

# Hot water boiler equipment

## A guide to equipment eligible for Enhanced Capital Allowances



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## Introduction

ECAs are a straightforward way for a business to improve its cash flow through accelerated tax relief. The scheme encourages businesses to invest in energy saving plant or machinery specified in the ETL to help reduce carbon emissions, which contribute to climate change.

The Energy Technology List (ETL) is a register of products that may be eligible for 100% tax relief under the Enhanced Capital Allowance (ECA) scheme for energy saving technologies<sup>1</sup>. The Carbon Trust manages the list and promotes the ECA scheme on behalf of government.

This leaflet gives an overview of hot water boiler equipment specified on the ETL and aims to help businesses present a sound business case for purchasing energy saving equipment from ETL manufacturers and suppliers.

## Background

The ETL comprises two lists: the Energy Technology Criteria List (ETCL) and the Energy Technology Product List (ETPL). The ETCL defines the performance criteria that equipment must meet to qualify for ECA scheme support; the ETPL is a qualified list of products that have been assessed as being compliant with ETCL criteria.

## Setting the scene

In 2005, the UK commercial sector consumed around 350,000GWh of fossil fuel at a cost of £16,500 million. The generation of hot water accounts for around 15% of fossil energy use in buildings and about 3% in industry, totalling around 22,000GWh per year<sup>2</sup>.

Hot water boilers and water heaters provide low or high-temperature hot water for uses such as industrial processes, space heating and the direct use of hot water for activities such as washing.

The diagram on page 3 shows the typical structure of a hot water boiler. Many of the component technologies are included on the ETL, and their energy saving properties are described below.

## Benefits of purchasing ETL-listed products

Many hot water boilers and their distribution systems have been in place for years, even decades. Developments in modern hot water boiler technology means that efficiencies of newer boilers have now advanced significantly. ETL-listed hot water boiler equipment offers a range of savings opportunities when compared to equipment not designated as energy saving. The degree of savings that can be achieved is dependent upon the nature of the current installation [as well as the new equipment that is installed.

When replacing equipment, businesses are often tempted to opt for that with the lowest capital cost; however, such immediate cost savings can prove to be a false economy. Considering the life cycle cost before investing in equipment can help enhance the cash flow benefits still further.

The ECA scheme provides businesses with 100% first year tax relief on their qualifying capital expenditure and the ETL specifies the energy saving technologies that are supported by ECA scheme. This means that businesses can write off the whole cost of the equipment against taxable profits in the year of purchase. This can provide a cash flow boost and an incentive to invest in energy saving equipment which normally carries a price premium when compared to less efficient alternatives.

Using this leaflet you can calculate the benefits of investing in qualifying ETL energy saving equipment over non qualifying equipment including accelerated tax relief, reduced running costs, increased efficiency, lower energy bills and reduced Climate Change Levy payments (if applicable), which in turn helps reduce payback periods.

### Important

Business purchasing equipment must check the ETPL at the time of purchase in order to verify that the named product they intend to purchase is designated as energy saving equipment. Hot water boiler equipment that meets the ETL eligibility criteria but is not listed on the Energy Technology Product List (ETPL) at the time of purchase is not eligible for an ECA, even if it meets the ETL eligibility criteria.

<sup>1</sup> Eligibility for ECAs is based on a number of factors. Visit [www.eca.gov.uk/energy](http://www.eca.gov.uk/energy) to find out more.

<sup>2</sup> Based on data reported in the DTI Digest of UK Energy Statistics published in 2006.

## Hot water boiler equipment eligible under the ECA scheme<sup>3</sup>

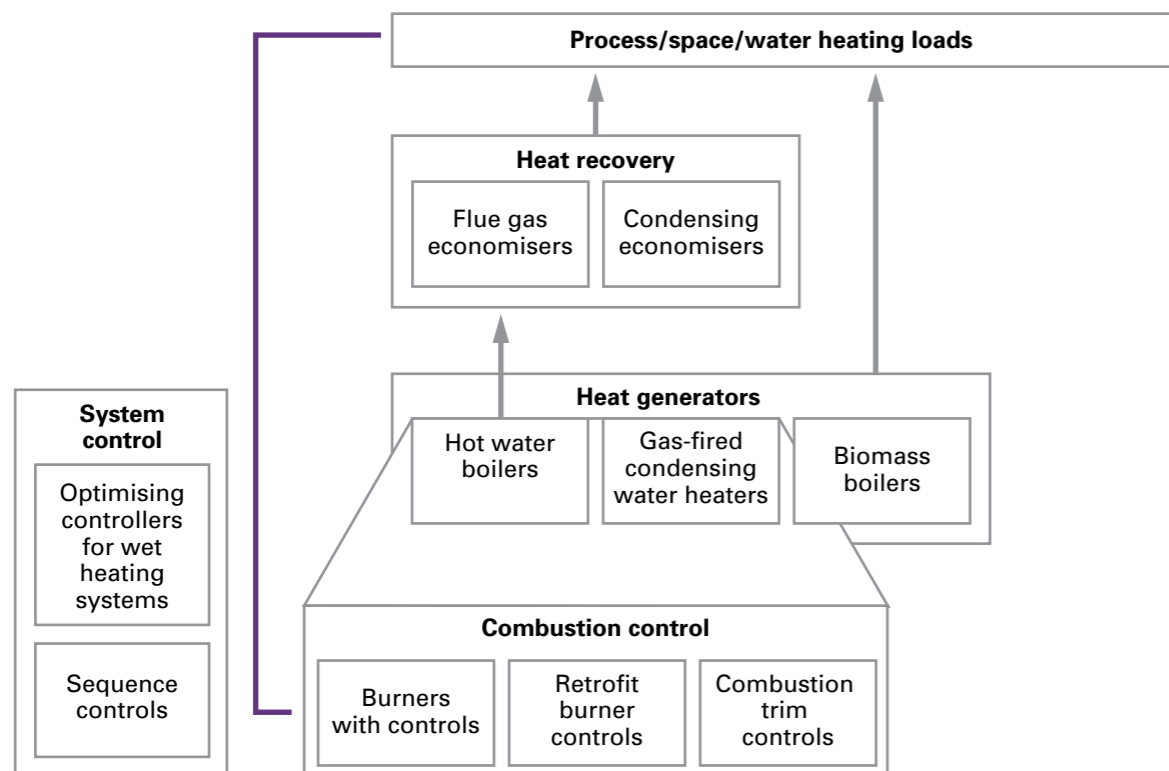
The following sections describe the hot water boiler equipment specified as energy saving under the ECA scheme. The diagram below illustrates these ECA-eligible components and their relationship to each other.

Using the stated baseline scenario the potential financial (£), energy (kWh) and carbon savings (tonnes CO<sub>2</sub>) have been calculated for replacing the component parts of the hot water boiler with ETL qualifying equipment to highlight the potential savings that can be achieved.

The following baseline scenario has been used for comparison unless otherwise indicated:

- Currently total installed capacity from two hot water boilers 5MW
- Burner 2-stage control
- Annual boiler efficiency 84% net
- Average boiler load 75%
- Annual utilisation 8,000h
- Fuel price 1.9p/kWh<sup>4</sup>
- Annual savings do not degrade.

**Figure 1** Hot water boiler equipment potentially eligible under the ECA scheme



## Hot water generators

There are several types of hot water generators eligible under the ECA scheme, described below. Please note that biomass boilers are covered by a separate technology information leaflet.

### Hot water boilers

The ECA scheme covers products that modulate their output to match heating demand, avoiding the heat losses associated with the purge cycles that occur when burners are repeatedly switched on and off to provide the overall required output.

Two main types of hot water boiler are included within the ECA scheme:

- High efficiency hot water boilers with rated outputs greater than 400kW
- Condensing hot water boilers (of all rated outputs)

High efficiency hot water boilers are listed under two categories depending on whether they are designed with high temperature (>105°C)/high pressure (>6bar) outputs, or as low temperature/low pressure boilers.

ETL-listed high efficiency hot water boilers with outputs greater than 400kW, achieve net thermal efficiencies of at least 93% and can provide fuel savings of around 8% compared<sup>5</sup> to the average hot water boiler currently installed in the UK.

### Hot water boilers over 400kW

Boilers covered by the ECA scheme with outputs over 400kW achieve net thermal efficiencies of at least 93%, and can provide fuel savings of around 8% compared<sup>6</sup> to the average hot water boiler currently installed in the UK.

Potential annual savings from replacing one boiler over 400kW in the baseline scenario with an ETL boiler.

- £54,000
- 2.7 million kWh
- 513 tonnes CO<sub>2</sub>.

## Hot water boilers up to 400kW

ECA-listed condensing, gas and oil-fired hot water boilers, at outputs up to and including 400kW, typically offer fuel savings of around 3%<sup>8</sup> when compared to boilers with efficiencies that meet the minimum standards specified in the Boiler Efficiency Directive.

Potential annual savings shown are based on installing an ETL 200kW boiler (compared to a unit that only meets the minimum requirements of the Boiler Efficiency Directive), which runs at an average load of 75% for 3,000h/year on gas priced at 3p/kWh.

- £1,600
- 52,000kWh
- 10 tonnes CO<sub>2</sub>.

## Gas-fired condensing water heaters

Dedicated water heaters enable the separate provision of hot water and space heating. This avoids the energy wastage that arises from the cycling of boilers (repeatedly turning them on and off) to maintain the temperature of water heating circuits and tanks when space heating is not required.

Three different types of gas-fired condensing water heater are included within the ECA scheme. Each of these which must be able to deliver maximum efficiencies of at least 102% on a fuel net calorific value basis:

- Storage water heaters rated at up to 150kW
- Non-storage – instantaneous type, not exceeding 45kW,
- Non-storage – circulator type which can generate larger volumes of hot water, either instantaneously or via a separate storage vessel.

ETL-listed condensing gas-fired water heaters typically use 9%-16% less fuel than the non-ETL products on the market<sup>8</sup>.

Potential annual savings are based on installing an ETL 150kW storage water heater (compared with a lower efficiency alternative), which runs at an average load of 75% for 3,000h/year on gas priced at 3p/kWh.

- £1,000
- 34,000kWh
- 6 tonnes CO<sub>2</sub>.

<sup>3</sup> The descriptions of the hot water boiler equipment given in this leaflet are examples only. The formal criteria and details governing the ECA scheme can be found at [www.eca.gov.uk/energy](http://www.eca.gov.uk/energy).

<sup>4</sup> DUKES 2007, Average manufacturing gas user firm price for 2006.

<sup>5</sup> Based on a simple comparison between minimum ETL efficiency of 93% net and estimated net thermal efficiency of 86% for boilers in the installed base.

<sup>6</sup> Where gas includes biogas and oil includes liquid biofuels.

<sup>7</sup> Based on a comparison of UK seasonal efficiency (SEDBUK [www.sedbuk.com](http://www.sedbuk.com)) values for gas fired boilers that just meet the requirements of each of these criteria.

<sup>8</sup> Based on a simple comparison between the ETL requirement of 102% net and the range of efficiencies for alternative products estimated as 86% net to 93% net.

## Combustion control

It is crucial to ensure accurate control of the amounts of fuel and air passing through a burner, to ensure complete combustion whilst minimising the energy used heating air.

Burners combust boiler fuel to generate heat. Burners and their control systems can have a major impact on overall boiler efficiency.

### Burners with controls

The level of improvement that can be achieved by upgrading burners depends on the age and design of the boiler system. Fuel savings of 3%-5% may result<sup>9</sup> from upgrading to burners whose heat output is modulated to ensure that it matches the heat demand. The benefits are greatest in applications where the output needs to be frequently adjusted to meet variations in demand.

Potential annual savings when replacing boiler burners with ETL-listed burners.

- £36,000
- 1.8 million kWh
- 342 tonnes CO<sub>2</sub>.

### Retrofit burner control systems

Microprocessor-based burner control systems offer precise and reproducible control of the fuel and air flows. These can be retrofitted to existing burners to improve fuel efficiency. Savings are achieved through reducing the excess oxygen level in the flue gas, and depend on the quality of the controls replaced. For example, a 3.5% reduction in the flue gas oxygen level can improve efficiency by around 2%<sup>10</sup>. Although this is lower than the improvements that may be available from complete burner replacement, the improvement in efficiency that can be achieved means that this is still an attractive option.

Potential annual savings from replacement of burner controls.

- £11,000
- 0.6 million kWh
- 105 tonnes CO<sub>2</sub>.

### Combustion trim controls

Combustion trim systems monitor the combustion process within the boiler and closely regulate and maintain the programmed air and fuel flows. They are able to precisely control excess air levels, reducing the loss of heat through the boiler flue. Installing an ECA eligible combustion trim control can lead to fuel savings of around 2%<sup>11</sup>.

Potential annual savings from adding combustion trim controls to boilers.

- £11,000
- 0.6 million kWh
- 105 tonnes CO<sub>2</sub>.

### Heat recovery

Fitting an economiser to a boiler increases the surface area across which heat can be transferred, enabling a greater proportion of the heat to be recovered from the boiler flue gases. This heat can be recycled, and is typically used for preheating boiler inlet water or to fulfil low-grade heat demands. As a result, fuel consumption is decreased and boiler efficiency increased.

### Flue gas economisers

Flue gas economisers recover heat from the boiler flue gases before they are released to the atmosphere. This allows the heat to be recycled, and raises boiler system efficiency. Installing a specified energy saving ETL flue gas economiser can provide fuel savings of more than 3%<sup>12</sup>.

Potential annual savings from adding a flue gas economiser to the boiler system

- £27,000
- 1.4 million kWh
- 260 tonnes CO<sub>2</sub>.

## Condensing economisers

Condensing economisers recover heat from boiler flue gases including the latent heat in the water vapour produced from combustion. They are used mainly for boilers fired on natural gas. Installing a specified energy saving ETL condensing economiser can provide fuel savings of 9%-15%<sup>13</sup>.

Potential annual savings from adding a condensing economiser to the boiler system.

- £75,000
- 3.6 million kWh
- 680 tonnes CO<sub>2</sub>.

## Boiler system control

Inadequate or incorrect application of boiler system control can increase fuel consumption by 15%-30% compared to a well-controlled system<sup>14</sup>. Around 90% of heating and ventilation control systems in buildings are thought to be inadequate<sup>15</sup>.

### Optimising controllers for wet heating systems

Optimising controllers reduce fuel consumption by adapting boiler firing and heat distribution patterns to match variations in heat demand. They shut off boilers during pre-set periods of no demand, and respond to changing weather conditions by providing

Potential annual savings from adding an optimising controller to a 450kW (three 150kW boilers) heating system operating for 3,000 hours/year at an average of 50% load where a 20% fuel saving is achieved.

- £4,000
- 0.2 million kWh
- 38 tonnes CO<sub>2</sub>.

heat when needed to protect from frost, and by adjusting the starting time to the minimum needed to reach the required temperature in time for use. They are available either as standalone units for direct control of boilers, burners and other wet heating system components, or as add-ons for incorporation into other control systems. The energy savings available depend on the functionality, configuration and set-up of any existing system.

### Sequence controls

Sequence controls optimise the number of boilers used, and/or the burner firing rates, to match heat demand. They are available either as standalone units for retrofitting to existing boilers, or as modular units that can be integrated into a boiler, burner or another control system. The level of savings available depends on the control system that is being replaced and on the system load profile. Fuel savings of 15%-20% may be possible<sup>16</sup> as a result of the installation of sequence controls.

Potential annual savings from adding sequence controls to the boiler system.

- £105,000
- 5.3 million kWh
- 998 tonnes CO<sub>2</sub>.

### Information for purchasers

For further information about the ECA scheme, the Energy Technology List (ETL) and other Technology Information Leaflets in the series please visit [www.carbontrust.co.uk/eca](http://www.carbontrust.co.uk/eca), contact the Carbon Trust on 0800 085 2005 or email [customercentre@carbontrust.co.uk](mailto:customercentre@carbontrust.co.uk)

<sup>9</sup> Based on a comparison of UK seasonal efficiency (SEDBUK [www.sedbuk.com](http://www.sedbuk.com)) values for gas-fired boilers that just meet the requirements of each of these criteria.

<sup>10</sup> *Steam generation costs* (ECG066), the Carbon Trust.

<sup>11</sup> *Energy efficient operation of boilers* (GPG369), the Carbon Trust.

<sup>12</sup> *Energy efficient operation of boilers* (GPG369), the Carbon Trust.

<sup>13</sup> Estimate based on adding to a boiler of 93% net thermal efficiency (ETL minimum) – leading to efficiencies from 102% net to 109% net depending on system constraints.

<sup>14</sup> Controls for wet heating systems in small commercial and multi-residential buildings (GPG132), the Carbon Trust.

<sup>15</sup> *Heating systems and their control* (GIR040), the Carbon Trust.

<sup>16</sup> *Controls and energy saving (Fuel Efficiency Booklet 010)*, the Carbon Trust, indicates 15-30% losses for poor control. Burner controls account for up to about 7%.

## Calculating the payback of your investment

Based on the operating conditions above, indicative savings can be calculated for replacing your existing equipment with either ETL-listed equipment or non-ETL-listed equipment.

The accelerated tax relief and cash flow benefit provided by the ECA, together with the life cycle cost savings from ETL-listed equipment, aid in bridging the price premium and shortening the investment payback period<sup>17</sup>.

To calculate the payback period for ETL-listed equipment and non-ETL-listed equipment for comparison you will need:

- The unit price (kW) of the energy your business consumes.
- Estimated energy usage (kW) for the ETL proposed equipment solution(s), which the manufacturer or supplier should be able to help you with.
- Estimated energy usage (kW) for the non-ETL proposed equipment solution(s), which the manufacturer or supplier should be able to help you with.
- Estimated annual maintenance costs incurred by your business for the ETL-listed equipment (your manufacturer or supplier should be able to help you with estimates).
- Estimated annual maintenance costs incurred by your business for the non-ETL-listed equipment (your manufacturer or supplier should be able to help you with estimates).
- The value of the proposed capital expenditure.
- Your business's corporation tax rate.

In addition, the following information is also required:

- A copy of the Carbon Trust fact sheet *Energy and carbon conversion* (CTL004).
- Incorporation of the fact that capital allowance (CA) tax relief for non ETL equipment is 20% (10% if allocated to the 'special rate' pool) and that enhanced capital allowance (ECA) tax relief for ECA equipment is 100%.

**Step 1:** To prepare your business case for investment you first need to estimate annual energy consumption of the ETL-listed equipment and non-ETL-listed equipment.

$$\text{Annual energy consumption (kWh/y)} = \text{Equipment consumption (kW)} \times \text{Number of operating hours/year}$$

Additionally, you can calculate the carbon emissions associated with the energy consumption using either the Carbon Trust fact sheet *Energy and carbon conversion* (CTL004) or by using the tool at [www.carbontrust.co.uk/conversionfactors](http://www.carbontrust.co.uk/conversionfactors) by simply multiplying the energy consumption by the carbon emission factor for that fuel type.

$$\text{Carbon emissions} = \text{Annual energy consumption (kW)} \times \text{Emission factor (kg CO}_2\text{/kWh)}$$

**Step 2:** Calculate the annual running cost (ARC) of ETL-listed equipment and non-ETL-listed equipment.

$$\text{ARC} = \text{Annual energy consumption (kW)} \times \text{Pence/kWh} + \text{Annual maintenance cost}$$

Step 1 and 2 can also be done for your existing equipment to calculate an ARC, in order to allow comparisons of the annual saving (step 3) between the existing equipment, the ETL-listed equipment, and the non-ETL-listed equipment.

**Step 3:** Calculate the annual saving between the ETL-listed annual running costs and non-ETL-listed annual running costs.

$$\text{Annual saving} = \text{ARC of ETL listed equipment} - \text{ARC of ETL non-listed equipment}$$

**Step 4:** Calculate the tax allowance for ETL-listed equipment and non-ETL-listed equipment which will be business-specific based on the following:

- The value of your capital expenditure
- Capital allowance (CA) tax relief for non-ETL equipment is 20%. If allocated to the special rate pool it is reduced to 10%.
- Enhanced capital allowance (ECA) tax relief for ECA equipment is 100%
- The rate of corporation or income tax for your business.

$$\text{CA tax allowance} = \text{Capital expenditure} \times 20\%^* \times \text{Rate of corporation tax}$$

$$\text{ECA tax allowance} = \text{Capital expenditure} \times 100\% \times \text{Rate of corporation tax}$$

**Step 5:** Calculate the pay back for ETL-listed equipment and non-ETL-listed equipment.

$$\text{Payback period} = \frac{\text{Capital expenditure} - \text{Tax allowance}}{\text{Annual saving}}$$

To calculate the available CA tax allowance on capital expenditure beyond Year 1 you need to decrease the capital expenditure by 20% per year (10% if allocated to the special rate pool) on a reducing balance basis. Over the nine years the available CA tax allowance are shown in the table below.

**Table 1** The cash flow boost to your business of an ECA over a CA for a capital investment of £10,000

	Year								
	1	2	3	4	5	6	7	8	9
Capital Expenditure (£)	10,000	8,000	6,400	5,120	4,096	3,277	2,621	2,097	1,678
Capital Allowance (CA) @ 20% (£)	2,000	1,600	1,280	1,024	819	655	524	419	336
CA Tax Allowance	560	448	358	287	229	184	147	117	94
Enhanced Capital Allowance @100% (£)	10,000	0	0	0	0	0	0	0	0
ECA Tax Allowance	2,800	0	0	0	0	0	0	0	0

Calculations are based on 28% corporation tax/income tax and a capital allowance rate of 20%.

### Further information

For more information visit

<sup>17</sup> The values used in the examples given are for illustrative purposes only and do not reflect specific case studies. Anyone considering purchasing this type of equipment would be advised to also analyse the benefits that would be available based on their own circumstances. It should also be noted that the use of formally trained hot water boiler equipment technicians can provide significant energy saving benefits.

\* Replace with 10% if allocated to the special rate pool.

## Go online to get more

The Carbon Trust provides a range of tools, services and information to help you implement energy and carbon saving measures, no matter what your level of experience.

**Carbon Footprint Calculator** – Our online calculator will help you calculate your organisation's carbon emissions.

→ [www.carbontrust.co.uk/carboncalculator](http://www.carbontrust.co.uk/carboncalculator)

**Interest Free Loans** – Energy Efficiency Loans from the Carbon Trust are a cost effective way to replace or upgrade your existing equipment with a more energy efficient version. See if you qualify.

→ [www.carbontrust.co.uk/loans](http://www.carbontrust.co.uk/loans)

**Carbon Surveys** – We provide surveys to organisations with annual energy bills of more than £50,000\*. Our carbon experts will visit your premises to identify energy saving opportunities and offer practical advice on how to achieve them.

→ [www.carbontrust.co.uk/surveys](http://www.carbontrust.co.uk/surveys)

**Action Plans** – Create action plans to implement carbon and energy saving measures.

→ [www.carbontrust.co.uk/apt](http://www.carbontrust.co.uk/apt)

**Case Studies** – Our case studies show that it's often easier and less expensive than you might think to bring about real change.

→ [www.carbontrust.co.uk/casestudies](http://www.carbontrust.co.uk/casestudies)

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→ [www.carbontrust.co.uk/events](http://www.carbontrust.co.uk/events)

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→ [www.carbontrust.co.uk/publications](http://www.carbontrust.co.uk/publications)

## Need further help?



### Call our Customer Centre on 0800 085 2005

Our Customer Centre provides free advice on what your organisation can do to save energy and save money. Our team handles questions ranging from straightforward requests for information, to in-depth technical queries about particular technologies.

**The Carbon Trust was set up by Government in 2001 as an independent company.**

**Our mission is to accelerate the move to a low carbon economy by working with organisations to reduce carbon emissions and develop commercial low carbon technologies.**

We do this through five complementary business areas:

**Insights** – explains the opportunities surrounding climate change

**Solutions** – delivers carbon reduction solutions

**Innovations** – develops low carbon technologies

**Enterprises** – creates low carbon businesses

**Investments** – finances clean energy businesses.

[www.carbontrust.co.uk](http://www.carbontrust.co.uk)

0800 085 2005

The Carbon Trust is funded by the Department of Energy and Climate Change (DECC), the Department for Business, Enterprise and Regulatory Reform (BERR), the Scottish Government, the Welsh Assembly Government and Invest Northern Ireland.

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Published in the UK: September 2010.

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ECA758 v3

