Scottish Water

Trusted to serve Scotland

Sustainability report 2016

Doing the right thing for Scotland

Our vital role

Scottish Water provides vital water and waste water services, essential to daily life, to 2.49 million households and 152,000 business premises across Scotland.

Every day we provide 1.37 billion litres of clear, fresh drinking water and take away 921 million litres of waste water, which we treat before returning to the environment.

The quality of drinking water provided to customers has reached an all-time high and our investment helps to support jobs and the economy of Scotland, while protecting and enhancing the environment.

Our average household charge remains among the lowest in Great Britain – £38 lower per year than the average household charge in England and Wales.

In 2015/16, we commenced a 6 year programme which will see £3.5 billion invested in maintenance and further improvements to drinking water quality, protecting the environment and supporting the Scottish economy.

Customer charges go towards maintaining and improving:

30,062
miles of water pipes

244
water treatment works

31,621
miles of sewer pipes

1,851
waste water treatment works

Contents

Icon key

We have developed the 3 icons shown below to represent the **Environment**, **Society** and the **Economy**. We have used the dark blue icons throughout this report to help you quickly identify the areas where our activities are having a positive impact.

Environment **Society** **Economy**

Foreword

"We are committed to playing our part in supporting a circular economy – increasing the value from 'waste' products and contributing to sustainable economic growth."

Douglas Millican, Chief Executive

Water and waste water services are vital to a sustainable society. Our challenge is to find ways to be increasingly sustainable in how we deliver those services.

Our purpose is to support the protection of public health and the environment through providing high quality affordable drinking water and safely managing society's waste water. We do this whilst ensuring our services are affordable and support Scotland's economy. These are integral to a sustainable society.

We have a vast asset base that requires significant investment to maintain and enhance services to improve our resilience and meet customer, societal and environmental needs. Our assets will last for many decades, serving both current and future generations.

In striving to sustain our vision of being trusted to care for the water on which Scotland depends, it is critical we fully understand what society and our customers expect of us, and that we respond to meet their needs.

We continue to work closely with customers and customer groups to understand what they want from their service. Their views have directly influenced our strategic projections and our current regulatory business plan, to help us to address society's needs over the next 25 years.

This, our fifth Sustainability Report, highlights a number of examples of our progress in delivering more resilient and sustainable services. It focuses on how we are contributing to the development of a circular economy within Scotland, seeking ways to enable the reuse of by-products that would otherwise become waste.

As anticipated last year, we have seen a partial reversal of the increase in carbon emissions we saw in 2014/15 due to changes in the emissions factor for grid electricity, and our carbon footprint has now resumed its downward trend.

We continued to improve our services while our household customers continue to enjoy one of the lowest average charges in Great Britain. Our focus remains on doing the right thing for our customers, the economy and Scotland's environment.

Circular economy

A circular economy is an alternative to a traditional linear economy (make – use – dispose) in which products and materials are kept in a high-value state of use for as long as possible, then recovered and regenerated at the end of each service life (make – use – repair – re-use – recycle).

For example, in the circular economy your phone would be designed to be easily repaired, and upgraded to prolong its use. At the end of its useful life, the phone would be easy to disassemble so that the components and raw materials could be re-used in another phone, made into a different product, or returned safely to nature.

A sustainable society and the circular economy

The water and waste water services we provide play a key role in supporting a sustainable, resilient Scotland. Our core purpose supports the 3 principles of sustainable development:

- **Society** – we provide vital public health protection through affordable access to safe, wholesome drinking water and safe sanitation, and we are committed to creating the right environment for our people to succeed.
- **Environment** – we work to ensure the sustainable use of many of Scotland's water resources and catchments, and to safely treat and return society's waste water to the environment.
- **Economy** – we provide efficient, effective services and help Scotland's communities grow and thrive while delivering value for money to our customers, and we support thousands of construction jobs across Scotland.

We must ensure we deliver our services in a sustainable way. This requires us to work with our customers and stakeholders to balance the demands of society, the environment and the economy.

As we continue to improve efficiency throughout the business, our customers can be reassured that we are delivering more for less as we fulfil our vision of being trusted to care for the water on which Scotland depends.

The average Scottish household pays less than £1 a day for water and waste water services – £38 lower per year than the average bill in England and Wales. We continue to invest, when required, in enhancing our assets to deliver benefits for our customers and supporting sustainable economic growth across Scotland.

We also work to improve our environmental performance through maintenance, operation and enhancement of our assets. Some practices in our day-to-day operations, such as recycling sludge to land, have been reusing wastes for decades. Other initiatives, such as the Development Centres, are very new and their potential is yet to be fully realised.

There are a number of reasons why we are applying circular thinking to our operations. Firstly, it is important that we provide our water and waste water services as efficiently as we can – doing so helps to keep our costs down, and keeps customers' charges low. At the same time, it can reduce our consumption of finite resources as part of our wider efforts to operate sustainably.

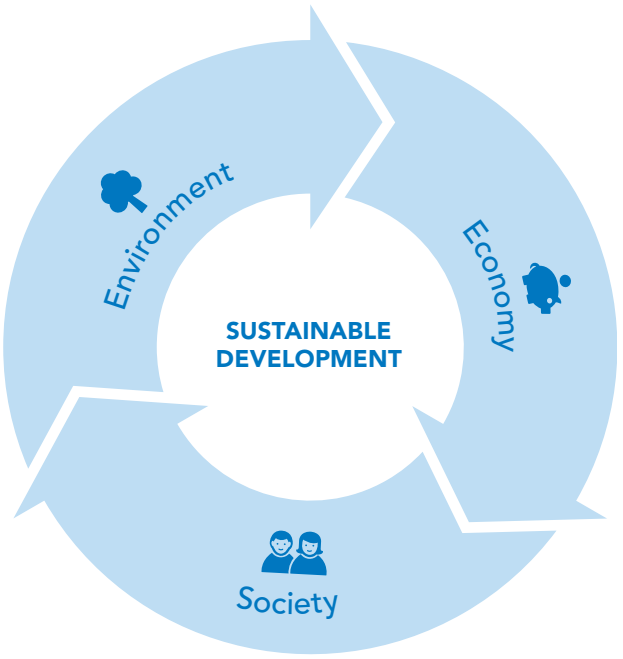
Finally, it helps us to minimise the amount of waste we produce, together with any associated environmental pollution. Embracing the circular economy helps us become a better water company.

In this report we consider how some of our activities help to support a circular economy in Scotland, including:

- Capturing heat from our sewers to heat a college in the Scottish Borders
- Recycling waste oil in partnership for a win-win-win outcome: for Scottish Water, for the environment and for customers
- Using sludge to return valuable nutrients to the soil
- Setting up Development Centres to trial new technologies that could contribute to growing the circular economy
- Turning food waste into energy

The work we do today and the developments we make will continue to contribute to Scotland's circular economy for years to come. We will continue to work in a more sustainable way to deliver your water and waste water services.

Principles of Sustainable Development



Borders College, Galashiels campus, now uses heat from the waste water network (see page 05)

A pilot scheme to recycle fats, oils and greases at Sainsbury's supermarkets is helping prevent sewer blockages (see page 07)

Highlights of the year

- Our carbon footprint has reduced, supported by the decarbonisation of the electricity grid.
- Working in partnership to develop sustainable solutions for Scotland starts to target renewable heat and waste oil opportunities.
- Development Centres are up and running, allowing the safe testing of new or innovative technologies that will support sustainable services in future.

How did this activity contribute to the circular economy?

We contribute to a circular economy in a number of ways. At the end of each chapter we explain how the initiatives we've explored have contributed to a circular economy in Scotland.

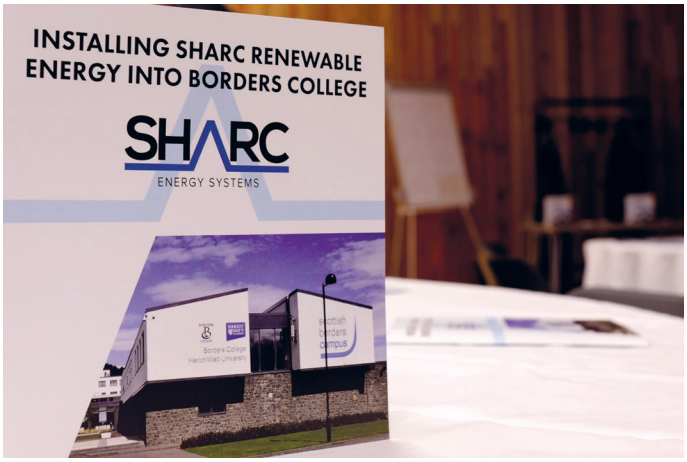
The WIN graphic shows the benefits of each initiative: reducing the need for raw materials, reducing costs, and/or reducing the impact of a former waste on the environment.

Heat from waste water

The Borders College campus in Galashiels is the first example in the UK of heat being extracted from the waste water network to be used for space heating and hot water. This scheme saves the college money and dramatically reduces its carbon emissions.

Water that is flushed into the waste water network from Scotland's homes and businesses represents a significant source of thermal energy. The heat comes from baths, showers, dishwashers, washing machines, some industrial processes, and naturally occurring warmth in the water itself. It results in the temperature of waste water typically being between 12° and 20° Celsius. This depends on location and the extent to which waste water is mixed with surface water runoff (rainwater).

Usually, this heat is lost throughout the treatment process and when treated effluent is returned to the environment. A partnership between Borders College, Scottish Water Horizons Ltd (our wholly-owned commercial subsidiary) and SHARC Energy Systems has resulted in a scheme that uses some of this heat to supply the majority of the campus's annual heating and hot water demand.



The Borders College Energy Centre was opened on the 8th December 2015

A purpose-built energy centre contains the technology required to extract heat from the waste water, amplify it through use of a heat pump, then transfer it to the college's existing heating and hot water system.

As well as the energy centre, the installation consists of two wet wells connected to the waste water network, and a one kilometre-long district heating system to transport the heat around the campus, delivering it to five individual plant rooms.

Since the effective treatment of waste water depends on heat to maintain the biological processes involved, Scottish Water needed to be confident that the scheme at Borders College would not reduce temperatures at the nearby treatment works too much. Modelling work, carried out in partnership with SHARC Energy Systems, provided assurance that there would be no significant impact on the biological treatment processes at Galashiels Waste Water Treatment Works. Additional temperature sensors have been placed in the waste water network downstream of the college to gather evidence that will inform future projects.

The project took a collaborative approach. Scottish Water Horizons introduced the project to SHARC Energy Systems and facilitated access to the local waste water network. SHARC managed the installation and commissioning of the project and is responsible for the ongoing operation and maintenance of the scheme. SHARC also met the capital cost of the installation, using finance raised from the Green Investment Bank and Equitix. Under a 20-year purchase agreement, Borders College buys the heat produced by the scheme and makes financial savings from day one – compared to the cost of running their existing gas-fired heating system – with no capital outlay. The college has also realised 150 tonnes a year of carbon savings against their carbon reduction commitments.

Pete Smith, Vice Principal – Finance and Resources at Borders College explained:

"Borders College is delighted to be the client in this project which places us at the forefront of renewable energy use in the UK.

"This solution goes a long way to meeting our own carbon-reduction targets, while offering long-term price certainty and offering a good degree of local control."

Alan Scott, Scottish Water's Finance Director, said:

"From industrial use to tourism, renewable energy and heating systems, Scotland's vast water resources offer tremendous opportunities for added economic benefit. The UK's first sewage to heat scheme in Galashiels is an excellent example of how water resources can be harnessed and maximised, furthering the development of Scotland's low-carbon economy."

Heat from the waste water scheme at Borders College is the first example of its kind in the UK, but there is significant potential for this technology to be expanded if we can match opportunities in our network with potential recipients of the heat. Scottish Water has almost 32,000 miles of sewer pipes, and we are using heat maps to actively explore locations where such schemes could be developed. We are expanding the programme to work with a number of public bodies and commercial customers across Scotland, including social housing and leisure facilities. By doing so, we are not only contributing to the circular economy but are also helping to tackle climate change in a cost-effective manner.

Fergus Ewing MSP, Minister for Business, Energy and Tourism, and Russ Burton, Chief Operating Officer of International waste water Systems (owners of Sharc Energy Systems) in the Energy Centre at Borders College

How did this activity contribute to the circular economy?

This initiative uses something that would otherwise be wasted – heat in waste water – to make something useful – space and water heating. This reduces the amount of new materials needed (gas used for heat generation); and it reduces the amount of greenhouse gas emissions from the college.

Waste oil recycling

We are working in partnership with Sainsbury's to provide recycling facilities for waste cooking oil and fat, which is a major cause of sewer blockages and flooding. This supports our Keep the water cycle running campaign that aims to remind customers about the potential impact of pouring waste fat, oil and grease down sinks, and provides a recycling option which is both environmentally friendly and will help to reduce blocked drains and sewers in their local area.

In our 2014 Sustainability Report, we described how our Keep the water cycle running campaign was raising awareness of the importance of knowing your bathroom checklist and not flushing items that can cause blockages in private drains and our sewer network.

We attend nearly 37,000 sewer blockages a year – around 20% of which are caused by waste fat, oil and grease (sometimes called FOG) being disposed of down the sink. Many more blockages are caused by FOG combining with bathroom waste (such as wet wipes and cotton buds) that is flushed away. Such blockages can lead to disruptive and costly flooding incidents.

We spend millions of pounds each year clearing blockages in our network to keep the water cycle running. Our advice for the safe disposal of FOG has been to leave it to cool before putting it in a sealable container. The FOG can then be put in the bin or recycled as food waste. However, local authorities find waste cooking oil troublesome to collect and process effectively – there are limited options for environmentally friendly disposal.

Scottish Water is now working with Sainsbury's, and their partners Olleco, to introduce an effective and sustainable way to dispose of waste FOG. The initiative is supported by Recycle for Scotland (part of Zero Waste Scotland) and local authorities. Sainsbury's have been trialling this innovative service at seven stores located in Edinburgh, West Lothian and Fife. To date almost 5,000 litres of waste oil have been collected and recycled.

Sainsbury's waste oil collection point. Scottish Water network operators Ian Stewart and Kenny Jack, with Scott Fraser (Scottish Water Campaign Manager) and James Skidmore (Sainbury's Environmental Resource Manager)

Dedicated collection points have been set up in store car parks, adjacent to existing recycling facilities, so customers can drop off containers of waste oil in a clean and easy way. Olleco, a resource recovery company, transports the waste oil to one of its processing centres, where it is removed from its packaging, heated, cleaned, and filtered. Once processed in this way, it can be converted into biodiesel for use in road vehicles.

The US Environmental Protection Agency has calculated that biodiesel made from waste FOG has greenhouse gas emissions 86% lower than petroleum-based diesel. Using waste oils also reduces the demand for palm oil and other fuel crops, whose cultivation for biodiesel has been criticised as being unsustainable.

Scott Fraser, Scottish Water Campaign Manager, says:

"Scottish Water deals with a huge number of blockages a year – 80% of which are caused by kitchen and bathroom waste being incorrectly disposed of down toilets or sinks.

"We are pleased to support this trial, which offers customers the chance to recycle their used fat, oil and grease and to play their part in helping to keep the water cycle running smoothly – while protecting the environment."

Paul Crewe, Head of Sustainability for Sainsbury's says:

"We've seen a great response by trialling oil recycling points in Scotland, with over 4,800 litres now processed into biodiesel. Not only does this provide a more sustainable alternative to traditional fuels, but it also saves oils going down the drain, with a positive impact on the operation of waste water systems."

Our ongoing Keep the water cycle running campaign is also supported by the work of Scottish Water volunteers, who visit schools across Scotland to talk to pupils about the water cycle and the importance of not putting inappropriate items down the sink or toilet. In 2015/16, our volunteers dedicated over 100 days to educational visits and events, helping to educate the next generation about the water industry and strengthening our links with communities across Scotland.

Norma Alexander, Scottish Water volunteer, with children from Shortlees Primary School, Kilmarnock. The bottles illustrate how toilet paper breaks down in water while "flushable" wipes do not

How did this activity contribute to the circular economy?

This initiative uses a waste – used fat, oil and grease – to make a useful product – biodiesel. In this way, something that would be at the end of its useful life becomes the raw material for another product, and so becomes useful again. This prevents the waste from needing to be disposed of; it reduces the amount of new materials needed; and it reduces the number of blockages and sewer flooding events caused by the incorrect disposal of the waste.

Sustainable sludge management

For decades, the management, treatment and recycling to land of sludge arising from the treatment of waste water has been a key example of the way in which the water industry supports a circular economy. Additionally, it may be used as a fuel in power generation. In 2015/16 almost all of Scotland's sludge was recycled to land or burned as a fuel.

Sludge is the main by-product of waste water treatment and is an essential resource that aligns with the circular economy principles recently adopted by the EU, UK and Scotland. It is treated by anaerobic digestion, liming or drying. This takes place at sites operated either by Scottish Water directly, or under Private Finance Initiative (PFI) contracts on behalf of Scottish Water.

Appropriately treated sludge, often called biosolids, is extremely valuable as a natural fertiliser on agricultural land, reducing mineral fertiliser costs to farmers, increasing crop yields and reducing the farmers' carbon footprint. It provides sustainable recovery of phosphorus and nitrogen, two essential plant nutrients. The high calorific value of sludge means it can also be used to generate renewable energy, helping to meet green energy targets.

The table below illustrates the outlets for treated sludge (biosolids) in 2015. Scottish Water treated over 20,000 tonnes dried solids (tDS) and PFI operators treated over 82,000 tDS.

Sludge Outlets in 2015

	Scottish Water	PFI
Agricultural land	64%	40%
Land Reclamation	26%	12%
Energy from Waste	–	48%
Landfill	1%	–
Other[1]	9%	–

[1] Sent from SW to PFI or third party for further processing prior to recycling to land

Sludge storage tank, Hamilton Waste Water Treatment Works

Land recycling

In 2015, 61% of biosolids produced in Scotland were recycled to agricultural land as a natural fertiliser or used in soil formation on land reclamation sites.

Treated sludge is rich in organic matter, slow release nitrogen and phosphorus nutrients and also contains valuable trace elements. These are all important in supporting crop growth and livestock nutrition. The material is also an ideal soil conditioner owing to its humus-forming properties.

Recycling of biosolids to agricultural land is widely recognised as the Best Practicable Environmental Option (BPEO) in most circumstances. It is a safe, sustainable and quality-assured process which is highly regulated and well managed in the UK, Europe and the United States, where it has been practised for many decades.

Power generation

Both treated sludge and biogas, a by-product of the anaerobic digestion process, can be used to generate renewable energy. In 2015, 48% of sludge treated by PFI operators was used as a fuel substitute in the cement manufacturing industry, thus reducing the use of virgin raw materials in that sector.

Biogas from an advanced anaerobic digestion process at the PFI-operated site at Seafield, which serves Edinburgh, has been used in an on-site combined heat and power (CHP) plant. Under certain conditions the waste water treatment process can be energy self-sufficient, eliminating the need for large amounts of grid electricity. This will fluctuate as energy demand and sludge volumes vary. Additional benefits of this process include a reduction in overall sludge volume and hence a reduction of vehicle movements and associated emissions. The pasteurised sludge produced from the anaerobic digestion process is a beneficial agricultural fertiliser and is an example of circular thinking in practice.

Strategy

Scottish Water is currently reviewing its strategy for sludge treatment for the next 25 years. Our aim is to safeguard and enhance the beneficial use of sludge by providing a compliant, sustainable sludge service that delivers value for Scotland.

Digested sludge cake from the Dalderse Sludge Treatment Centre

How did this activity contribute to the circular economy?

This initiative uses a waste – sludge – to make useful products – fertiliser or electricity. In this way, something that would be at the end of its useful life becomes the raw material for another product, and so becomes useful again. This prevents the waste from needing to be disposed of; it reduces the amount of new materials (mineral fertilisers or fuels used for electricity generation) needed to make the useful products; and it reduces the amount of greenhouse gases produced.

Development centres

Scottish Water Horizons has created two Development Centres in support of the Scottish Government's Hydro Nation Agenda to promote innovation and growth in the water sector.

Delivering more sustainable and effective water and waste water services relies on development of new technologies. One of the key challenges faced by Scottish Water and our supply chain is the ability to test, at a realistic scale, new technologies for the management and treatment of water and waste water processes. Development of these technologies to treat water and recover waste materials can be useful in supporting the circular economy.

The Development Centres are located at a waste water treatment works at Bo'ness and a water treatment works at Gorthleck. The works have been converted to support testing of new processes, technologies and equipment under live conditions, at an operational scale and in a safe environment. This enables developers to demonstrate the functionality of the tested products without risk to our operations.

The centres were funded by a grant from the Scottish Government. Gorthleck was commissioned in January 2015, with Bo'ness following in January 2016. They are operated and managed by Scottish Water Horizons.

Users of the Development Centres can benefit from the UKAS accredited sampling and analysis services offered by Scottish Water Scientific Services, as well as from health and safety evaluations before the commencement of trials, project supervision and operator support.

Bo'ness Development Centre – waste water

Bo'ness Development Centre, near Falkirk, is Scotland's first purpose-built facility to enable testing of waste water technologies. It is located within a redundant building at the Bo'ness Waste Water Treatment Works (itself an example of asset reuse and circular thinking).

The centre can provide waste water from three different stages in the treatment process, namely: post screening, post primary treatment, and final effluent. There is also a dedicated area allowing testing of new screening technologies at the inlet of the works.

The facility carries a Waste Management Licence, which enables users to import waste streams from alternative sites for test purposes, providing a flexible and dynamic environment. All discharges from the centre are returned into the adjacent operational treatment works, allowing users to access live test conditions in a low-risk environment.

Testing bays at the Bo'ness Development Centre, showing the three different waste water feeds and the pipework to return final effluent to the adjacent treatment works inlet

Interest in the waste water Development Centre includes work to recover and recycle priority substances and nutrients, such as phosphorus, from waste water streams. Funding has been made available for research into this area under the Small Business Research Initiative, supported by Zero Waste Scotland and Highlands and Islands Enterprise as part of moves towards a circular economy. Phosphorus is classified as a pollutant if discharged to the environment, but is also a valuable resource derived from non-renewable sources such as mining.

Gorthleck Development Centre – water

Gorthleck Development Centre, near Inverness, is Scotland's first dedicated facility to enable the testing of water technologies. It is created from a redundant membrane water treatment plant.

The centre has a varied raw water quality which is typical to many rural areas in Scotland. It is sampled monthly to provide an indication of the character of the water. As the centre is no longer connected to the distribution network, users have a unique opportunity to trial new equipment in a live testing environment with no risk to drinking water quality or public health.

There are four test bays within the centre, each benefiting from dedicated feeds of varied raw water quality. This site has also recently benefitted from the installation of a 25 kilowatt roof mounted solar panel system, designed to reduce the site's carbon emissions.

The testing facility at the Gorthleck Development Centre, showing the raw water storage tank, multimedia filters and ten membrane modules. Two testing bays can be seen in the foreground

Positive start

Access to both centres is co-ordinated with Hydro Nation Water Innovation Services (HNWiS), a Scottish Government appointed strategic service provider, which offers guidance on funding options, specialist support and development.

Trials carried out at the Development Centres to date have involved external companies and academic institutions, who had found it challenging to get access to sites in order to trial new products at full scale in a live environment. Early feedback from users has been very positive.

How did this activity contribute to the circular economy?

The Development Centres provide an invaluable resource to help test innovative technology that will support more sustainable services.

Dr Daniel Jarman from Hydro International (one of our customers) said:

"Being able to run our technology on a full scale site meant we were able to test the effectiveness of our system under a number of scenarios… such a unique facility in a central location has been invaluable to us."

Keith Brown MSP, Cabinet Secretary for Infrastructure, Investment & Cities said:

"Scotland has an enviable natural abundance of water resources that is of fundamental importance to our economy, health and environment.

"The opening of Scotland's first ever dedicated water technology testing facilities at Gorthleck and Bo'ness offers the industry an invaluable opportunity to test new technologies and processes for future use in the treatment of water and waste water.

"Scottish Water's new development facilities will further enhance Scotland's reputation for innovation through increasing international collaboration and trade by bringing more water technology products to market."

Andrew Macdonald, Head of Scottish Water Horizons:

"What's really unique about our Development Centres is that they are located within an actual and former treatment works – meaning they are not only the first dedicated testing facilities of their kind in Scotland, but also the first on an operational scale.

"The treatment of water and waste water can be energy intensive and costly. Our Development Centres at Gorthleck and Bo'ness will offer companies in the water industry an opportunity to test new processes and equipment which could potentially be more effective and produce savings for customers."

Deerdykes food waste digestion

Across Scotland, almost 2 million tonnes of food waste are generated each year. Sending this to landfill is a significant source of greenhouse gases. The anaerobic digestion (AD) plant at Deerdykes, near Cumbernauld, is capturing some of this waste. It uses it to generate renewable heat and power, and to produce a valuable agricultural fertiliser.

Operated by Scottish Water Horizons, the plant is Scotland's first large-scale commercial AD facility. Funding from Zero Waste Scotland enabled its construction, with the plant opening in September 2010. In early 2016, the plant passed the milestone of having processed its 100,000th tonne of food waste.

Built on the site of a redundant waste water treatment works, the facility uses modern AD technology to convert food waste into renewable energy. The waste is broken down during a biological process in sealed, oxygen-depleted tanks to produce an energy-rich biogas and a natural fertiliser.

Food waste being loaded into the anaerobic digestion plant at Deerdykes

The biogas fuels two combined heat and power (CHP) engines, with a total output of 1 megawatt (MW) of electricity and 1.1 MW of heat. The electricity powers the on-site offices and the plant itself, with any excess being fed into the national grid. Since commissioning, the plant has generated 17 Gigawatt hours (GWh) of green electricity, enough to power 2,000 homes a year. The heat produced is used to warm the digester and the feedstock pasteurisers that are used to treat the incoming food waste.

The solid by-product (digestate) of the AD process is a valuable fertiliser that is a ready source of key nutrients, including nitrogen, phosphorous and potassium. It provides long-term soil conditioning benefits for agriculture and land restoration. Most of the digestate (around 2,500 tonnes annually) produced at Deerdykes is used in the ongoing restoration of an open-cast coal mine in South Lanarkshire, with smaller amounts going to agricultural land. The digestate produced is compliant with the requirements of PAS 110, a specification developed to provide confidence that digestate produced in AD plants is of a consistent quality.

By diverting biodegradable food waste away from landfill, the plant provides a valuable environmental service. Food producers, commercial businesses and local authorities who send their food waste to Deerdykes also benefit. The Scottish Landfill Tax was introduced in 2015, and replaced the UK landfill tax in Scotland. By sending food waste for anaerobic digestion, commercial businesses and local authorities can reduce their landfill tax liabilities.

New waste regulations, which came into force in January 2016, now require most food businesses to present food waste separately for collection. These regulations have resulted in an increase in the volume of food waste sent to the plant Deerdykes. The expansion of the facilities at Deerdykes is a key service provider in supporting companies to comply with the regulations, leading in turn to a more sustainable Scotland.

Colin Lindsay, Operations Manager of Deerdykes Development Centre said:

"Over the past few years we have seen a marked increase in the number of businesses realising the potential of food waste recycling now that food waste segregation has become a legal requirement for smaller waste volumes. We offer a sustainable, commercially-attractive alternative for the many businesses who are having to make arrangements to reduce the volume of waste they landfill.

"By separating food waste for recycling, businesses can keep a tighter hold on waste volumes and associated costs, which is important in our current economic climate. It's all about getting the message out to the wider business and public sectors – food waste recycling is not only good for the environment, it's also good for business."

Stephanie Clark, Policy Manager at Scottish Renewables:

"Facilities like Deerdykes show the positive things that can happen when we look at waste in different ways. The plant is providing green electricity to the grid and reducing the amount sent to landfill – both outcomes which help the environment."

Deerdykes anaerobic digestion plant

How did this activity contribute to the circular economy?

This initiative uses a waste – food waste – to make useful products – electricity and heat. In this way, something that would be at the end of its useful life becomes the raw material for another product, and so becomes useful again. This prevents the waste from needing to be disposed of; it reduces the amount of new materials (fuels used for electricity generation and gas used for heat generation) needed to make the useful products; and it reduces the amount of landfill tax businesses and local authorities have to pay to dispose of their waste.

Operational carbon footprint 2015/16

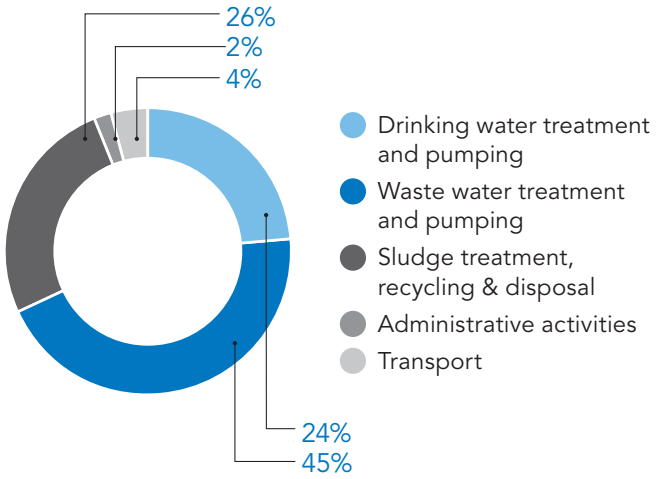
We are pleased to report that our operational carbon footprint (CFP) for 2015/16 was 390,000[1,2] tonnes of carbon dioxide equivalent (tCO_2e); a decrease of around 14,000 tCO_2e or nearly 3.5% compared to 2014/15. We have seen our CFP fall by nearly 16% since we started reporting in 2006/07.

This, our 10th annual operational footprint report, covers the greenhouse gas (GHG) emissions associated with the delivery of water and waste water services to customers across Scotland. In keeping with all other UK water companies, we use the Carbon Accounting Workbook (CAW) developed by UK Water Industry Research Ltd. (UKWIR). This was developed in partnership with the Carbon Trust and is updated annually to reflect the latest emissions factors, accounting rules and guidance from the Department for Environment, Food & Rural Affairs (Defra) and the Department for Energy and Climate Change (DECC[3]).

Our footprint is externally verified in accordance with ISO 14064-3, a process that provides assurance that our reporting is relevant, complete, consistent, accurate and transparent.

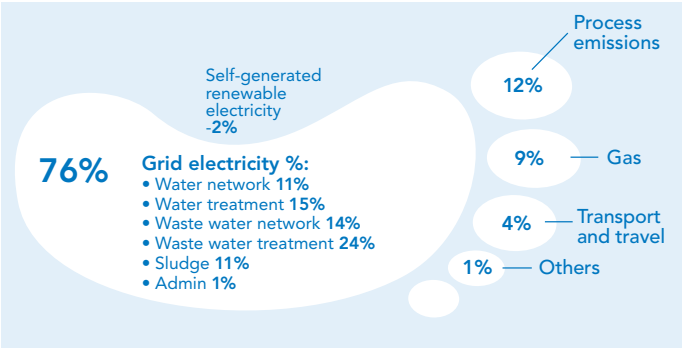
The chart above shows our CFP broken down by the types of activities that deliver our services. It shows that the majority or our emissions, 71% of the total, are produced through the treatment of waste water and sludge (the treatment and pumping of waste water and the treatment and recycling of sludge). Our emissions relating to transport make up only 4% of our CFP, despite operating a large fleet across a wide geographical area.

GHG emissions by activity 2015/16



Another way to look at the CFP is to examine the sources of emissions, such as in the foot diagram below. We can see that grid electricity is by far the largest contributor at 76%. Process emissions (GHGs such as methane and nitrous oxide formed from organic matter breakdown), and natural gas use also make significant contributions at 12% and 9%.

GHG emissions by source 2015/16

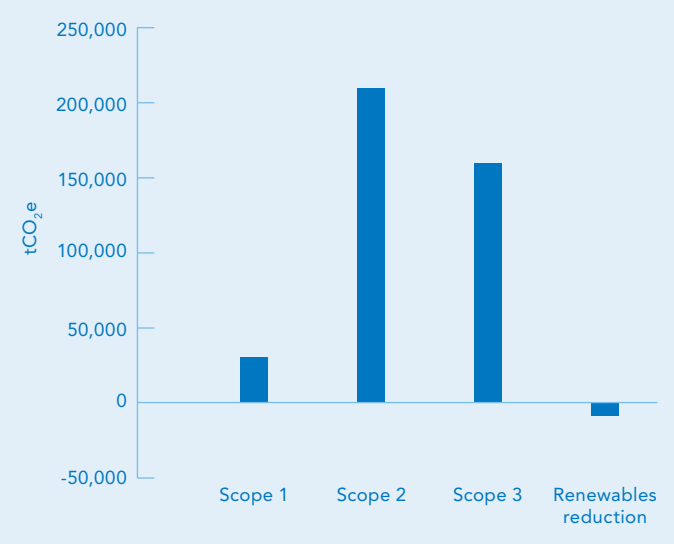


Defra advises reporting GHG emissions in terms of 'Scope':

- Scope 1 – Direct emissions: on-site combustion of fossil fuels; process emissions; and emissions from vehicles owned or leased by Scottish Water.
- Scope 2 – Indirect emissions: use of grid electricity.
- Scope 3 – Indirect emissions: business travel by public transport and private vehicles used for company business; outsourced activities (including sites run by PFI[4] companies on our behalf, including their electricity use); emissions associated with electricity lost in the electrical transmission and distribution system.

[1] This value is rounded to the nearest thousand tonnes
[2] Our CFP includes waste sent to landfill, which is not included by water companies in England and Wales. Therefore, for comparison purposes, our 'water industry comparable' CFP is 388,000 tCO_2e.
[3] Although DECC is now closed and integrated into the Department for Business, Energy & Industrial Strategy, it was in place for the revision of the CAW used for our 2015/16 CFP.
[4] Some of our waste water treatment works are run on our behalf by Private Finance Initiative (PFI) companies. The emissions from these sites are included in our CFP as Scope 3.

GHG emissions by scope 2015/16



Carbon intensity of water and waste water

It is useful to understand the carbon intensity of our service – the amount of carbon emitted to treat and supply a litre of water or collect and treat a litre of waste water.

Our water service has one of the lowest carbon intensities in the UK. This is mainly due to more opportunity to use gravity to supply our customers (rather than pumping).

The carbon intensity of our waste water service is lower than the UK average. As explained last year, the current metric takes account of the 'flow to full treatment' (i.e. it includes much of the rainwater that enters our sewers) and is a more accurate reflection of the carbon intensity of pumping and treatment.

Customers who know how much water they use and waste water they produce (in litres or megalitres) can use the carbon intensity figures in the table below to calculate their water and waste water CFP (CO_2e in grams per litre (g/l) or tonnes per mega litre (t/Ml)).[5,6]

Customer footprinting

Emissions Sources	CO_2e emissions (g/l or t/Ml)
Drinking water services – includes extraction, treatment & pumping of drinking water supply	0.16
Waste water services – includes pumping & treatment of waste water and transport & treatment of sludges	0.30[7]

Changes to the method of accounting 2015/16

The Carbon Accounting Workbook (CAW) is updated annually to take into account changes to emissions factors (EFs) or to reflect changes to reporting guidelines. For version 10.1 there were changes to EFs for a number of inputs, most of which were small and had a negligible impact. There were however two changes that had a more significant impact on the emissions estimated:

Grid Electricity Emissions Factor – This factor represents average annual emissions (in $kgCO_2e$ per kWh) for electricity in the UK national grid. The factor changes year to year as the fuel mix (coal, gas, renewable etc.) used in power stations changes. The electricity EF decreased by almost 7% between 2014/15 and 2015/16.

Global Warming Potential (GWP) – GWP is used by the CAW to convert emissions from methane (CH_4) and nitrous oxide (N_2O) to carbon dioxide equivalent (CO_2e). Carbon dioxide has a GWP of 1. Methane has a GWP of 25, meaning that a kilogram of methane has 25 times the global warming potential of a kilogram of carbon dioxide. The table below outlines the changes in GWP.

Global warming potential	2014 /15	2015 /16	Change in GWP	% change
CH_4 (kg CO_2e/kg)	21	25	4	19.05%
N_2O (kg CO_2e/kg)	310	298	-12	-3.87%

The changes to GWP impact our CFP most significantly in 'process emissions', which is discussed overleaf.

[5] Figures include emissions associated with administration, transport and waste sent to landfill; i.e. our whole operational CFP shared between water and waste water. They are indicative and based on the best available information. They will change over time and customers should ensure they use the latest figures if calculating emissions associated with their water and waste water services.

[6] Water Industry Comparison: As with overall CFPs, UK water industry carbon intensity ratios exclude waste to landfill. Our 'water industry comparable' carbon intensity figures are: Water = 0.14; Waste water = 0.29.

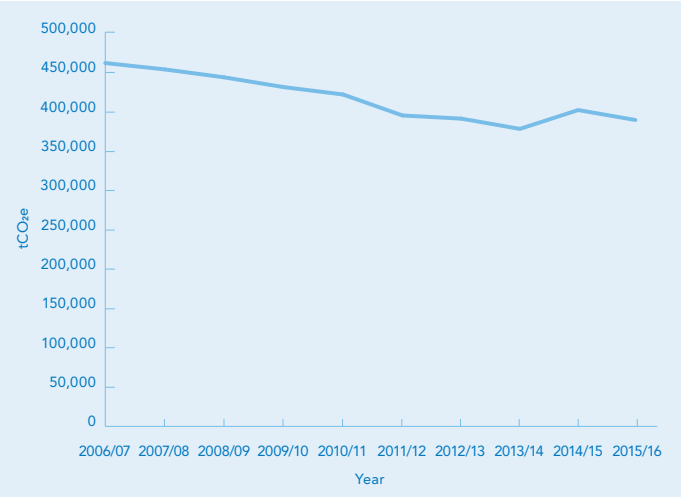
[7] The carbon intensity figure for waste water is comparable to 2014/15 but not the years prior to that because the metric has changed as explained.

Changes to our carbon footprint

Across the first 8 years we reported our CFP (2006/07-2013/14) we saw a consistent downward trend in our emissions, leading to an overall reduction of over 18%. The majority of this reduction (almost 15%) was attributable to Scottish Water activities such as leakage reduction, investment in energy efficiency and renewable generation. The remaining 3% was due to changes to the electricity grid EF.

In 2014/15 however, we saw an increase in emissions compared to previous years. This was principally caused by an increase in the EF for grid electricity rather than for operational reasons. In 2015/16 our CFP reduced by around 14,000 tCO_2e (3.5%) compared to 2014/15. This reduction is largely due to the electricity EF, which has decreased compared to the previous year but is still above the values used in the 2013/14 reporting period. As can be seen in the graph below, this has had a positive impact on our CFP.

Carbon footprint trend 2015/16



Differences in carbon footprint compared to 2014/15 CFP

It is important to understand changes between years and whether they are genuine or caused by a change in the accounting methodology. When we analyse changes between years, we split them into three categories. Often more than one category can have an impact on emissions from the same area of the CFP. The three categories we use are:

- **Genuine** – real changes in CO_2e emissions (i.e. from operational changes).
- **Baseline** – the inclusion of previously unavailable data or the exclusion of previously available data sources or changes in emissions factors. These changes may mask genuine increases and decreases.
- **Reallocation** – moving emissions from one part of the CFP to another (affecting the relative size of the divisions in the GHG emissions by activity chart on page 15 but not the total CFP).

The main changes leading to a net decrease of around 14,000 tCO_2e in our 2015/16 CFP were:

- Grid electricity (decrease)
- Renewable electricity (decrease)
- Natural gas (decrease)
- Other fuels (decrease)
- Process emissions (increase)

Grid electricity

Electricity use accounts for 76% of our total CFP therefore any changes here will have the largest impact on our overall footprint.

The total amount of grid electricity used by Scottish Water increased in 2015/16 compared to the previous year by around 3% (almost 20GWh). A major factor in this increase was the heavy rainfall events experienced between November 2015 and February 2016, which resulted in an additional 10GWh of electricity needed for pumping during this time.

Despite this increase in grid electricity used, emissions decreased by over 11,500 tCO_2e (nearly 4%). As is stated above this decrease is due to changes to the electricity emissions factors. This would be classed as a baseline decrease.

Renewable electricity

The amount of renewable electricity (REGO and non REGO[8]) reported within our CFP has increased compared to 2014/15. This can be attributed to 3 factors:

- An increase in the number of sites at which we are producing renewable energy.
- An increase in the amount of energy produced at a number of sites.
- An increase in the amount of REGO accredited renewable energy exported.

The changes above have resulted in a further reduction of over 2,500 tCO_2e (54%) compared to the previous year. This saving is subtracted from our CFP. In 2015/16 the total reduction in emissions due to renewable generation was over 9,000 tCO_2e.

This reduction is a combination of baseline changes (sites that have come on line) and genuine (from the increased output and sites receiving REGO accreditation).

Natural gas

Emissions relating to the use of natural gas have decreased by over 1,200 tCO_2e (4%). This is a genuine decrease in emissions because less gas was used, mainly due to operational issues at PFI sites.

Other fuels

Emissions from fuels used on site, such as gas oil, kerosene, diesel and propane, are aggregated and reported as 'other fuels'. These fuels are most often used in generators and mobile plant or, in the case of propane and kerosene, for heating. The amount used depends upon operational reasons, such as a reduced need for heating, or a decrease in the use of mobile plant such as pumps and generators. The emissions relating to the use of other fuels decreased by over 1,000 tCO_2e (29%). The use of these onsite fuels accounts for less than 1% of our emissions.

Process emissions

Process emissions are generated during the secondary treatment of waste water and the treatment, storage and disposal and/or recycling of sewage sludge. These are separate from the emissions resulting from the fuel (electricity and other fuels) used in waste water and sludge treatment and recycling.

Process emissions comprised the largest single area of emissions increase in the carbon footprint. They saw an increase of around 3,200 (7%) tCO_2e in 2015/16 compared to 2014/15, attributable to several factors:

- An increase in the amount of sludge treated (around 2.5%).
- An increase in the proportion of sludge incinerated and digested (around 7% and 3.5% respectively).
- Increase to the global warming potential (GWP) of methane.

Verification

Once completed, our CFP was externally verified[9] by a consultancy experienced in GHG inventories, who stated:

"The data quality of the 2015/16 Scottish Water carbon footprint has improved compared to previous years, especially with regards to:

- Application of a consistent and documented methodology to Biogas and Combined Heat and Power section, and
- Documentation of data sources, conversion factors and methodologies."

Conclusion

As anticipated, we have seen a partial reversal of the 2014/15 CFP increase. The emission factors for grid electricity remain higher than those in 2013/14. Additionally, we note that electricity usage increased during 2015/16 as Scottish Water invested more effort in pumping waste water during the significant storm events of that winter.

In the 2016/17 reporting period, the electricity EF will decrease to a level below that seen in 2013/14. At that point we expect to see our CFP reduce to below the 2013/14 level irrespective of other actions we are taking.

[8] Renewable Energy Guarantees of Origin.
[9] In accordance with Part 3 of the British Standard BS EN ISO 14064-3:2012 Specification for guidance for the validation and verification of greenhouse gas assertions.

Carbon footprint report glossary

CFP – Carbon footprint
This is the reportable amount of carbon that we have emitted as a result of our operations. It is expressed in tonnes of carbon dioxide equivalent.

CAW – Carbon Accounting Workbook
This is the tool that all UK water companies use to calculate their operational carbon footprint. Using the same accounting tool ensures consistency of approach for Regulators.

GHG
Greenhouse gases, including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) as well as some refrigerant gases.

tCO_2e – tonnes of carbon dioxide equivalent
This measure allows us to express the impact of different greenhouse gases in terms of the amount of CO_2 that would create the same amount of warming. See Global Warming Potential.

ISO 14064
The international standard that specifies how organisations should quantify and report their greenhouse gas emissions. ISO 14064-3 specifies the verification process for emissions reports.

UKWIR – UK Water Industry Research
A not-for-profit company that conducts research on behalf of the UK water industry. UKWIR develops the Carbon Accounting Workbook used to calculate carbon footprints.

DEFRA – Department for Environment, Food and Rural Affairs
The UK Government department with the remit for the provision of guidance on calculating organisational carbon footprints.

DECC – Department of Energy and Climate Change,
The former UK Government department that developed policy on climate change mitigation. DECC became part of the Department for Business, Energy and Industrial Strategy in July 2016.

PFI – Private Finance Initiative
A number of large waste water treatment works are operated on Scottish Water's behalf by private companies. The emissions associated with these works are reported as part of our operational carbon footprint.

Ml – Megalitre, or one million litres
The standard measure used by water companies to report the volume of water supplied or waste water treated.

EF – Emissions factor
A figure used to calculate GHG emissions resulting from a unit of material or fuel, such as a kilowatt hour of grid electricity or a litre of diesel.

kWh – kilowatt hour
A standard measure of energy, used to report consumption of electricity or natural gas.

MWh – Megawatt hour
Or one thousand kilowatt hours.

GWh – Gigawatt hour
Or one million kilowatt hours.

GWP – Global Warming Potential
This is a relative measure of how much heat a given mass of a greenhouse gas traps in the atmosphere, relative to the heat trapped by a similar mass of carbon dioxide. Methane (CH_4) has a GWP of 25, meaning that one tonne of CH_4 has the same warming impact as 25 tonnes of CO_2. See carbon dioxide equivalent.

CH_4 – Methane
A greenhouse gas with a global warming potential of 25.

N_2O – Nitrous oxide
A greenhouse gas with a global warming potential of 298.

The water industry in Scotland

Regulators provide assurance that Scottish Water meets the interests of our customers, protects the quality of drinking water and the environment, and is accountable for our performance. The water industry in Scotland is regulated as shown in the diagram on this page.

The Scottish Parliament
Holds Scottish Water and Scottish Ministers to account and regularly calls executives to its committees to give progress updates.

The Scottish Government
Scottish Ministers set the objectives for Scottish Water and appoint the Chair and Non-executive Members.

Scottish Water
Responsible for providing water and waste water services to household customers and wholesale Licensed Providers. Delivers the investment priorities of Scottish Ministers within the funding allowed by the Water Industry Commission for Scotland.

Water Industry Commission for Scotland (WICS)
Economic regulator. Sets charges and reports on costs and performance.

Drinking Water Quality Regulator (DWQR)
Responsible for protecting public health by ensuring compliance with drinking water quality regulations.

Scottish Environment Protection Agency (SEPA)
Responsible for environmental protection and improvement.

Scottish Public Services Ombudsman (SPSO)
Responsible for investigating complaints about public services in Scotland, including Scottish Water, once the services' complaints procedure has been completed and sharing lessons from complaints to improve the delivery of public services.

Citizens Advice Scotland (CAS)
Represents the interests of consumers within Scotland's water industry.

Customer Forum
Responsible for ensuring that customers have a clear voice in the business planning and price setting processes and at the heart of key decisions that affect the services Scottish Water customers pay for.

Other regulators
Like other companies and utilities, Scottish Water is also regulated by a variety of other bodies such as the Health and Safety Executive (HSE), Environmental Health Officers and the Scottish Road Works Commissioner.

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