CHECKLISTS for ENERGY MANAGERS

FUELS
All leaks of fuels, materials and energy should be prevented.

COAL

avoid manual handling.
use recent deliveries first.

OIL

Minimise the use of trace lines.
Control the temperatures of tanks and pipelines.
Optimise atomising temperatures.

GAS

Check continuously for leaks.
Optimise storage arrangements.

ELECTRICITY
Examine tariff structure.
Meter electricity use to all sectors.
Select optimal tariffs.
Attempt to balance load factors.
Identify equipment contributing to peak demand.
Check and correct power factors.
Peak lop.
Stagger start-up times.
Reschedule peak activities.
Convert to thermal energy (heat or cold) at off-peak periods and introduce thermal storage.
Consider the use of standby generators to peak lop.
Try to use nightrate electricity, i.e. for charging the batteries of electric vehicles.
Introduce compressed air storage to
peak lop.
use off-peak electricity.
Select electrical motors so that they run at near full load.
Consider the uses for variable speed drives.
Maximise power factors - introduce capacitances.
Switch off plant and lighting when not required.
Pay attention to lighting.
Consider the use of standby generators for peak lopping.
Consider the introduction of a TOTAL ENERGY system.
Invest in an ENERGY MANAGEMENT CONTROL SYSTEM.

Electricity should only be used as a last resort

This statement arises from the fact that, for every kWh of electricity consumed, 3 to 4 kWh of fossil fuel is consumed at the power station. For certain industrial heating applications, however, it may be more efficient to heat by induction or microwave heating in which the heat can be precisely directed to the component to be heated.

ENERGY RELEASE -FURNACES

E.g. Batch Ovens, Rotary Kilns, Tunnel Kilns.

Check and review maintenance and operating procedures.
Check conditions of plant and equipment.
Check that plant if operating efficiently.
Check the control arrangements.
Check the adequacy and operation of monitoring instruments and controls.
Check air/fuel ratios.
Carry out combustion performance tests at regular intervals.
Evaluate performance by comparing the fuel input to perform a specific task under standard conditions.
Construct an energy balance over the furnace.
Perform efficiency checks - indirect (flue gas losses).
Check furnace insulation.
Check state of furnace lining.
Optimise insulation levels.
Look for air leaks into furnace - confounding air-fuel ratios.
Eliminate infiltration - a slightly positive internal pressure will assist this..
Use doors for as short a time as possible - consider the use of chain barriers, air curtains and the like.
Check burners and combustion conditions.
Avoid fluctuations in fuel or air supplies.
Select proper firing and control equipment.
Minimise excess air - do not produce CO unless a reducing (non-oxidising) atmosphere is required.
Optimise flame temperatures.
Avoid flame impingement (sting) on refractory surfaces.
Aim for a uniform flame distribution filling the combustion chamber.

Optimise conditions to give maximum heat transfer rates by convection or radiation (or by both mechanisms according to the purpose of the furnace and the method used to achieve this purpose - drying verses sensible heating).

To maximise radiative heat transfer:

gas and surface temperatures should be high.

the flame should be highly luminous.
the distance between flame and stock should be short.
the flame coverage of the hearth should be good.

To maximise convective heat transfer:
gas temperatures should be high.
gas velocities should be high.
stagnant pockets should be avoided by good circulation and mixing.
all heat transfer surfaces should be maintained clean.

Warm waste gases rather than cold inlet air should be used for dilution (i.e. for flue gas temperature control).
Maintain full load if possible.
Investigate load patterns and operating cycles.

Attempt to balance load factors and hence avoid periodic modulationor intermittent operation (switching) when much of the energy supplied heats up the furnace to the working temperature, the furnace room and the surroundings.

Use lightweight carriers - especially in highly intermittent plant or tunnel kilns.
Look for heat recovery opportunities.
Check possibilities for heat recovery.

ENERGY CONVERSION - BOILERS, AUTOCLAVES and LIQUID HEATERS
Check flow and return temperatures.
Check conditions of plant, equipment and flues.
Check steam pressures and temperatures.
Check for leaks.
Check levels of insulation.
Check insulation of hot wells.
Investigate loading schedules.
Check load patterns and operating cycles.
Investigate sequencing of modular boilers.
Check the control arrangements.
Investigated adequacies and operations of controls for
start-up.
modulation.
sequencing of modular boilers.

Check maintenance procedures?
Carry out boiler efficiency checks, i.e.direct (e.g. steam generated/fuel supplied).
Carry out combustion performance tests at regular intervals.
Construct an energy balance over the device.

Before increasing device capacity, seek every opportunity to reduce demand, smooth the load and increase thermal efficiency.

When demands fluctuate, use energy accumulation to smooth firing rates.
Always operate in accordance with design specifications.
Check cleanliness of heat transfer surfaces.

Ensure that correct feedwater treatment is carried out - this reduces inefficiencies due to scaling and blowdown losses.

Check blowdown arrangements.
Recover heat during blowdown if possible.
Recover as much condensate as possible.
Ascertain effects of energy-conserving measures on boiler loads and performances.
Look for heat recovery opportunities.

BOILERHOUSE AUXILIARIES
Check pump glands for leakages.
Check motors, bearings and belts.
Check boiler feedwater treatment.
Look for heat recovery opportunities
    from blow-down.
    to pre-heat air or feedwater.
    from economisers.
Check make-up water quantities.
Check insulation of heated pipework and storage vessels.
Check all lines for leaks.
Check ventilation arrangements.

INDIRECTLY HEATED VESSELS
Check insulation and covers.
Check heating supply conditions.
Check load patterns and operating cycles.
Check heat transfer surfaces.
Check controls.
Check steam trap operations.
Look for heat recovery prospects.
Consider thermal accumulation for ballasting mis-matches between supply and demand.

DRIERS
Check water quantities (too much-too little).
Check insulation of drying plant.

Check drier gas circulation patterns.
Check load patterns and operating cycles.
Check controls and monitoring procedures.
Check waste heat recovery operations and possibilities.

HEAT DISTRIBUTION SYSTEMS
Check conditions of plant and equipment.
Check for leaks of hot water or steam.
Leaks should be prevented.
Check amount and condition of thermal insulation on equipment and.pipework.
Estimate distribution losses.

Apply optimal levels of insulation and ensure that the insulant does.not become dirty, compressed, water-logged or degraded.

Ensure that direct losses from uninsulated pipelines, heaters or hot surfaces through building boundary walls do not occur.

Insulate all hot (cold) storage tanks to optimal economic levels.

HEATING SYSTEMS
Check heating control arrangements.
Check building/system response to controls.
Check that temperatures and ventilation rates are not excessive.
Check supply and return temperatures.
Check conditions of plant and equipment.
Check insulation levels and conditions throughout.
Check maintenance procedures.
Specify the exact purpose for which heating is required (sensible heating versus drying).
Analyse load profiles.
Do not overcapitalise plant - reduce the demand before increasing the amount of heat supplied.

Consider thermal accumulation to avoid maximum demand and low- or intermittent-fire inefficiencies.

Keep heat transfer surfaces clean.
Look for heat recovery opportunities.

SPACE HEATING
Stick to minimum fresh air requirements
Consider the use of obscuration meters

Question the minimum airchange rate adopted

Ensure that the required airchange rate is attained in working areas but do not airchange volumes where fresh air changes are not required (e.g. roof spaces, storage areas, unoccupied rooms or regions)

When minimum airchange rates are being achieved, consider the introduction of waste heat recovery

Isolate and vent-off processes which contaminate the working atmosphere.
Analyse area/capita.
Ensure adequate air distribution.
Check for unoccupied heated parts of the building.
Check zonal heating requirements.
Minimise infiltration and uncontrolled air flows.
Measure zonal airchanges rates.
Split space-heated areas into zones having different requirements - consider partitioning.
Check that ceiling heights are not excessive - consider the use of false ceilings.
Maximise the extraction of contaminant and minimise the supply and extraction of fresh air.
Ensure that the ventilation system is controlled.
Ensure that opening windows or doors is not used to control temperatures.
Eliminate random infiltration.
Eliminate arbitrary manual adjustment of air flows and temperatures.
Balance inlet and extract fan sets.
Maintain a slight positive pressure to eliminate draughts.
Introduce self-closing exterior doors, plastic or air-curtains, vestibules and air-locks.

ENERGY STORAGE SYSTEMS
Check heating arrangements for storage tanks .
Check temperatures of storage vessels.
Check temperature control arrangements.
Check amount and condition of insulation.
Check maintenance procedures.
The use of energy accumulation should be considered to

- balance load factors.
- peak lop and use off-peak electricity.
- increase overall energy efficiencies of boilers and distribution systems.
- harness ambient energy.

PLANT AND EQUIPMENT
Check conditions of plant and equipment.

Check functions and efficiencies of electrical equipment.
Measure process temperatures and pressures and check if appropriate.
Check efficiencies of plant and equipment.
Check maintenance procedures.
Check control arrangements.
All hardware should be matched to the purpose for which it is required.

All systems should be operated at rates corresponding to maximum efficiency (normally fully-loaded in continuous operation).

Intermittent operations and fluctuations should be avoided.
Efficiency checks should be carried out frequently using standardised procedures.
Plant should be selected on sensible extreme conditions.
Look for heat recovery opportunities.

LIGHTING

Check zonal lighting requirements.
Check conditions and cleanliness of luminaires and windows.
Check the maintenance procedures.
Check lighting controls.
Check that parts of the building are not being lit unnecessarily.
Challenge the need for large areas of glazing.
Obtain the economic balance of artificial versus daylighting.
Check colours of room surfaces.
Eliminate glazing.
Keep windows and rooflights clean.
Eliminate luminaires.
Keep luminaires clean.
Replace lamps when their efficiency drops.
Avoid dark background colours.
Use automatic controls.
Zone lighted areas.
Do not light unoccupied areas - use infra-red detecting switches.
Use separate circuits for cleaners and for times outside working hours.
Use separate circuits at the daylighted peripheries.
Never use filament lamps.
Use low-energy fluorescent or discharge lamps.
Maintain lighting systems in good order.
Look for heat recovery opportunities.

THERMAL INSULATION

Check conditions of buildings, Plant and Equipment.

Check weather-stripping of external doors and windows.
Check seals on doors leading to stairwells and vertical shafts.
Check self-closures.
Check loading bays.
Check structural integrity.
Seal unused stacks and vents.
Check effective use of building space.
Check thermal insulations of roofs, walls, windows and floors.
Is insulation and draughtproofing adequate and in good repair?
- roof, walls, floors,interzones, doors, windows?

Insulate all high temperature surfaces according to economic optima, bearing in mind maximum refractory temperatures allowable.

The "law of diminishing returns" applies.
Apply insulation to the inside of intermittently heated enclosures.
Apply insulation to the outside of continuously heated systems.
Conduct a comprehensive transmission heat loss survey.
Specify all insulating opportunities and evaluate cost-effectivenesses.

Produce a schedule describing the optimal sequence for the application of insulating options and compare this with schedules for other energy saving options.

Evaluate the diseconomies ensuing from reduced firing rates arising from lessening the demand.

Consider the additional diseconomic effects of the likelihood of mechanical damage, moisture or vapour ingress, leading to condensation within the insulant or structure, infestation, fire hazard or deterioration which may occur.

Check vapour barriers and look for interstitial condensation.
Wet insulation acts as a heat pipe thermal fin !
Insulation also masks problems which may occur in the future.

Incorporate vapour barriers and ensure adequate ventilation to vent off moisture and drainage arrangements should water infiltrate the insulant.

VENTILATION
Check air handling plant.
Check thermal insulation of plant.
Look for blockages.
Check filters for cleanliness.
Check settings and operations of dampers.

Check cleanliness and operations of heating/cooling coils.
Check ventilation rates.
Check ventilation arrangements.
Check how air gets in.
Check how air gets out.
Measure ventilation rates in different zones.
Check air distributions.
Check zonal ventilating requirements.
Check local extract requirements.
Check extract flow rates.
Check operations of fans.
Check if parts of the building are being ventilated unnecessarily.
Check for vertical stratification.
Check maintenance procedures for fans, ducts and filters (sick building syndrome).
Check control arrangements.
Check for infiltration of outside air at
   loading and delivery bays.
   external doors.
   openable windows.
   shafts and flues - consider the introduction of controlled dampers.
   other openings.
   broken glazing.
Consider the introduction of vestibules, air curtains and the like.
Consider the introduction of automatic door closures.
Minimise infiltration and uncontrolled air flows.

Divide the building into zones having different temperature and airchange requirements - consider the use of partitions and local variable-speed fans.

Check that ceiling heights are not excessive - causing stratification and presenting a large unoccupied volume to heat or cool - consider the use of false ceilings.

Minimise vertical stratification by ensuring adequate mixing throughout the volume.
Consider the use of destratifiers.
Ensure adequate air distribution.

Stick to minimum fresh air requirements - consider the use of obscuration meters - Question the minimum airchange rate adopted.

Ensure that the required airchange rate is attained in working areas but do not airchange volumes where fresh air changes are not required (e.g. roof spaces, storage areas, unoccupied rooms or regions).

When minimum airchange rates are being achieved, consider the introduction of waste heat recovery.
Isolate and vent-off processes which contaminate the working atmosphere.
Maximise the extraction of contaminant and minimise the supply and extraction of fresh air.
Ensure that the ventilation system is controlled.
Check start-up shut-down and sequencing.
Check controls.
Eliminate random infiltration.
Eliminate arbitrary manual adjustment of air flows and temperatures.
Balance inlet and extract fan sets.
Maintain a slight positive pressure to eliminate draughts.

Draughts lead to demands for higher temperatures, which lead to calls for higher ventilation rates to combat excess heating, the opening of windows and doors, activating an insidious spiral towards excess airchanges and room temperatures - Stop this happening !

Introduce self-closing exterior doors, plastic or air-curtains, vestibules and air-locks.

Check that ceiling heights are not excessive - causing stratification and presenting a large unoccupied volume to heat or cool - consider the use of false ceilings.

Look for heat recovery opportunities.

AIR CONDITIONING SYSTEMS
Check cooling control arrangement.
Check building/system response to controls.
Check that temperatures and ventilation rates are not excessive.
Check supply and return temperatures.
Check conditions of plant and equipment.
Check that heating and cooling systems cannot conflict.
Specify the exact purpose for which air conditioning is required.
Analyse load profiles.
Do not overcapitalise plant - reduce the demand before increasing the amount of cold supplied.
Consider ice accumulation to avoid maximum demand changes and on-peak tariffs.

Keep heat transfer surfaces clean.
Check zonal cooling requirements.
Measure zonal airchanges rates.
Split areas into zones having different air conditioning requirements - consider insulated partitioning.
Check insulation levels and conditions throughout.
Check for unoccupied air conditioned parts of the building.
Check maintenance procedures for fans, ducts and filters (sick building syndrome).
Minimise infiltration and uncontrolled air flows.
Measure zonal airchanges rates.
Check that ceiling heights are not excessive - consider the use of false ceilings.
Ensure adequate air distribution.

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Ensure that the ventilation system is controlled.
Ensure that opening windows or doors is not used to control temperatures.
Eliminate random infiltration.
Eliminate arbitrary manual adjustment of air flows and temperatures.
Balance inlet and extract fan sets.
Maintain a slight positive pressure to eliminate draughts.
Introduce self-closing exterior doors, plastic or air-curtains, vestibules and air-locks.

Solar gains, lighting dissipations and high temperature thermal loads, emanating from electronics and electrical systems, should be extracted by cooling windows, louvres, shutters, luminaires or equipment, using air or water at outside environmental temperatures. This avoids the wasteful practise in air conditioning systems of allowing such energy to infiltrate into and so disturb the thermal equilibrium of a room, for which it is necessary to use high grade chilled water or refrigerant to remove the excess heat via a large heat transfer surface in order to regain comfort conditions.

Look for heat recovery opportunities.

DOMESTIC HOT WATER SYSTEMS
Investigate uses for hot water.
Chronicle water usage patterns.
Check for leaks of hot water.
Check the maintenance procedures.
Check the control arrangements.
Temperatures should be controlled and optimised.
Leaks should be prevented.
Check condition and insulation of hot water storage tanks.
Pipes and storage tanks should be adequately lagged.
Look for heat recovery opportunities.

COMPRESSED AIR SERVICES
Check conditions of plant and equipment.
Check compressor efficiency.
Check the position of the inlet air duct.
Check the maintenance procedures.
Check the control arrangements.
Check the amount of compressed air supplied.
Check delivery temperature and pressure.
Check for leaks.
Leaks should be prevented.
Check the uses of compressed air.
Check pressures at points of use.
Challenge every use of compressed air - ***this is the most expensive energy commodity.***

1st Law of Thermodynamics:

Heat = Work + change in internal energy

In compression,

Work in = Pressure energy + change in internal energy

$m\, c_p\, \Delta T = pV + m\, c_v\, \Delta T$

$m\, c_p\, \Delta T = m\, R\, \Delta T + m\, c_v\, \Delta T$

$$c_p = R + c_v$$

For air

$$1005 = 287 + 718 \text{ J kg}^{-1} \text{ K}^{-1}$$

Thus 1005 units of work are required to produce 287 units of pressure energy, even with 100% efficient compression.

Furthermore, the work (electricity) has been produced in the first place in the conversion of heat to work at 30% efficiency at best.

Thus it requires at least 3350 units of heat to produce 287 units of pressure energy or 11.7 units of heat to produce 1 unit of pressure energy.

Ensure that minimum pressure is utilised for the required operation.

Compressed air is invariably generated at the highest pressure needed in multifarious activities and then throttled down the pressure of each activity.

For example, paint spraying is best accomplished at 40 psi although air is supplied to the adjustable spray guns at 100 psi.

Savings by Reducing Compressed Air Delivery Pressures.
(assuming a compressor efficiency of 75%)

Delivery Pressure psi(10^5Pa(=N m^{-2}))	Adiabatic delivery temperature K	Total Work Done MJ kg^{-1}	Savings by Reduction MJ kg^{-1}	% saving	£ saving /£1000 Annual Bill
100(6.90)	489	0.20	0	0	0
90 (6.21)	477	0.19	0.01	6	60
80 (5.52)	461	0.18	0.02	10	100
70 (4.83)	443	0.16	0.04	22	220
60 (4.14)	407	0.13	0.07	40	400
50 (3.45)	403	0.12	0.08	42	420
40 (2.76)	377	0.09	0.11	54	540
30 (2.07)	348	0.07	0.13	68	600
20 (1.38)	310	0.03	0.17	87	870
14.7(1.013)	273	0.00	0.20	100	1000

Note:

For a perfect gas, $P_1V_1^n = P_2V_2^n$ and $P_1V_1/T_1 = P_2V_2/T_2$

Therefore, $T_2/T_1 = (P_2/P_1)^{(n-1)/n} = (V_2/V_1)^{(n-1)}$

For isentropic compression, $n = \gamma$, and then

$T_2 = T_1 (P_2/P_1)^{(\gamma-1)/\gamma}$

If $P_1 = 14.7$ psi, $T_1 = 283$ K

If $P_2 = 100$ psi, $T_2 = 489$ K

The work of compression is

$W = (P_1V_1 - P_2V_2) / (\gamma - 1)$

Now, PV = mRT, where R is the characteristic gas constant for dry air = 287 J/kg K.

and so,

$P_1V_1 = R\ T_1 = 287 \times 283 = 81221$ J/kg

$P_2V_2 = R\ T_2 = 287 \times 489 = 140343$ J/kg

W = -147805 J/kg = 0.15 MJ/kg

Assuming an efficiency of 75%, the total work supplied is 0.20 MJ/kg.

Opportunities should be identified for using the waste heat from the compressed air cooling system, such as for space heating.

Reduce the generating pressure to a minimum0.
Consider interstage bleed-off.

Consider the use of localised booster compressors when higher pressures are unavoidable, especially where usage is intermittent.

Switch-off compressors when not in use.

Consider the introduction of compressed air accumulation to
peak lop to reduce maximum demand payments.
use off-peak electricity when possible.
balance the load.

Consider the use of pressure stabilising heated bellows and bags containing phase change (liquid-to-vapour) materials in accumulators.

There are two ways to obtain compressed air - heating at constant volume to increase pressure, and by mechanical compression.

Site air inlets in cool, dry positions - up to 7% of electricity costs can be saved by supplying cold denser air from outside the building. Often reject air from coolers is recycled through the compressor
getting hotter and hotter, lighter and lighter and hence more expensive to compress, as well as worsening cooling and intercooling effectivenesses.

Recover heat from cooling and intercooling systems.

Supply outside air for cooling and intercooling systems.
Avoid condensation in pipelines - this must be forced along with the air and wastes pressure energy.
Reheat compressed air where possible to increase discharge pressures.

Compressed air should only be used as a last resort. It is not uncommon in manufacturing systems for the cost of compressed air to be of the order of 50% of the entire electricity bill, which itself constitutes the major proportion of the overall energy bill.

Never use compressed air for swarf-blowing and cleaning purposes.
Meter compressed air usage.
Look for heat recovery opportunities.

REFRIGERATION PLANT and CHILLED WATER DISTRIBUTION SYSTEMS
Check maintenance and operating procedures.
Evaluate load patterns and operating cycles.
Check conditions of plant and equipment.
Check for evidence of inefficient compressor operation.
Calculate coefficient of performance and energy efficiency.
Check for leaks.
Leaks should be sealed.
Check for leaks of refrigerant or chilled water.
Check the maintenance procedures.
Check operation of condenser fans.
Check cleanliness of air-cooled condenser coils.
Check cooling tower spray water system and water treatment.

Check cooling tower performance.
Check Cooling Tower outlet-to-inlet by-pass air circulation.
Check operations of pumps and valves.
Check the control arrangements.
Check operating pressures and temperatures.
Temperatures and pressures should be controlled and optimised.
Provide monitoring instruments.
Ensure that adequate controls are provided.
Check effective operation of controls.
Check temperature settings.
Check controls for cooling tower and condensers.
Check condition and insulation of cold water storage tanks.
Check condition of insulation and vapour seals on cold lines.
Pipes and storage tanks should be adequately lagged.
Look for heat recovery opportunities.
Check whether useful heat recovery from the condenser might be accomplished.

STEAM PLANT

Check conditions of plant and equipment.
Check efficiency.
Check for steam leaks.
Check for condensate recovery.
Check condition of steam traps.
Check maintenance procedures.
Check control arrangements.
Look for heat recovery opportunities.

WASTE HEAT AND MATERIALS RECLAMATION

High grade energy (which may be 'hot' or 'cold' with respect to the environmental datum) should not be allowed to be dissipated directly to the environment.

The energy rejected from a high grade process should be collected and redirected via heat exchangers (or simply fans or pumps) to be employed at another place, collected and stored to be employed at another time, or concentrated for another higher grade purpose using a heat pump or other thermal transformer, as long as these operations are economically justifiable.

Attempts should be made to introduce feedback from energy loss centres to higher grade stations in the energy flow sequence (e.g. by recyling materials, heat pumping or incinerating waste).

Attempts to reduce or reuse waste should be made before any attempts at recycling or recovery.

Waste energy and materials should be reused wherever economically possible ensuring that practical grade, time and space-matched uses have been found for the reclaimed amounts.

The value of the savings must clearly exceed the cost of recovery.
Before attempting to recover 'waste' heat, ensure that a matched need exists for it.
Attempt to balance the load factor between recovered heat and utilisation.
Evaluate the economics of using flue gas to pre-heat combustion air.
Consider the use of thermal accumulation at the interface to compensate for phase mismatches.

Consider the grade of energy recovered - match this to the grade of the energy required - the use of heat pumps may be considered.

Evaluate diseconomic effects (i.e. the reduction of plume buoyancy and hence flue gas dispersal effectiveness resulting from recuperating heat from (and hence lowering the temperature of) exhaust gases, and the onset of condensation (especially from sulphurous fuels producing corrosive sulphuric acids) inside the flues).

Optimise the amount of heat recovered.

Greater energy efficiency always requires an expenditure of materials and vice versa (e.g. the greater the area of a heat exchanger, the more effective the transfer of heat).

The "law of diminishing returns" applies.

Consider the direct use of exhaust gases (i.e. for drying or for secondary combustion when the first combustion is reductive).

Consider the advantages and diseconomies of latent heat recovery from flues.

Consider recuperative or regenerative heat exchange (with possibly a latent heat exchange facility), heat piping or heat pumping to reclaim waste heat from extract ventilating air in order to pre-heat fresh air.

Be careful to maintain minimum fresh air requirements if regenerators are adopted.

CONTROLS

That which is not measured cannot be controlled

Energy or materials cannot readily be conserved unless accurate and comprehensive measurements in consistent units are first obtained for all activities within the system boundary.

Ensure that all sensors are situated in sensible positions.
Use the widest possible bandwidths for heating/cooling systems.
Use the minimum setting for heating systems.
Use the maximum setting for cooling systems.

Control separately areas with different heat (cold) demands (e.g. sundry gains due to solar irradiance, people, lights, equipment, etc.).

Use optimum start controllers.
Use optimum stop controllers.
Ensure that systems are operated on optimised time schedules.
Switch off equipment when not in use.

Install a computerised ENERGY MANAGEMENT CONTROL SYSTEM to monitorall electricity use and maximum demand.

Remember to track back energy saved to that fuel (money) saved at the boilerhouse.