HOME OF THE FUTURE

Can you develop a game that will make a house more energy efficient?

Use any programming software and your creative skills to create a game that would make a house more environmentally-friendly.

1st prize	£100 for you, £2,000 for your school
2nd prize	£50 for you, £1,000 for your school
3rd prize	£25 for you, £500 for your school

Register here:

bit.ly/TCHomeoftheFuture

Everything you need to know will be included in the information workshop on Thursday 29th April.

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Important dates:

Information workshop	Thursday 29th April, 4.30pm
Technical session	Tuesday 4th May, 4.30pm
Scratch Game Development	Thursday 6th May, 4.30pm
Check-in session	Thursday 10th June, 4.30pm
Deadline	Friday 2nd July
Awards Ceremony	Thursday 8th July, 4.30pm

Register here:

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Information Guide

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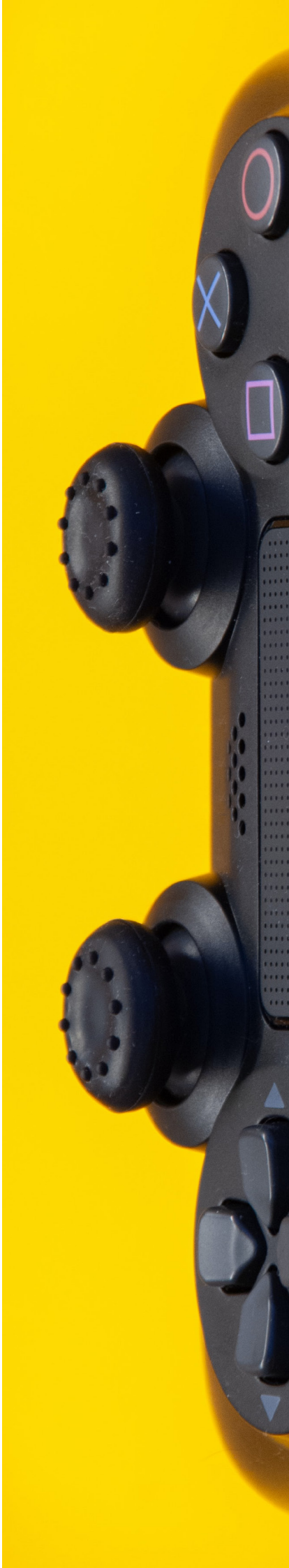
The Challenge

Can you develop a game that will make a home more energy efficient?

Using any programming software as well as your creative skills, your challenge is to create a game that will make a home more energy efficient and environmentally friendly. The concept of for your game should focus on energy saving and reducing carbon emissions in the home. As the game designer, you will consider who your target audience is and why they would want to play your game.

The game could be aimed at single occupancy or family homes, challenging consumers to be more energy conscious and help reduce their bills. Your game might be targeted young people, helping to educate them on energy use in the home and how they can play a part in saving our planet. How your game looks and whom it's aimed at is down to you.

This pack will support you in developing your game and is full of useful statistics that you might want to include. There will also be a workshop session where you'll have the opportunity to quiz an expert on the information shared within this pack.



Caveats

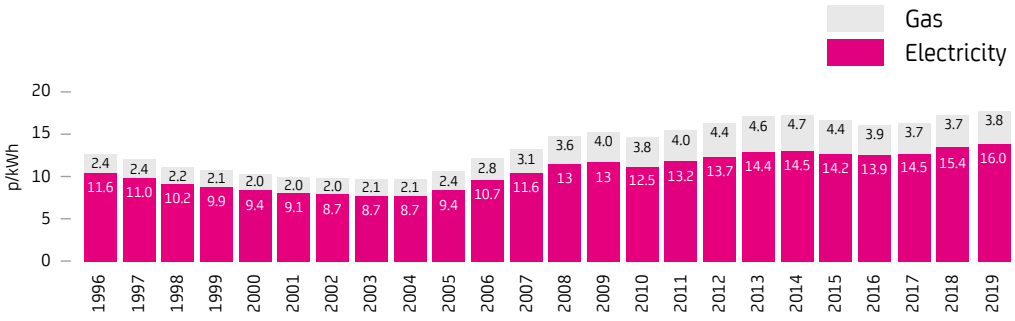
Based on a typical three-bedroom semi-detached gas heated house, with an 85% efficient gas boiler and average gas tariff of 4.17p/kWh and electricity tariff of 16.36p/kWh.

All emission savings include all scopes and greenhouse gas equivalents expressed as carbon dioxide equivalent. Correct as of April 2020 and valid for one year.

General facts and figures

The average households gas and electricity bill is around £1,290 a year! That's around £680 for electricity and £610 for gas. Provisional figures show that the average annual electricity bill in 2019 across all payment types rose by £38 (6%) compared to 2018. The average provisional 2019 gas bill across all payment types has risen by £17 (2.9%) since 2018.

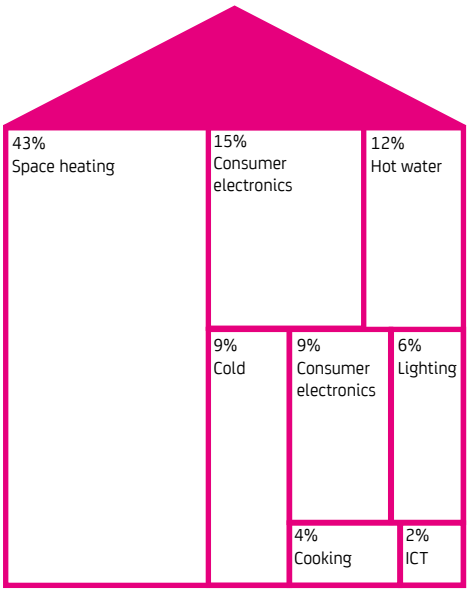
Average annual electricity and gas prices



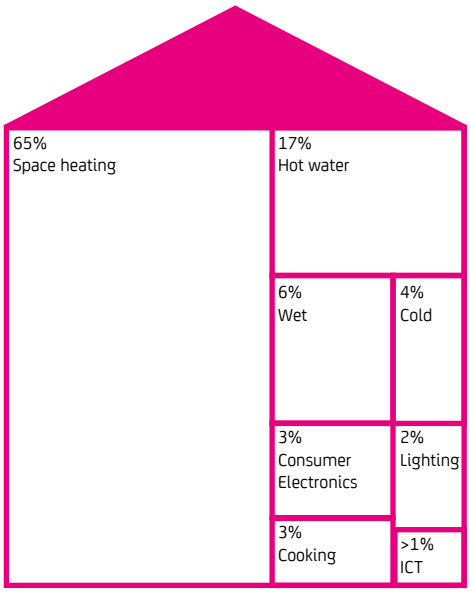
Energy consumption

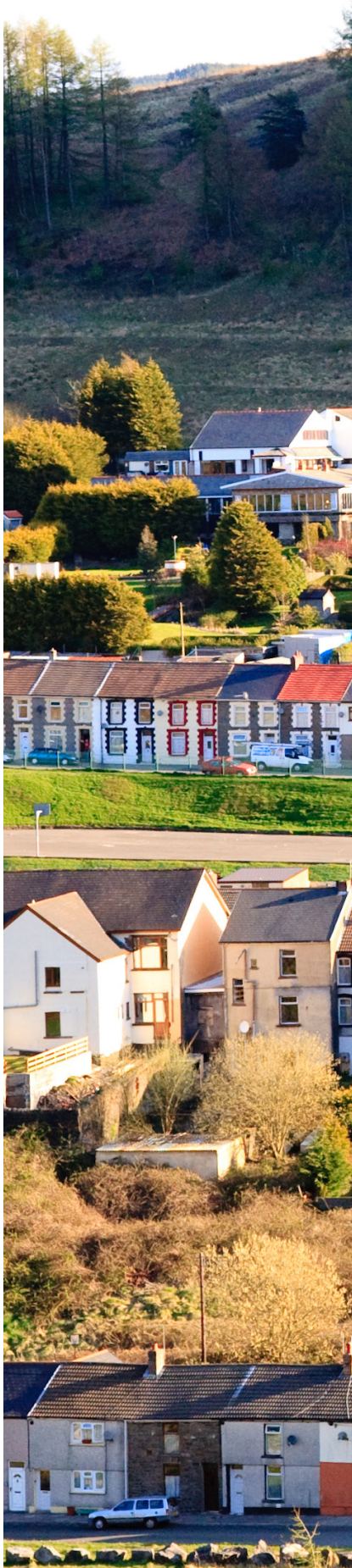
Although space heating and hot water heating accounts for 82% of the energy consumed in an average household, it only makes up 55% of the average household energy bill. This is because electricity is almost four times more expensive than gas per unit.

Average household energy bill split



Average household energy consumption split

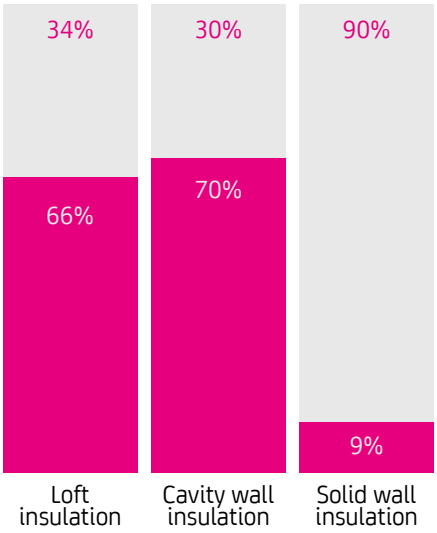




Energy efficiency activity

At the end of December 2019, 16.4 million homes in Great Britain (66% of total homes with lofts) have at least 150mm of loft insulation. However, over 8 million (34%) have less than this Even amongst those with over 150mm insulation, the majority could still top-up further – the recommended depth of insulation for mineral wool is 270mm[2]. There are 14.1 million homes with cavity wall insulation in Great Britain and 5.3 million homes without cavity wall insulation[2]. Only 9% of the 8.5 million homes with solid walls have had solid wall insulation[2].

Percentage of UK homes with and without insulation



Installing 270mm of new loft insulation could save up 610kg of CO_2 a year.

Smart meters

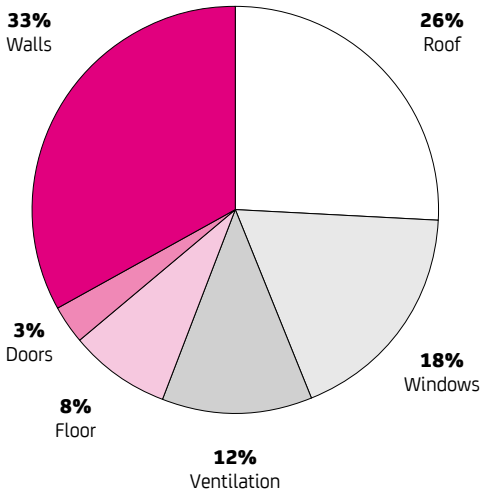
By December 2019, almost 15.2 million domestic smart meters for gas and electricity are operating in Great Britain[4].

Water meters

Approximately 15.8 million households in England and Wales have a water meter, that's 62% of homes in England and Wales. Very few homes in Scotland and Northern Ireland have water meters[4].

Heat loss

This pie chart shows the typical heat loss rates for an uninsulated three bedroom gas heated semi-detached home. Insulation does not stop heat loss completely; it reduces the rate at which heat is lost.



Typical heat loss rates for an uninsulated three bedroom gas heated semi-detached home

2 - Source from BEIS' Household Energy Efficiency detailed release: Great Britain Data to December 2019
4 - Source from Waterwise

Solar panels

Solar electricity panels, also known as photovoltaics (PV), capture the sun's energy and convert it into electricity that you can use in your home. By installing solar panels you can generate your own renewable electricity.

How do solar PV cells work?

Solar PV cells are made from layers of semi-conducting material, usually silicon. When light shines on the material, electrons are knocked loose, creating a flow of electricity. The cells don't need direct sunlight to work, they can work on a cloudy day. However, the stronger the sunshine, the more electricity generated.

Solar PV cells are grouped into modules, and modules are usually grouped into solar arrays. Modules and arrays come in a variety of shapes and sizes. Most PV systems are made up of panels that fit on top of your roof, but you can also install on the ground, or fit solar tiles. The electricity generated is direct current (DC), whereas the electricity you use for household appliances is alternating current (AC). An inverter is installed along with the system to convert DC electricity to AC.

Solar tiles and slates

Solar tiles are designed to be used in place of ordinary roof tiles. A system made up of solar tiles will typically cost about twice as much as an equivalent panel system. Solar tile systems are not normally as cost-effective as panel systems, and are usually only considered where panels are not considered appropriate for aesthetic or planning reasons.

Benefits of solar electricity

Sunlight is free, so once you've paid for the initial installation, your electricity costs **will be reduced**.

It could **provide you with an income** through the UK government's Renewable Heat Incentive (only applies to air-to-water heat pumps).

Maintenance

Solar PV needs little maintenance. Keep an eye on nearby trees to ensure they don't begin to overshadow them. In the UK, panels that are tilted at 15° or more have the benefit of being cleaned by rainfall to ensure optimal performance. Debris is more likely to accumulate if you have ground mounted panels, or if you live in an area with more dust in the air. In these cases, you might need to have the panels cleaned.

Once fitted, your installer should leave written details of any maintenance checks that you should carry out from time to time to ensure everything is working properly. This should include details of the main inverter fault signals and key trouble-shooting guidance. Ideally, your installer should demonstrate this to you at the point of handover. Keeping a close eye on your system and the amount of electricity it's generating (alongside the weather conditions) will familiarise you with what to expect and alert you to when something might be wrong.

The panels should last 25 years or more, but the inverter is likely to need replacing sometime during this period, at a cost of about £800.

Air source heat pumps

Air source heat pumps absorb heat from the outside air to heat your home and hot water. They can still extract heat when air temperatures are as low as -15°C. Air source heat pumps need electricity to run, but because they are extracting renewable heat from the environment, the heat output is greater than the electricity input. This makes them an energy efficient method of heating your home.

If you have large garden space outside, you could consider a ground source heat pump. Despite the greater upfront cost of installing a ground source heat pump, this type of pump is more efficient when it comes to heating your home, which results in higher fuel savings and lower energy bills. Heat from the ground is absorbed into the fluid and then passes through a heat exchanger into the heat pump. The ground stays at a fairly constant temperature under the surface, so the heat pump can be used throughout the year. The length of the ground loop depends on the size of your home and the amount of heat you need. Longer loops can draw more heat from the ground, but need more space to be buried in. If space is limited, a vertical borehole can be drilled instead.

How do air source heat pumps work?

Heat from the air is absorbed at low temperature into a fluid. This fluid passes through a compressor, increasing the temperature, and transfers that higher temperature heat to the heating and hot water circuits of the house.

There are two main types of air source heat pumps, air-to-water and air-to-air. Choosing an air-to-water or an air-to-air system will determine the type of heat distribution system you need.

Benefits of ground source heat pumps

It could **lower your fuel bills**, especially if you replace conventional electric heating.

It could **provide you with an income** through the UK government's Renewable Heat Incentive (only applies to air-to-water heat pumps).

It could **lower home carbon emissions**.

There are **no fuel deliveries** needed.

It will **heat your home as well as your water**.

It can be **easier to install** than a ground source heat pump.

Ground source heat pumps

Ground source heat pumps use pipes that are buried in the garden to extract heat from the ground. This heat can then be used to heat radiators, underfloor or warm air heating systems and hot water in your home. A ground source heat pump circulates a mixture of water and antifreeze around a loop of pipe, called a ground loop, which is buried in your garden.

Heat from the ground is absorbed into the fluid and then passes through a heat exchanger into the heat pump. The ground stays at a fairly constant temperature under the surface, so the heat pump can be used throughout the year. The length of the ground loop depends on the size of your home and the amount of heat you need. Longer loops can draw more heat from the ground, but need more space to be buried in. If space is limited, a vertical borehole can be drilled instead.

How does a ground source heat pump work?

Heat from the ground is absorbed at low temperatures into a fluid inside a loop of pipe (a ground loop) buried underground. The fluid then passes through a compressor that raises it to a higher temperature, which can then heat water for the heating and hot water circuits of the house. The cooled ground-loop fluid passes back into the ground where it absorbs further energy from the ground in a continuous process as long as heating is required.

If there is enough space, the collector loop can be laid horizontally in a trench about a metre or so below ground. Where there isn't room to do this, you can drill vertical boreholes to extract heat from much further down, typically between 90m and 160m deep. The space you need for a horizontal loop, and the depth you need for a borehole, will depend on many factors. Your heat pump installer will design the collector array based on local conditions and the heat requirements of your home. Heat pumps have some impact on the environment as they need electricity to run, but the heat they extract from the ground, the air, or water is constantly being renewed naturally.

Benefits of ground source heat pumps

It could **lower your fuel bills**, especially if you replace conventional electric heating.

It could **provide you with an income** through the government's Renewable Heat Incentive (RHI).

It could **lower home carbon emissions**, depending on which fuel you are replacing.

There are **no fuel deliveries** needed.

It will **heat your home as well as your water**.

There is **minimal maintenance** required.

Unlike gas and oil boilers, heat pumps d**eliver heat at lower temperatures over much longer periods**.

In winter, it may need to be on constantly to heat your home efficiently, but **radiators won't feel as hot to the touch** as with a gas or oil boiler.

Often they are more difficult to install than air source heat pumps, but ground source heat pumps are often **more energy efficient**.

Energy efficiency behaviour

Smart meters and energy monitors

- A smart meter's in home display can help to identify how much energy is used at different times of theday. This can help households identify energy thatis wasted.
- The Government estimates that smart meters will help households to reduce electricity usage by around 2.8% and gas use by around 2% on average.
- Over 15.2 million domestic smart meters for gas and electricity are being used in Great Britain.

Washing and drying

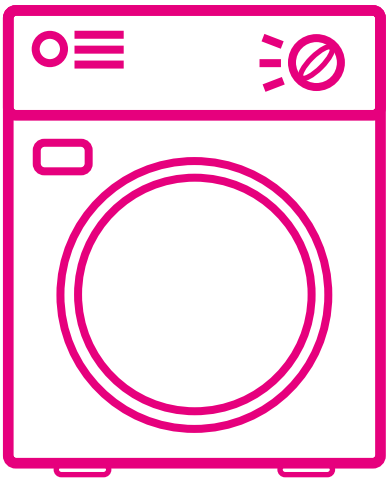
- Setting your washing machine to wash at 30 degrees rather than higher temperatures will save around £8 a year on energy bills and around 14kg of carbon dioxide.
- Setting your washing machine to wash at 30 degrees uses around 57% less electricity than washing at higher temperatures[12].
- If households in the UK switched from higher temperature washes down to 30 degrees, together we could save around £230 million on electricity bills in a year.
- You can save on average £35 a year on your electricity bill and 55kg of carbon dioxide in emissions, by line drying clothes instead of using a tumble dryer during the summer.
- Only filling the kettle up with as much water as you need could save around £6 in energy bills a year.

Thermostat

- A room thermostat switches a home's heating system on and off according to the set temperature. A common misconception is that turning the thermostat up will heat up a home quicker, but this will only heat the home to a higher temperature at the same rate. Insulation increases the speed a home heats up as less heat is being lost through the building.
- Turning your central heating thermostat down by 1 degree could save you £60 and 310kg of carbon dioxide every year[13].

Switch it off

- Avoiding standby and turning appliances off when you're not using them could save £35 and up to 55kg of carbon dioxide ever year[14].
- If every household in the UK avoided standby and turned appliances off when not being used, together we could reduce energy bills by as much as £950 million every year, and save enough carbon dioxide emissions to fill Wembley Stadium over 210 times.
- Turning off your lights when you don't need them could save you around £15 on your annual energy bills, and avoid 25kg of carbon dioxide emissions a year.



57% Washing at 30 degrees uses around 57% less electricity than washing at higher temperatures.

11 - Savings are based on a gas tariff of 4.17p/kWh and electricity tariff of 16.36p/kWh. Correct as of April 2020 and valid for one year.
12 - Based on the average energy use at different temperatures from lab testing of 55 washing machine models. Energy use was monitored on an empty load.
13 - Based on turning down a room thermostat from 22 degrees to 21 degrees in the main living areas. Based on a typical 3 bedroom, semi-detached, gas heated home with a gas tariff of 4.17p/kWh
14 - This saving includes all appliances, consumer electronics, lights and chargers that have been left on standby mode or have been left on and not in use.

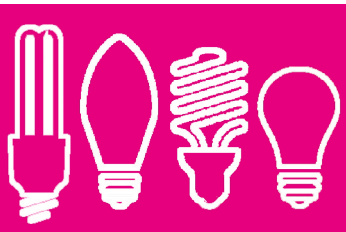
Lighting and water

Lighting

In 2017, 42% of light bulbs in homes were energy saving, 53% were halogens, only 4% were traditional incandescent light bulbs and 14% were LEDs. LEDs are the most energy efficient bulbs you can buy, followed by CFLs (compact fluorescent lighting). You can still buy halogen bulbs, but they are much less efficient than their LED or CFL equivalents. You can no longer buy incandescent bulbs, which are the most inefficient, but many people still have them in their homes.

LEDs

- A household still using an old fashioned 60W incandescent bulb in its lounge could save £3 a year by replacing it with an LED equivalent.
- Replacing a 50W halogen bulb with an LED will save around £75 over the bulb's lifetime, and that doesn't include the saving from reduced bulb replacement.
- In a typical home replacing all your light bulbs with LEDs will cut your lighting bill by around 69%, saving £39 a year and reducing carbon emissions by 65kg a year.



69%

replacing all your light bulbs with LEDs could cut your lighting bill by around 69%

Water

Approximately 62% of households in England and Wales have a water meter. Very few homes in Scotland and Northern Ireland have water meters. The average household water and sewerage bill in Great Britain is around £400 per year. In England and Wales around £190 is the charge for water supplied and around £210 is the charge for sewerage.

Showers

- A typical household could save around £25 off their yearly gas bills and £30 off their metered water and sewerage bills by replacing their inefficient shower head with a water efficient one, that's a total saving of around £5521.
- Spending one minute less in the shower each day could save £16 off your energy bills each year, in a typical household. With a water meter this could save a further £25 off yearly water and sewerage bills.
- If everybody in a typical household replaces one bath a week with a 5 minute shower it could save around £8 on energy bills and around £8 on metered water and sewerage bills every year.

Washing up

Using a bowl to wash up rather than a running tap can save you money on your energy and water bills if you have a water meter. In fact you only need to run a typical tap for 95 seconds before you would have filled a washing up bowl[23].

Washing machine

Always try to fill your washing machine - combining less than full loads, and cutting back washing machine use by just 1 cycle per week could save a household £8 a year of energy, and a further £5 a year on metered water bills[20].

Toilets

Fitting a cistern displacement device in an old toilet, could save over 5,000 litres of water a year. That would save around £13 a year in metered sewerage and water bills.

20 - Savings based on an average electricity price of 16.36p/kWh. Correct as of April 2020 and valid for one year.
21 - Assumes that a household replaces a 9.82 litre a min shower head with a 7.7 litre a minute shower head
22 - Based on a average shower flow rate of 9.82 litres a minute used 1.16 times per person per day in a 2.4 person household.
23 - Based on filling a 10 Litre washing up bowl compared with a 12.65 litre/min kitchen tap at 50% of its full flow.

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