be considered as an efficiency measure only when large amounts of make-up water are currently used.	
Economisers must be sized for the volume of flue gas, its temperature, the maximum pressure	

drop allowed through the stack, the fuel type used in the boiler, and the demand for energy recovery.	
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MOTORS	<input checked="" type="checkbox"/>
Upkeep and cleaning of motors should be routinely undertaken and include: <ul style="list-style-type: none"> • Lubrication of parts such as the bearings; • ensuring cooling vents are cleaned regularly; and • Checking alignment of motor couplings and alignment and tension of belts and pulleys. 	
Replacement—suitable professional advice should be sought to consider: <ul style="list-style-type: none"> • Appropriate sizing; and • Replacement rather than rewind. 	
Consider retrofit options including inverter drives.	

BUILDING ENVELOPE – DOORS AND ENTRANCES	<input checked="" type="checkbox"/>
Where the UN is a tenant and its offices have direct outside access through main doors, the lease should be reviewed and landlord engaged to determine whether permission would be needed to alter/change doors and entrances.	
Consideration could be given to installing windbreakers near exterior doors to block prevailing winds.	
Subject to space constraints, vestibules or revolving doors could be installed at the main building entrance to prevent the infiltration of cold air and drafts. Revolving doors provide an air lock to reduce heating/cooling losses. In smaller offices with doors straight to the outside, door closer mechanisms should be installed.	
Optimise or minimise use stack effect in high rise buildings depending on the climatic zone of the building.	
Replacing single glazing with double glazing in doors will cut the door's heat loss in half. Glass or "patio" doors, especially sliding glass doors, lose heat much faster than other types of doors because glass is a very poor insulator. Install a thermal break which is a plastic insulator between inner and outer parts of the metal frames to prevent heat loss .	

BUILDING ENVELOPE – DRAFT PROOFING	<input checked="" type="checkbox"/>
For offices where the UN is a tenant, the lease should be reviewed and landlord engaged to determine whether permission would be needed to undertake draught-proofing.	
Test for air tightness, which can be done by visual inspection or by room pressurisation which requires sealing of ducts and main doors. Asking occupants/users to report discomfort can also help in identifying leaks/gaps.	
Use caulk, backer rods, gasketing and weather-stripping to close cracks, openings and gaps.	
Common areas of air leakage include: <ul style="list-style-type: none"> • Drafty windows and doors, roof or basement doors or hatch. • Holes or chases that lead down into the building from the roof and leads up into the building from the basement. • Air leaks through gaps around plumbing, electrical penetrations, bathroom and fan vents. • Air leaks around recessed lights. 	
Checking and repairing caulk should become part the maintenance plan for the building undertaken every year.	
Windows, doors, skylights can gain and lose heat in the following ways: <ul style="list-style-type: none"> • Direct conduction through the glass or glazing, frame, and/or door. • The radiation of heat into the building (typically from the sun) and out of the building from room-temperature, objects, such as people, furniture, and interior walls. • Air leakage through and around them. 	
For offices where the UN is a tenant, the lease should be reviewed and landlord engaged to determine whether permission would be needed to undertake draught-proofing.	

BUILDING ENVELOPE – WINDOW FILMS	<input checked="" type="checkbox"/>
For offices where the UN is a tenant, the lease should be reviewed and landlord engaged to determine whether permission would be granted for installing window films.	
Understand local climate and solar data, the office's orientation and how/when direct sunlight shines on windows.	
Determine the existing window and physical fenestration specifications.	
Research and investigate solar film suppliers and work with them to define the appropriate specification to suit the office's needs.	
It may be necessary to evaluate whether particular window surfaces are well-suited to, and will benefit sufficiently from, the installation of films, by virtue of either location or physical construction.	

BUILDING ENVELOPE – GLAZING OPTIONS	<input checked="" type="checkbox"/>
For offices where the UN is a tenant, the lease should be reviewed and landlord engaged to determine whether permission would be granted for window upgrades.	
Compile a list of the number of windows in the office per floor and room, including their current form of glazing, their condition and their orientation. Single glazed windows should be considered for upgrading, as well as windows which are subjected to strong sunlight at certain times of the day and year. The weather patterns should be an important consideration.	
Undertake cost benefit analysis to replace identified existing windows with double/triple glazed windows. Windows should be chosen based upon their insulation (R-value) and heat transfer (U-value) properties, visible light transmittance (VT) and emissivity.	
If full window replacement is not viable or practical, consider the installation of secondary glazing, which will not affect the structural integrity of the main windows, or the use of DIY insulation films.	
As well as the glazing, other considerations include the air leakage (AL) of the window unit (the lower the better) and the window frame materials, where fibreglass, vinyl or wood should be chosen over aluminium/metal frames.	

BUILDING ENVELOPE – NATURAL VENTILATION	<input checked="" type="checkbox"/>
<p>Natural Ventilation: Have a good understanding of the existing natural ventilation scheme in the office including:</p> <ul style="list-style-type: none"> • The façade type and depth of floor plate (some offices will not be suitable). • Room layouts, current open pathways for air, and external openings such as windows, louvers and doors. • External features such as landscaping and weather patterns. 	
<p>Office layout and surroundings. Some useful considerations include:</p> <ul style="list-style-type: none"> • Ensuring unobstructed ventilation corridors. • Ensuring sufficient external openings such as windows and doors. • Ensuring the active participation of the office occupants. • External ambient air conditions (to determine what time of day and year natural ventilation could be used). • External factors such as shading and vegetation (to direct winds). • Factors which may negatively affect the use of natural ventilation such as external noise or pollution. 	
Ensure that mechanical systems are switched off when natural ventilation is being used.	

BUILDING ENVELOPE – SOLAR SHADING	<input checked="" type="checkbox"/>
Understand the specific solar angles and intensities throughout the year applicable to the	

office's location.	
Restricting direct sunlight into a building is the most effective manner in which to inhibit solar heat gain, whether by internal or external means.	
Internal measures include the use of internal blinds or curtains and are applicable to all offices.	
External shading requirements, which will depend upon the level of control the UN has for the office, may comprise one or a combination of the following: <ul style="list-style-type: none"> • External louvres, overhangs and awnings. • Shutters, external roller blinds and even vegetation may all classify as forms of solar shading. • Conversion of some windows to insulated spandrels. 	
The colour of the materials is also important to maximise reflectance.	

BUILDING ENVELOPE – SOLAR REFLECTIVE SURFACES	<input checked="" type="checkbox"/>
For offices where the UN is a tenant, the lease should be reviewed and landlord engaged to determine whether permission would be granted for this measure, or whether the landlord will implement it.	
Determine the annual office temperature profile and electricity consumption and compare with the local climate trends (cooling and heating degree days).	
Determine the existing roof materials and their solar reflectivity.	
It may be necessary to evaluate whether particular roofing surfaces are physically suitable for repainting, or whether complete replacement would be preferred.	
Consider the solar reflective roof solution to be applied such as membrane coating, paint or roof gardens	

BUILDING ENVELOPE - INSULATION	<input checked="" type="checkbox"/>
Compile an inventory of current insulation types and where they are located in the office.	
Compile an inventory of the equipment space that requires insulation, and link with 1. above. A rough indication is to feel the temperature of a ceiling/roof, wall or floor on a hot or cold day. If the surface feels much warmer or colder than the inside air, then take a look at the insulation to determine whether it is sufficient.	
Gather climatic condition data such as heating degree days (HDD) and cooling degree days (CDD).	
Undertake an insulation audit of the office and undertake the implementation of an insulation strategy for the office, which should consider the following: <ul style="list-style-type: none"> • Insulation of the ceiling spaces and roofs • Insulation of walls and spandrel panels • Insulation of floors above unconditioned space or car-park areas • Replacement of thermal bridges such as metal window frames. 	
Assess the right type of insulation needed including its performance (R-value).	

BUILDING ENVELOPE – GREEN ROOFS	<input checked="" type="checkbox"/>
For offices where the UN is a tenant, the lease should be reviewed and landlord engaged to determine whether permission would be granted for this measure, or whether the landlord will implement it.	
Identify possible roof areas suitable for green roofs. A structural evaluation will be required to determine whether a building will be able to support the additional green roof load.	
If a green roof solution is to be considered, expertise should be sought in terms of the design based upon the amenity and energy efficiency requirements. Key considerations should include: <ul style="list-style-type: none"> • The local climate and what vegetation this can support. • The vegetation to be used (e.g. grasses, shrubs etc.) • The depth of soil. • The irrigation and drainage needs. 	

- Associated maintenance requirements.

OFFICE EQUIPMENT – EQUIPMENT SETTINGS



- Determine existing switching arrangements through discussion with facilities and office staff.
- Ensure that all auxiliary equipment is energy compliant and where possible includes off switches rather than standby modes.
- Switch off equipment during non-working hours either by manual shut down or by standby power down.
- Increase awareness of employees to efficiently use and reduce operating hours of auxiliary equipment.
- Determine if smart power strips are cost effective to install. If it is, plug all office equipment into occupancy sensor power strip that can turn off equipment if employees leave the room for more than a few minutes.
- Establish standard default settings for all equipment such as:
 - Use of screensavers and timings of stand-by activation.
 - Computer screen brightness levels.
 - Power-down timings and automatic switch-off times.
- Ensure that all equipment is maintained and if faults are identified, corrective actions are taken.
- Many employees have individual extra heaters, fans, humidifiers or air filters. This extra equipment consumes significant amount of energy and are signs of problematic ventilation systems. Undertake a walk through audit to determine if employees use this type of equipment.

OFFICE EQUIPMENT – EQUIPMENT CENTRALISATION



- Compile an inventory of all equipment than can be connected to the local network such as printers, scanners, copiers and computers
- Consult the IT manager (or external IT support) and obtain a quote to implement local area network (LAN) connected systems rather than each employee having their own equipment.
- Install a LAN system to connect one or two copiers and printers that are centrally located in “islands” on each floor to cater for all printing and copying needs of the employees.
- Ensure that all IT and computing equipment is of the most energy efficient type and that they have automatic shut down or sleep modes.
- When replacing equipment, purchase equipment with a seven-day clock that allows programming to allow the equipment to be turned off at the end of each work day and on weekends.
- In larger offices, where dedicated copier and printing rooms are established, localised cooling requirements can be delivered to these rooms rather than general office cooling to compensate.

OFFICE EQUIPMENT – ENERGY EFFICIENCY EQUIPMENT



- Compile an inventory of all equipment in the office.
- Research the relevant energy efficiency labelling schemes that may be relevant to the country of the office, and if no local scheme exists, assess available international standards e.g. Energy Star. In addition, determine the energy consumption of the equipment when in use and in stand-by (in either watts or kWh).
- Implement “the buying of only energy certified compliant product” as a policy into the procurement process of the organisation, and as part of the maintenance and replacement programme.
- Ensure all energy saving modes are being used – and in the case of computing and printing equipment, it may be possible to make these changes across the network
- Also look at equipment substitution such as laptops over standard computers (up to 90% more energy efficient), and use of LED screens over monitors (again up to 90% energy savings).

OFFICE EQUIPMENT – SERVER ROOMS	<input checked="" type="checkbox"/>
<p>Compile an inventory of the equipment load in the server room and the rated power consumption. Determine if the server room is sub-metered and if not seek to implement.</p>	
<p>There are many different configurations and approaches to server room and data centre set-up, and hence numerous energy reduction opportunities. The following provide a few key initiatives to be considered:</p>	
<p><i>Servers and racks, and server room:</i></p> <ul style="list-style-type: none"> • Locate server room away from high temperature rooms, and ensure doors are always closed; • Ensure servers are turned off when not in use and apply effective power management; • Server virtualisation and rack consolidation to reduce the number of servers needed; • Remove all equipment that does not require cooling out of the server room; and • Provide overhead cabling to reduce heat gain and reduce airflow restrictions. 	
<p><i>Cooling strategies and measures:</i></p> <ul style="list-style-type: none"> • Incorporate outside air or water economiser strategies (see HVAC-03 for air and HVAC-04c for water); • Supply air reset coupled with rack temperature sensing to maximise supply air temperature; • Cooling air delivery should be at floor level and located close to where it is needed; • Challenge the operating temperatures in the server room and seek to raise them; and • Install energy efficient lighting , minimise lighting levels (LIG-01b) where possible and use occupancy sensors, therefore reducing any lighting cooling loads. 	

GREENHOUSE GAS COMPOUND MANAGEMENT	<input checked="" type="checkbox"/>
<p>Compile an inventory of all equipment using greenhouse gases (GHG) such as air conditioning units, chillers and fire suppression systems, and the type of greenhouse gases present in the equipment. Specifically, an inventory of refrigerant containing equipment, and the types and quantities of refrigerants should also be developed and maintained.</p>	
<p>Ensure that the maintenance requirements of the equipment is being followed, which will likely require the use of an external contractor. For refrigerant-containing equipment, a contractor will use one of three methods, recommended by equipment manufacturers, to verify the correct refrigerant level. These methods include super -heating, sub-cooling, or weighing.</p>	
<p>The refrigeration equipment should also be tested for pressure and leaks.</p>	
<p>Analysis of the contractor's logs and records will give an indication of the amounts of recharging necessary for items of equipment, and this will also give an indication of potential leakage and loss.</p>	
<p>Air trapped in the refrigerant loop increases pressure at the compressor discharge, and therefore increases the work. Therefore purge air from refrigerant. Daily or weekly tracking will show if a leak has developed that allows air into the system.</p>	
<p>Leak tests are normally conducted after a repair is complete.</p>	
<p>Greenhouse gas compounds that are removed from the equipment should be captured and recycled through certified recyclers.</p>	

REPLACEMENT OF GREENHOUSE GAS CONTAINING EQUIPMENT	<input checked="" type="checkbox"/>
<p>Compile an inventory of all equipment using greenhouse gases (GHG) such as chillers, fire hydrants and refrigerators and the type of greenhouse gases present in the equipment, and its associated GWP and ODP.</p>	
<p>Research for alternatives to replace the current equipment containing greenhouse gas compounds, or in limited cases the actual compounds themselves (such as for R11 chillers), based upon improved refrigerant performance, lower GWP and ODP</p>	
<p>Research of any regional/federal programs for replacement of greenhouse gas compounds.</p>	
<p>Suppliers and manufacturers will need to be consulted for direct greenhouse gas compound</p>	

replacement considerations.

Update procurement policies and processes to reflect findings, and implement replacement as part of office maintenance and replacement procedures.

Wherever equipment is replaced, or greenhouse gas compounds are substituted, ensure that appropriate gas capture and disposal routes are followed to prevent leakage and release of the compounds.