**Guiding Principles of Energy Efficient Design**

Optimise energy use and consumption in the following sequence;

1. Avoid using energy eg. maximise natural daylight and water
2. Conserve energy eg. insulation, timers, thermostats
3. Energy efficiency eg. A rated appliances and windows, LED lighting etc
4. Energy sources – low carbon or renewable energy



**Suggestions : Short term & Long term energy efficiency decisions and measures**

Source: **TRIBE - TRaIning Behaviours towards Energy efficiency**

The main objective to identify energy efficiency measures expected from the public buildings users, owners and operators aiming to maximize the potential energy savings that can be achieved.

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| **Component of a Building**  | **Examples**  |
| **Envelope** Consisting of the building's foundation, walls, roof, windows, and doors, the envelope controls the flow of energy between the interior and exterior of the buildingA well-designed envelope allows the building to provide comfort for the occupants and respond efficiently to heating, cooling, ventilating, and natural lighting needs.  | Adding or increasing external insulation in walls, installation of efficient windows, improve insulation in thermal bridge areas |
| **Heating, Ventilation and Air-Conditioning (HVAC) system**The design and choice of HVAC equipment also has a big impact on Indoor Environmental Quality (IEQ).  | Installation of a condensing boiler or heat pump, installation of radiant floor heating, use of free cooling, heat recovery system |
| **Domestic Hot Water (DHW)** it takes energy to heat, pump and treat waterIn seeking to reduce a water heater’s energy consumption, it makes sense to start by reducing demand.   | Installation of low-flow showerheads, use shower instead of bath, installation of taps with flow reductionInstallation of a hot water return circuit, installation of heat pumps |
| **Lighting**  | Optimise natural light, installation of daylighting sensors, reduce the number of lamps, turn off lighting in unused rooms or zones |
| **Electrical devices**Choosing efficient devices and making an appropriate use of them further reduce the energy use. In addition, these devices generate heat with their use, increasing the internal load and indirectly influencing in the air conditioning energy demand of the building.  | Purchase A rated appliances, monitors with LCD screen, purchase Energy Star label or Triple E Register devices<https://www.seai.ie/business-and-public-sector/triple-e-register-for-products/>  |
| **Other**  | Installation of solar thermal panels |

 **Short term & Long term energy efficiency decisions and measures**

*Source: TRIBE - TRaIning Behaviours towards Energy efficiency: Play it! 2015*

1. **Short term energy efficiency - Envelope measures**

Use silicone, putty or draught excluder to reduce air infiltrations through windows and doors

Seal air leaks located in all cavities present in the building

Close windows and doors when HVAC systems are operating

Manage properly the opening of windows and doors for natural ventilation

Periodic and suitable cleaning of windows

Correct use of external solar shading

Correct use of internal solar shading

Improve insulation of roller shutter box

Substitution of roller tape guide

Maintenance of wood and aluminium windows frame

Adding a low Emissivity (E) window film

Adding a solar control window film

Put foil behind radiators to avoid heating the wall

Maintenance of room surfaces

1. **Long term energy efficiency - Envelope measures**

Adding or increasing external insulation in walls

Adding or increasing internal insulation in walls

Adding insulation in air chambers of walls through injection

Installation of a ventilated façade

Adding or increasing external insulation in roofs

Adding or increasing internal insulation in roofs

Adding or increasing external insulation in floors

Adding or increasing internal insulation in floors

Installation of efficient windows (double glazing with aluminium frames with thermal break)

Installation of efficient windows (double glazing with wood frames)

Installation of efficient windows (double glazing with PVC frames)

Installation of efficient windows (low-E double glazing with aluminium frames with thermal break)

Installation of efficient windows (low-E double glazing with wood frames)

Installation of efficient windows (low-E double glazing with PVC frames)

Installation of efficient windows (solar control double glazing with aluminium frames with thermal break)

Installation of efficient windows (solar control double glazing with wood frames)

Installation of efficient windows (solar control double glazing with PVC frames)

Installation of efficient windows (triple glazing with aluminium frames with thermal break)

Installation of efficient windows (triple glazing with wood frames)

Installation of efficient windows (triple glazing with PVC frames)

Installation of double windows

Convert balconies into galleries

Build a greenhouse

Installation of a green roof

Use of appropriate materials to increase the thermal inertia of the exposed surfaces to solar radiation 2.1.26 Improve insulation in thermal bridge areas

Installation of false ceiling to reduce internal height

Application of an appropriate solar reflectance coating for the roof

Application of an appropriate solar reflectance coating for the external walls

Application of an appropriate solar reflectance coating for the internal walls

Improvement of the percentage of transparent envelope

Substitution of transparent for opaque insulated envelope

Installation of solar tubes

Build a Trombe wall

Installation of basement windows

Installation of revolving doors

Create entrance vestibule with two doors

Installation of an air-barrier system

Adding a electrochromic window film

Installation of fixed external systems for solar shading (louvres)

Installation of fixed external systems for solar shading (overhangs)

Installation of mobile external systems for solar shading (louvres)

Installation of mobile external systems for solar shading (shutters)

Installation of flexible external systems for solar shading (awnings and blinds)

Installation of internal solar shading (curtains and blinds)

Installation of solar shelf

Use of argon in chambers of double and triple glazing

Automatic control of mobile and flexible external devices

Use of Phase Change Materials (PCMs)

Installation of a green wall

Convert courtyards into atriums

Convert traditional in motorized roller shutters

Installation of transpired air collectors for ventilation preheating

1. **Short term energy efficiency - Heating Ventilation Air Conditioning measures**

Turning off air conditioning systems when rooms are empty

Upgrade and maintain the filters of the HVAC system

Adjust the temperature of the thermostat properly

Adding or repairing HVAC distribution system insulation

Verify the appropriate operation of timers of the ventilation system

Use of free-cooling

Analysis of the combustion and maintenance of heating boilers

Replacement of the refrigerants fluids in heating and cooling equipment

Adding or repairing boilers insulation

Proper operation of the regulatory systems of the temperature of the heating and cooling equipment

Cleaning the radiator surfaces

Place the condenser unit in a ventilated area without solar radiation

Installation of a programmable thermostat

Purge radiators at the beginning of the heating season

Use ceiling fans instead of air conditioning when possible

Relocate thermostats to appropriate areas

Avoid using personal heaters in air-conditioned spaces

Turn off kitchen and bath fans immediately after use

Cleaning heat exchangers of chillers

Installation of dampers on flue gas ducts

Installation of motion sensors for HVAC systems

Installation of humidity sensors

Installation of an efficient destratification fan system

Installation of thermostatic radiator valves

Installation of a radiator booster

1. **Long term energy efficiency – Heating Ventilation Air Conditioning measures**

Installation of a condensing boiler

Installation of a biomass boiler

Installation of an evaporative condenser

Installation of a heat recovery system in the ventilation air

Installation of Variable Frequency Drives (VFDs) on motors

Installation of high efficient motors for fans and pumps

Installation of a wireless room energy control system

Installation of a desiccant dehumidification system

Installation of pollutant detectors

Installation of ground-air heat exchangers

Installation of radiant floor heating

Installation of radiant ceiling cooling

Installation of an absorption cooling system

Installation of Variable Refrigerant Flow (VRF) system

Installation of micro-cogeneration boilers

Replace V-belts with cogged or synchronous belt drives

Installation of a low temperature boiler

Replacement of electric radiators or unit heaters by heat pumps

Installation of electronic expansion valves (EEVs) in the cooling equipment

Installation of modulating burners and oxygen sensors

Replacement of diesel and fuel oil per natural gas

Convert the constant volume system to a Variable Air Volume (VAV) system

Install small modular boilers

Convert the primary/secondary chilled water plant to variable flow primary

Installation of a Thermally Active Building System (TABS)

Installation of aero-thermal energy

Installation of zoning valves with time and temperature controls

Installation of air curtains

Installation of a gas-powered heat pump

Eliminate reactive power with the installation of capacitor banks

1. **Short term energy efficiency - Domestic Hot Water measures**

Lower the DHW temperature set-point

Adding or repairing tank insulation

Adding or repairing DHW distribution systems

Maintenance and inspection of DHW pumps

Installation of a timer for the DHW recirculation pump

Installation of a timer for the DHW boiler

Installation of mixing valves in the outlet of the DHW tank

Installation of taps with flow reduction (faucet aerator)

Adding or repairing water heaters insulation

Installation of low-flow showerheads

Use shower instead of bath

Fix dripping taps

Installation of thermostatic taps

Installation of motion sensor faucets

Limit shower length to 5–7 minutes

Cleaning the DHW tank to avoid sediments

Disconnect the DHW tank in case it is not working for more than three days

Wash hands with cold water instead of warm water

1. **Long term energy efficiency – Domestic Hot Water measures**

Substitution of instant system for accumulation system

Installation of a hot water return circuit

Installation of a heat recovery in the condensers of the air conditioning system

Installation of a CO2 heat pump

Change from an individual to a collective DHW system

Installation of Drain Water Heat Recovery (DWHR) systems

Replace existing DHW system with heat pump water heaters

1. **Short term energy efficiency - Lighting measures**

Change to task lighting method when required

Change to accent lighting when required

Cleaning and maintenance of lamps and luminaires regularly

Reduce the number of lamps

Reduce the number of luminaires

Turn off lighting in unused rooms or zones

Appropriate orientation of the work place

Lighting zoning through manual switches

Programming different scenarios for the same place

Turn off the luminaires close to windows when there is enough daylighting

Optimized interior security lighting

Place floor lamps and hanging lamps in corners

1. **Long term energy efficiency - Lighting measures**

Installation of program warm-start ballast

Installation of electronic ballast

Replacement of conventional halogen lamps by Infrared Reflective Coating (IRC) halogen lamps

Replacement of incandescent lamps by Compact Fluorescent Lamps (CFLs)

Installation of Lighting Emitting Diode (LED) lamps

Replacement of fluorescent tubes by others with less diameter

Replacement of standard fluorescent tubes by triphosphorous fluorescent tubes

Installation of more efficient luminaires with suitable light distribution

Installation of presence detectors in sporadic use zones

Installation of time delay switches in sporadic use zones

Installation of manual potentiometer switches

Installation of programmable timer switches

Installation of daylighting sensors (on/off)

Installation of daylighting sensors (dimmer)

Reduce lamps wattage or illuminance where there is over-illumination

1. **Short term energy efficiency - Electrical devices measures**

Use of multiple power strips with switch and/or programmable plugs

Set the energy saving mode of the electrical equipment

Turning off the screen of the monitor

Adjusting the brightness of the TV or monitor screen to a medium level

Using the desktop screen in a proper way

Using the screensaver in a proper way

Use and manage properly the energy consumption of printers and photocopiers

Turning off the TV

Set the economic program of the washing machine

Set the economic program of the dishwasher

Set the economic program of the oven

Set the appropriate temperatures of refrigerator and freezer

Unplug battery chargers when their use is not necessary

Use of networking printers

Use pressure cookers

Use a toaster oven or microwave instead of the oven

Turning off communal equipment at the end of the day

Air dry dishes instead of using the dishwasher’s drying cycle

Wash only full loads of dishes and clothes

Turn off the oven or the electric cooker before finishing

Air dry clothes

Regularly defrost manual defrost refrigerators and freezers

Cover liquids and wrap foods stored in the refrigerator

Repair refrigerator door seals

Match the size of the pan to the heating element

Use a covered kettle or pan or electric kettle to boil water

Use the washing machine with cold water

Cleaning of the backside of the fridge

When cooking on the range, use pot lids to help food cook faster

Promote the use of solar chargers

Using hand cleaners instead of electrical ones

Try to optimize the delivery of print jobs or photocopies

Remove refrigerators from places next to heat sources

Print only necessary documents

Decalcify home appliances

Use dishwasher instead of hand-washing dishes

Install coffee machines with thermal jug

Ironing efficiently

Defrost food naturally instead of using the microwave

Disconnect the fridge in case it is not working for long times

Dry hair naturally

1. **Long term energy efficiency - Electric devices measures**

Purchase of Energy Star label devices

Purchase of A+++ electrical appliances

Purchase of laptops instead of desktop computers

Purchase of monitors with LCD screen

Purchase double-sided copiers and printers

Purchase bi-thermic washing machines

Purchase bi-thermic dishwashers

Install vending machine misers

De-lamp vending machines

Purchase of induction plates

Consider the use of a common laundry instead of in-unit washing machine

1. **Short term energy efficiency - Other measures**

Pressing one button to call the lift in case there are several ones

Use stairs instead of lifts

Inspection and maintenance of lifts

Sensitizing of occupants through workshops

Wear adequate clothing

Optimization of the conditions of the electric bill

Create reminders and promotional materials to raise awareness

Move the furniture or objects that block the natural light

Remove furniture from the front of HVAC terminal units

Implementation of a compressed work schedule

Allow employees to work from home on alternate days

1. **Long term energy efficiency - Other measures**

Installation of solar thermal panels

Installation of photovoltaic panels

Installation of direct traction electric lifts

Installation of mechanisms of selective manoeuvre for several lifts

Installation of a Building Energy Management System (BEMS)

Installation of an ICT system

Installation of smart meters

Installation of a Geothermal Heat Pump (GHP)

Installation of micro wind turbines

Hire a qualified company to conduct an energy audit of the building

Installation of an Energy Storage System (ESS)

Installation of fuel cells

Integration of hybrid Photovoltaic Thermal solar collectors (PVT)