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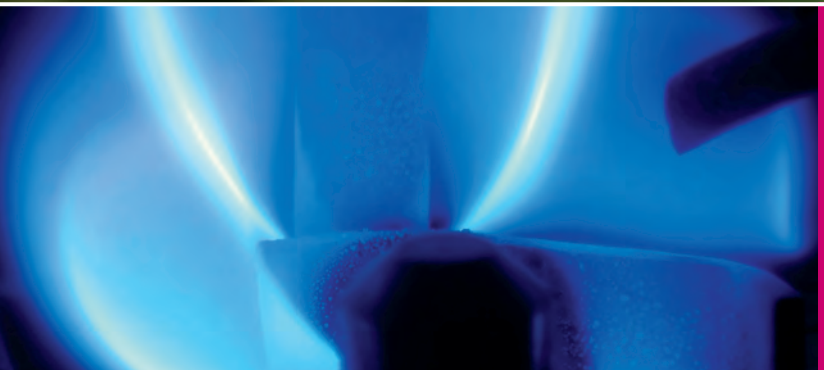
Switched on



ENERGY EFFICIENCY

GAS HEATING IN COMMERCIAL PREMISES

www.energia.ie

"Typically, energy reductions of 10% or more can be made easily through maintenance and low cost improvements."

Why you should read this brochure...

Real savings are often realised immediately or have a very short payback. Longer-term solutions are also well worth considering. Many premises may still be using old hot water boilers that could have an efficiency of about 70% when first installed; poor maintenance will make this figure worse. New condensing boilers can achieve efficiencies of over 90% and can be worth replacing installing.

This brochure focuses on low and no-cost energy efficiency measures. It demonstrates that cost-saving opportunities are achievable with minimum investment. It will help you in these areas:

- Determine the potential for energy savings and show where your premises can make improvements.
- Increase awareness of energy conservation with all staff and help motivate them to reduce waste.
- Show how to plan and take action.

> “Condensing boilers have extra heat exchanger surfaces to extract much of the waste heat and return it to the system.”

Get switched on to savings

Identifying your boiler

Since the end of 1997, legislation has imposed minimum efficiency requirements for boilers with outputs of up to 400kW. Boiler efficiency regulations recognise three types of boiler: ‘standard’, ‘low temperature’ and ‘condensing’.

Standard Conventional boilers

If your boiler is more than 15 years old, it is likely to be a conventional type of standard boiler, designed to operate with an average water temperature of 60 to 70°C.

They tend to be larger than boilers of more modern design. Businesses using such boilers should consider replacing them with models that comply with current regulations.

High-efficiency boilers

Standard and low temperature boilers that meet the minimum efficiency requirements of the current regulations are generally marketed as high-efficiency boilers. If you have a standard boiler which was installed from 1997 onwards, it is likely to be this type.

High efficiency boilers can work with all types of heating system. They are particularly suited to applications where a higher water temperature is required.

Condensing boilers

Even in modern high-efficiency boilers, waste heat in the exhaust gases is lost to the atmosphere via the boiler flue. Condensing boilers have extra heat exchanger surfaces to extract much of the waste heat and return it to the system.

Condensing boilers are the most efficient on the market and since April 2005, regulations require that they must be considered as the first choice for all new or replacement space heating installations.

Boiler Efficiency

No boiler is 100% efficient. Energy (heat) is lost via the flue and through the main body of the boiler itself. Poor maintenance will increase these losses. Care should be taken when considering boiler efficiencies.

Manufacturers often quote instantaneous efficiencies which is useful when comparing boiler types however; for a more meaningful indication of performance in space heating applications 'seasonal efficiency' is a better measure as it takes into account the efficiencies of a boiler measured at full and part load.

The table below shows typical seasonal efficiencies for the different boiler types to meet a heating demand of 100kW.

Boiler type	Typical seasonal efficiency	Energy input rate required to meet 100kW* heating demand
Standard, old, poor condition	45%	222kW
Standard, good condition	70%	143kW
High-efficiency	82%	122kW
Condensing (used with fixed temperature radiators)	85%	118kW
Condensing (used with variable temperature radiators)	87%	115kW
Condensing (used with under floor heating)	90% or more	111kW or less

* As a general rule of thumb, most commercial buildings will require a heating demand of around 70-90W/m^2. So, a 100kW boiler would be sufficient to heat a building of 1,100-1,400m^2. Retail and educational buildings will have a bigger heat demand (100-110W/m^2) and so a 100kW boiler would be sufficient to heat a space of 900-1000m^2.

> “ Poor insulation can account for heat losses of as much as 10% of the energy input.”

Improvements to existing boiler plant

Many of these measures will need specialist help so always consult a qualified technician.

Insulate boilers, pipework and valves

Heat loss through the boiler, pipework and valves leads to poor efficiency. All businesses should check their systems’ insulation. Most modern boilers are well insulated to reduce heat losses however, on older boilers; the insulation may be in poorer condition and can account for heat losses of as much as 10% of the energy input. The boiler insulation should be assessed and replaced where it is insufficient or showing signs of decay. This can result in additional savings of up to 10% of the boiler energy input.

Fit flue dampers

On larger boilers, the flue can cause a flow of air through the boiler, even when it is not firing. This cools the boiler and valuable heat is lost to the atmosphere - known as ‘standing losses’. A flue damper can be used to close off the flue automatically when the boiler is not firing, thus preventing this energy loss. When retrofitting a flue to an existing system the advice of a qualified technician is essential.

Install variable speed drives and pumps

On forced/induced-draught boilers, a variable speed drive can be installed on the fan. This enables the fan to operate at lower speeds when less air flow is required. A reduction in fan speed of just 10% can result in fan energy consumption savings of around 20% and a reduction in fan speed of 20% will save up to 40%. This is particularly relevant for larger boiler systems. Variable flow control works on a similar principle with the pump. Variable speed pumps can be fitted which decrease the flow in the system to match demand. This can save 25-50% of the annual pumping energy consumption. The advice of a qualified technician is essential to assess the economic feasibility of this option.

Recover heat from exhaust gases

In conventional boilers, the heat contained within the exhaust gases is lost to the atmosphere. If replacement with a condensing boiler is not possible, this heat can be recovered through the use of a heat exchanger. The heat can be used to pre-heat the return water or the combustion air. Increasing the temperature of the combustion air by 20°C can improve the overall efficiency of the boiler by 1%. Always consult a qualified technician.

> “The first step is to assess what controls are already in place.”

Boiler controls

The first step is to assess what controls are already in place is to find out if they are set correctly and check that their settings match the business’s requirements. If they do not, adjust them either by asking for help from a qualified professional, or referring to the operating manual. The next step is to decide whether additional controls would be beneficial. Installation of new controls should be carried out by a professional.

Burner controls

Burner controls manage the fuel-to-air ratio which is critical to the efficient operation of the boiler. The fuel-to-air ratio is normally set on the burner controls and will be based on the boiler manufacturer’s recommendations. As part of routine servicing, a qualified technician will measure the fuel-to-air ratio of a boiler. This can then be compared with the manufacturer’s recommendations and where necessary, the appropriate remedial actions taken.

Types of burner control

The simplest form of burner control is singlestage or ‘on-off’ control and is the type of control found on most older, standard boilers. With this type of control, the burner fires at full capacity when heat is required and is off otherwise. An advance to the above is two-stage or ‘high-low’ control. With this type of control rather than being completely switched off, the burner has the option of going to a low firing rate, typically 40% of full capacity. This reduces the number of times the burner switches off and the number of air purges, and improves boiler efficiency under part-load conditions. A further improvement is modulating control. With this type of control, the fuel and air supplies are regulated to exactly match the required heat demand. This ensures good efficiency across the whole heat output range of boilers.

Boiler interlock

Boilers can continue to fire even when there is no demand for heat (called dry-cycling) and so all the heat energy is lost to the flue. Find out whether this is happening by turning off the heat distribution system and then observing the boilers themselves. If they continue to fire when no load is required, dry-cycling is occurring. Clearly this should be avoided.Linking the boiler controls with the heating system controls (such as room thermostats) via a boiler interlock will ensure that the boiler does not operate when there is no heat demand and will prevent dry-cycling.

Boiler Controls

Sequence control

If there are two or more boilers, it is a good idea to consider sequence control if it is not already installed. Find out whether or not sequence control is operating by observing the boilers during part-load conditions, such as in spring or autumn. If all boilers are firing and shutting down simultaneously, it is likely that they are operating only at part-load and do not have sequence control. Good sequence control could save 5-10% of the overall energy consumption of the boiler plant.

Optimised start/stop control

Most heating systems will be controlled via a timeswitch. This will be set to switch the heating system (and hence the boiler) on and off at pre-set times in the morning and evening, corresponding to building occupancy patterns. An optimiser is a sophisticated timeswitch linked to the internal and external thermostats that switches the boiler on at exactly the right time to ensure that the building reaches the required internal temperature in time for occupation. Savings of 5-10% of the overall energy consumption of the boiler plant could be achieved.

Building Management Systems

Controls work best when their operation is integrated and linked to the actual requirements of the building. A Building Energy Management System (BEMS) is a computer-based control system which automatically monitors and controls a range of building services. Installing a BEMS means that control options such as sequencing, optimisation and compensation can be carried out by one system. 10-20% of heating energy can be saved by installing a BEMS in place of several independent control options.

Direct weather compensation control

To achieve more savings, the temperature of the water can be regulated according to outside temperature. In milder weather, the flow temperature is reduced, thus saving energy. This is done through the use of a compensator linked to internal and external thermostats.

Check controls

The benefits of improved controls will be realised only if frequent checks are carried out on control settings and their operation. This is particularly important if business needs have affected the controls. For example, controls are set to cover a period when staff work out of hours, but are not returned to their original settings. Simple control settings (such as timeclocks) can be adjusted by non-professional building staff as circumstances require, provided they have had appropriate training and take care. More sophisticated controls should be adjusted by a qualified technician.

Maintenance

Effective maintenance can highlight potential problems quickly and enable corrective action to be taken before there is a major impact on performance.

Perform regular servicing

A full boiler service should be carried out by a qualified technician on an annual basis, ideally before the start of the heating season. This service should include a flue gas analysis (to check fuel-to-air ratio), an operational check, controls calibration, burner cleaning and limescale treatment. Boiler maintenance should be carried out by an engineer on the Gas Safe Register (NI) or a registered RGI gas installer (ROI).

Analyse flue gas

The fuel-to-air ratio is critical in ensuring efficient boiler operation. Analysis of the boiler's flue gases for levels of carbon dioxide (CO_2), oxygen (O_2) and carbon monoxide (CO) will determine whether this ratio is correct and what adjustments need to be made. Flue gas analysis should be carried out every three months by a suitably qualified technician.

Remove soot

If combustion conditions are not correct, particularly if too little air is used, fuel combustion will not be complete and excessive amounts of CO_2 and particles of carbon (soot) will form. If these particles build up on the fire side of the boiler's heat exchanger they will form an insulating layer inhibiting heat transfer to the water. More heat input is required to meet the heat demand and more heat energy will be lost to the flue. Cleaning should be carried out by a qualified technician. A 1mm layer of soot will cause a 10% increase in energy input to the boiler to meet the same heat demand.

Minimise limescale build-up

In hard water areas, limescale can build up on the water side of the boiler's heat exchanger. This creates an insulating layer, inhibiting heat transfer to the water in the same way as the soot deposits above. The most effective method of limescale removal is through chemical treatment of the water. This should be done annually by a qualified technician to minimise limescale build-up and keep your boiler running at its most efficient. A 1mm layer of limescale will cause a 7% increase in energy input to the boiler to meet the same heat demand.

Produce a maintenance plan

To ensure effective maintenance is carried out, a maintenance plan should be put in place. This will detail what maintenance tasks are to be carried out, the frequency of these tasks and who is responsible.

A maintenance manual should be produced that is updated regularly. This manual should include:

- The maintenance plan
- Block diagram of the boiler plant showing the of key components and controls.
- Schematic diagrams of the heating system and the controls
- Operating instructions and control settings
- Emergency shutdown procedures.
- Contact details of installation/maintenance technicians and boiler manufacturers.
- A maintenance logbook giving detailed records of maintenance tasks, including which actions were taken.

Replacing boilers

If a boiler is more than 15 years old, or if it is showing signs of inefficient operation, it should be replaced.

When considering a boiler replacement, advice should be sought from a qualified building services engineer or boiler technician. To help them, consider the following information.

The building's heating requirements

The most important aspect in selecting a new boiler is getting the size right. It was once common practice to oversize boiler plant with the mistaken notion that this would provide greater flexibility in the future. However, it is now realised that this is unnecessary as the heating demand for many commercial buildings has fallen. This is due to improvements in building insulation and an increase in internal heat gains, such as from IT equipment, lighting and occupants. If a boiler has not been replaced for many years, the heating load of the building may have changed significantly.

Start by reviewing the building's general operation. What is the current internal temperature of the building? Are employees happy with the internal environment? Are there any hot or cold spots within the building? Are there any areas of the building where temperature is critical? When is the building occupied?

Next, review your annual energy bills. What fuel do you currently use for heating? How much energy has the building used over the last year and how much did it cost? How does this compare with other similar building types? To do this, divide the annual heating energy used by the area of the building to gain a 'benchmark' in kWh/m^2. Look for ways of reducing the heating demand. Can the insulation of the building be improved? Could draught-proofing be improved?

Technical considerations

The choice of boiler will be dependent on a number of technical issues. A building services engineer or boiler technician can give advice, but you can provide some basic information to help.

Fuels

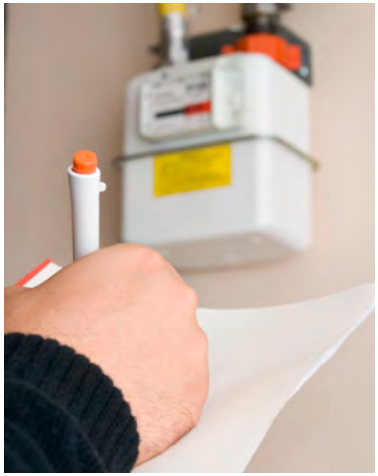
Ultimately, the choice of fuel will be based on cost and availability of supply. Ask which fuels are available onsite. Boilers are designed to operate with particular fuels and are rarely interchangeable so it is important to make an appropriate selection. Of the fossil fuels natural gas is the best choice where a supply is available, as it is the most versatile and has the lowest carbon emissions.

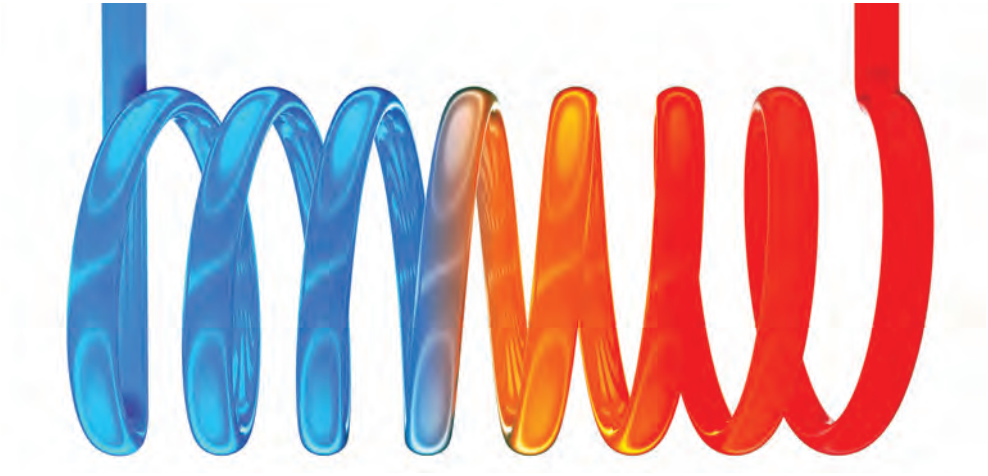
Location

Where you have more than one boiler, find out if the existing boiler plant is centralised or de-centralised. Centralised plant (where all boilers are in one plantroom) may be easier to maintain and control, but heat losses through long pipework runs will be higher. Combine the replacement of boilers with upgrades to the pipework insulation. Also take advantage of the central location to install upgraded controls or reprogramme existing ones. De-centralised plant (where a number of smaller boilers are located around the building) will reduce pipework losses, but you will not have the option of integrating control operation and maintenance may be more problematic and expensive. This is because it costs more to carry out maintenance checks on several smaller boilers than one large boiler.

Flue outlet

Where is the boiler flue outlet? Condensing boilers generate lower temperature flue gases and visible plumes of steam. This may cause problems if the flue outlet is close to other building surfaces.





> “ Replacing a conventional boiler with a condensing model can save 10-20% of annual energy costs.”

Heating system

What type of heating system is currently used in the building? Unless a major refurbishment is planned, it may not be cost-effective to replace the whole heating system so the new boiler must be compatible with what is there already. Condensing boilers work best with low temperature, applications such as under floor heating, but will still provide a higher level of efficiency when applied to a radiator circuit. It may be necessary to upgrade the heating controls of the system to get the best from the new boiler. Do not forget to account for these costs when considering the purchase price.

Replacing a conventional boiler with a condensing model can save 10-20% of annual energy costs - more if the original boiler is in a particularly poor condition.

Environmental considerations

As well as reducing running costs, condensing and high-efficiency boilers will have reduced emissions of carbon dioxide (CO_2) and harmful pollutants such as sulphur dioxide (SO_2) and nitrogen dioxide (NO_2). Does your company have an environmental policy? Will this influence the choice of a new boiler?


ALIM. GLYCOL CHAUD

> “You may need specialist support from your contractor or consultant.”

Next steps

The checklist below will help you to carry out an initial review of the boiler plant and assess what actions can be taken. Many such actions can be taken in-house; however, you may need specialist support from your contractor or consultant for others.

Review	Questions	Actions to be considered	Comments
Make, model, size, type and age of boiler	Is the boiler more than 15 years old? Is the boiler oversized?	Replacement Replacement	Different improvement options will apply depending on boiler type
Fuel consumption of boiler plant	How efficient is the plant?		Assess through meter readings. Estimate efficiency based on consumption and rated output
Check physical condition	Is there any corrosion? Is insulation adequate / in good condition?	Get service done Replace/upgrade insulation Replacement	Poor physical condition will cause poor performance; consider replacement
Assess controls	What type? Are sequencers, optimisers or compensators used?	Install additional controls	Improved control will reduce energy consumption
Check control settings	Are they appropriate? Do they match building operation patterns?	Adjust settings	Improved control will reduce energy consumption
Review maintenance history	When was the last maintenance carried out? Is a proper maintenance plan in place?	Establish a proper maintenance plan Order service/maintenance check	Poor maintenance can reduce boiler performance by up to 10%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For further help and assistance

This brochure addresses the main areas for attention when improving the energy efficiency of your premises. Further information and links are available by calling or emailing us, or by visiting our website.

Call Energia on:

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1850 36 37 44 (ROI)

Email: energy.efficiency@energia.ie

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