Water today, water tomorrow

Playing our part – reducing greenhouse gas emissions in the water and sewerage sectors Supporting information

OFWAT

About this document

This document sets out and considers the data we have collected from the water companies in England and Wales on the projected greenhouse gas emissions associated with the sectors over the next five years.

It also sets out for the first time the projections for the 'embedded' emissions resulting from the companies' capital activities. We consider the accuracy and reliability of this data and draw some conclusions on what this means for future decision-making.

Finally, it touches on the existing and future incentives on the companies to reduce their emissions. We are considering this work in more detail as part of our overall strategy to contribute to delivering sustainable water.

Contents

1. Introduction

Climate change has both global causes and consequences. Dealing with it requires international collective action. The key means by which the world can mitigate the extent of climate change is by reducing the amount of greenhouse gas emissions[1] that are released into the atmosphere.

As part of the Copenhagen Accord of 2009, most countries have now recognised the goal of limiting the average global temperature rise to 2ºC or below. To achieve this, recent studies have estimated that global greenhouse gas emissions will have to peak between 2015 and 2021 and be reduced by 50% by 2050 from 1990 levels[2]. The Copenhagen Accord includes the aim of "achieving the peaking of global and national emissions as soon as possible."

The Climate Change Act 2008 makes the UK the first country in the world to have a legally binding long-term framework to cut emissions. It sets targets to reduce them by 80% from 1990 levels by 2050. The Government aims to meet this target by achieving reductions of 18% below 2008 levels by 2020; with a minimum reduction of 1.4% a year.

With such challenging national targets, it is clear that the water and sewerage sectors in England and Wales have a part to play. Reducing the sectors' emissions in a way that is effective, efficient and equitable requires us and the companies to gain a robust understanding of where those emissions come from and the drivers for change. This includes the emissions for which the companies are directly and indirectly responsible.

From 2007, we required the companies to calculate and report the annual operational emissions for which they are responsible. In order to encourage uniformity, maintain comparability and reduce the regulatory burden, we have based our guidance on Defra's national emissions accounting guidance. As Defra has adapted its guidance over time, we have done the same, so that we remain consistent.

[1] Greenhouse gas emissions are measured in terms of carbon dioxide equivalent (CO_2e). This is the unit of measurement (also sometimes expressed as CO2e) used throughout this document. In this document the terms "emissions" and "carbon" should be considered to mean all greenhouse gas emissions.
[2] From an information note released by UN Environment Programme, available at: http:www.unep.org/PDF/PressReleases/temperature-briefing-21-02-10-final-e.pdf

As part of the 2009 price review (PR09), we required the companies to project and report the emissions that would result from the activity they proposed to carry out over the next five years. The information we collected from the companies' business plans falls into two main categories. These are:

- operational emissions; and
- embedded emissions.

The data that the companies provided in their business plans enables us, for the first time, to assess with a degree of confidence the future emissions that will result directly and indirectly from the business of delivering clean water and managing wastewater.

Having this data allows us to develop our understanding on the key causes of emissions from those processes. It also enables us to draw conclusions about the sectors' current capacity for emissions reduction, given the existing standards and service outputs that the companies must meet. This is vital because we do not want water customers to pay an unfair proportion of the costs of reducing emissions across the UK.

The companies are now using the latest accounting guidance in their reporting. This has allowed them to present more detail on their emissions and the sources of those emissions for 2009-10 than in previous years. This will give us much greater understanding and allow us to track progress consistently in specific areas over the next five-year asset management period (AMP5). We will use this information to help us determine the most appropriate regulatory responses.

Most of the companies that we regulate recognise that they must play a part in reducing global emissions. Based on their developing understanding, many have set themselves ambitious, long-term, emission reduction targets in their strategic direction statements.

We have also seen numerous schemes in the companies' business plans for the next five years, which contribute towards reducing emissions and providing benefits to consumers. These include measures to:

- improve energy efficiency;
- increase renewable energy generation; and
- manage catchments to reduce the depletion of existing carbon stores.

We have set out some examples of this work in 'Climate change – good practice from the 2009 price review', which we published in April 2010.

2. Defining greenhouse gas emissions

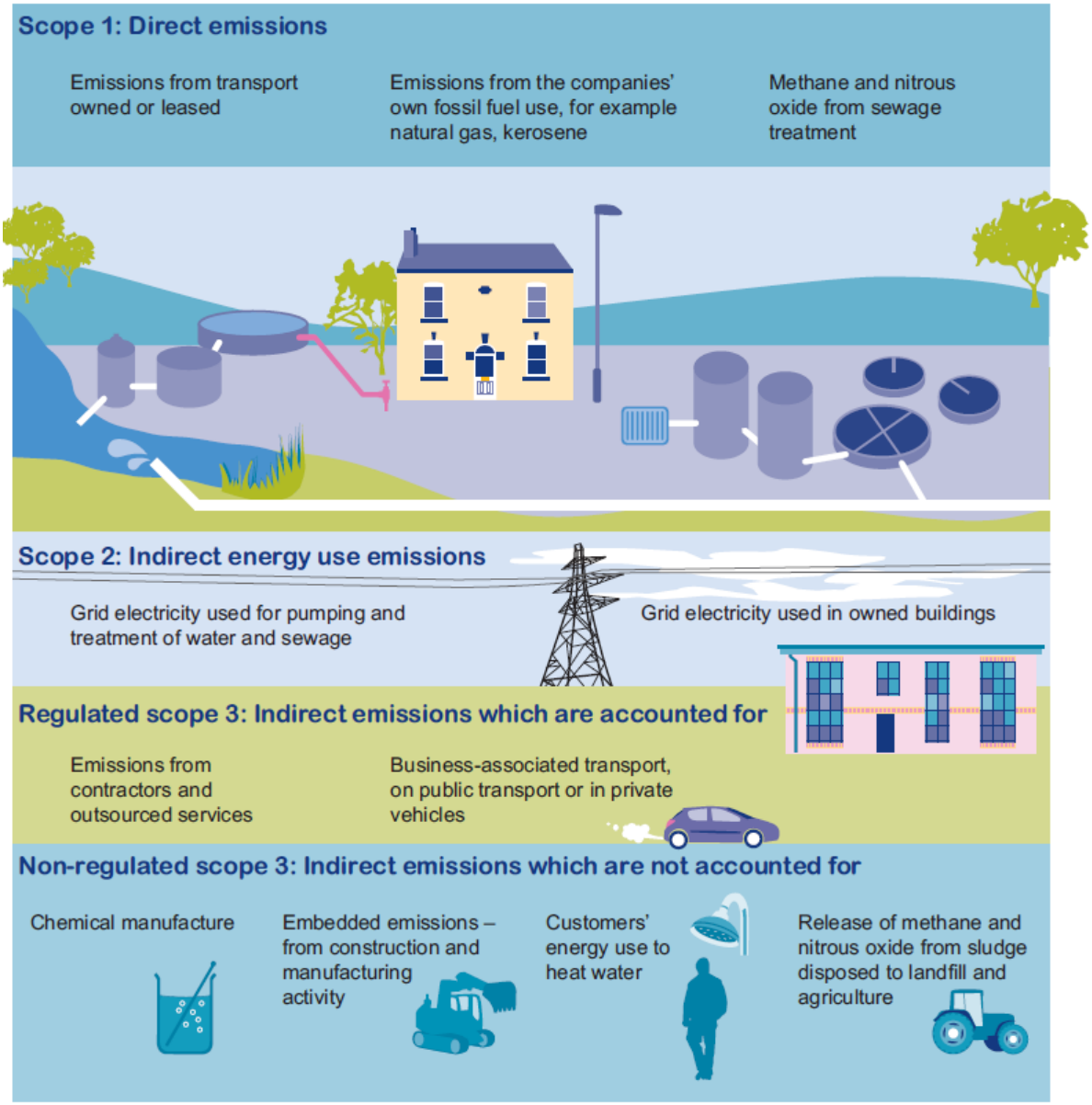
The sectors have a direct and indirect influence on a number of sources of emissions. This is illustrated in figure 1 below.

We have used definitions and distinctions that are derived from the most recent national guidance on this issue. We aim to ensure that the data we collect and use conforms to national reporting conventions and is nationally comparable.

In line with this guidance, we split the companies' emissions into three categories.

- **Scope 1** – all emissions from processes which are the organisation's direct responsibility.
- **Scope 2** – the emissions associated with the organisation's grid electricity use.
- **Scope 3** – all other emissions, which may be indirectly associated with the organisation, but which come from sources that the company does not own or control.

Figure 1 The greenhouse gas emissions associated with the water and sewerage sectors



We also distinguish between emissions directly associated with the day-to-day business of delivering clean water and removing and treating wastewater, and those that are not. We term these 'operational' and 'non-operational' emissions.

When we refer to operational emissions, we mean all of a company's scope 1 and 2 emissions, and the operational scope 3 emissions shown in figure 1[3].

The embedded emissions from construction activity and those that result from customers' use of water in the home are the two most significant non-operational scope 3 emissions associated with the sectors. We explore these in more detail later in this document.

[3] Up until the 2009-10 reporting year, operational emissions have also included the emissions resulting from disposal of sludge to land. These emissions are now not included unless the company owns that land. This is on the basis that the emissions are the primary responsibility of the land owner.

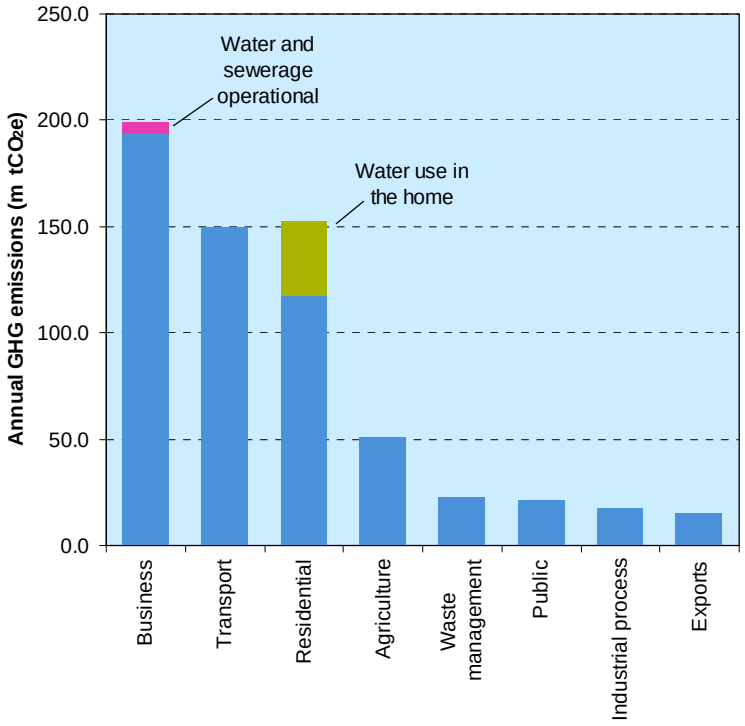
3. Greenhouse gas emissions in the water and sewerage sectors

The sectors' operational emissions make up approximately 0.7% of the UK's total greenhouse gas emissions. They are a large contributor predominantly because of the highly energy-intensive pumping and treatment activities and the large volumes of water and wastewater that they deal with.

Figure 2 below shows the UK's annual total greenhouse gas emissions split into eight organisational categories, according to data from the Department of Energy and Climate Change (DECC). We have shown the proportion of this total that is directly and indirectly associated with the sectors according to the data that the companies have reported to us in their June returns.

For simplicity, we have shown the sectors' operational emissions as a proportion of the business sector. However, it should be noted that these emissions will actually fall across a number of different categories, for example transport and waste management.

Figure 2 Annual UK emissions of all greenhouse gases by sector[4]



[4] Using Department of Energy and Climate Change statistics for UK emissions by sector available at: http://www.decc.gov.uk/en/content/cms/statistics/statistics.aspx

The graph shows that the sectors' operational emissions are only a part of the overall picture. But we must remember that the national total is made up of lots of sectors of varying sizes. Most of these contribute less than the water companies. For example, the total annual operational emissions of the sectors are comparable to the total annual emissions of all the buses in the UK (4.9m tCO_2e in 2008)[5]. This means that the sectors have role to play in reducing UK emissions.

The graph also shows emissions attributed to consumers' water use (predominantly by heating it). Heating water in the home for personal use, and household washing, cooking and cleaning is responsible for approximately 26% of domestic energy use. This is estimated to result in emissions of approximately eight times that of the sectors' operational emissions[6].

In general, we exclude these when we look at the emissions for which the companies are responsible. This is because they are the primary responsibility of the consumer. However, it is clear that the companies have a vital role in indirectly reducing emissions in this area by promoting water efficiency.

This is the current position, representing what is traditionally understood to be the sectors' greenhouse gas emissions. However, until recently the companies have only considered the operational emissions associated with their routine activity. This is not the whole picture. 'Embedded' emissions from the extensive construction activity that takes place every year has not previously been included or discussed in detail. It is for this reason that we asked the companies to quantify those emissions in their business plans. We explore the extent of these emissions in more detail in chapter 6.

[5] DECC Statistics on emissions of all greenhouse gases from 1990-2008 by NC source and end-user sector available at: http://www.decc.gov.uk/en/content/cms/statistics/climate_change/gg_emissions/uk_emissions/uk_emissions.aspx

[6] As calculated by the Environment Agency – see the report available at: http://publications.environment-agency.gov.uk/pdf/GEHO0508BOBS-E-E.pdf

4. Greenhouse gas emissions accounting in the water and sewerage sectors

The companies have been proactive in measuring and understanding their emissions. WaterUK, the industry body, has published estimates for the sectors' greenhouse gas emissions in its sustainability indicators reports since 1998. Initially, this data was reported at an industry level and was highly uncertain.

Since 2007-08, the companies' emissions have been reported in a more complete sense. We now collect and publish each company's operational emissions and its relative emissions intensity in our annual service and delivery report. Our reporting requirements have evolved over the past three years to reflect improved understanding and the latest national guidance.

UKWIR methodology

UKWIR, the sectors' collaborative research body, has been proactive in developing methodologies for estimating actual and projected emissions.

In 2005, it developed a carbon accounting workbook, which all the companies now use. This is a spreadsheet-based tool that allows the companies to estimate the emissions from all aspects of water and sewerage activity. This was a significant step forward in the sectors, as it developed means of estimating emissions from energy, transport, administration and treatment processes.

The workbook now provides a consistent means of calculating a company's operational emissions that all companies can apply. UKWIR has updated the workbook periodically to account for revised regulatory guidance and improved understanding. The latest version, which we helped to support, was released in April 2010.

UKWIR has also produced additional work to help the companies estimate embedded emissions and non-CO_2 emissions from sludge and sewerage processes. Current understanding of these is poor. This research has helped us and the companies greatly to determine projections for greenhouse gas emissions in the sectors.

In their business plans, the companies' projected their future greenhouse gas emissions using methods derived from the common approaches that UKWIR developed. This work forms a core of principles and methodology for the companies to use. However, in order to understand their own emissions properly, the companies have to build on this work and develop their approaches further. As a result, the approaches that the companies have taken differ greatly in rigour.

Projecting future operational emissions usually involves estimating current emissions and then accounting for future changes; for example, in energy use. This is the general approach that many of the companies have taken.

A more robust approach also seeks to estimate the degree to which each project in the business plan is expected to result in a change to existing operational emissions. For example, the degree to which a project to replace old pumps with more efficient ones will reduce energy consumption. Most large companies did this for projects where a change in emissions was an obvious benefit of the scheme.

For embedded emissions, there are two main types of approach.

- A ‘top-down’ approach, where a company makes an overall estimate of the emissions associated with a group of projects using broad general assumptions. Some companies had as few as three of these groupings in their entire programme.
- A more accurate, but more difficult, approach calculates the emissions associated with different parts of each project from a component level. This requires an in-depth understanding of each project.

There is also a third approach, which combines elements of the two outlined above. This involves carrying out bottom-up assessments for large schemes, but using top-down estimations for groups of smaller projects. Most companies have taken this approach to calculating embedded emissions.

There is a great deal of uncertainty in the methodologies that the companies have used for projecting both operational and embedded emissions. Many of the companies’ assumptions are based on limited research and do not account for future changes.

This is especially true of the embedded emissions projections. These rely on developing data and an often poor understanding between the companies and third parties. In some cases, the error margins for embedded emissions projections are as high as +/- 100%. Since the primary factors determining operational emissions, such as energy consumption, are comparatively well understood, the level of confidence in operational emissions projections tends to be much higher.

Inevitably, there is significant uncertainty in projecting future emissions from the companies’ business plans. This is because the details and scopes of many schemes are not fully worked out at that stage. Most companies’ projections for emissions are based on high-level, preliminary design information. And companies often reprioritise and change their planned activity following a price determination. This is because in most cases they are obliged to deliver the high-level outputs we set rather than the specific projects that they proposed.

We can conclude that the accuracy of the emissions projections for the next five years is relatively low. For the reasons described above, there is significant uncertainty even for the companies that have the most well-developed estimation techniques.

Having said this, the large sample range of available data from the companies' business plans and the general commonality of approach across the sectors mean that we can place some confidence in the results at a high level. Comparative conclusions on the relative scale of emissions attributed to different companies and activity types and over time are also possible.

5. Operational emissions

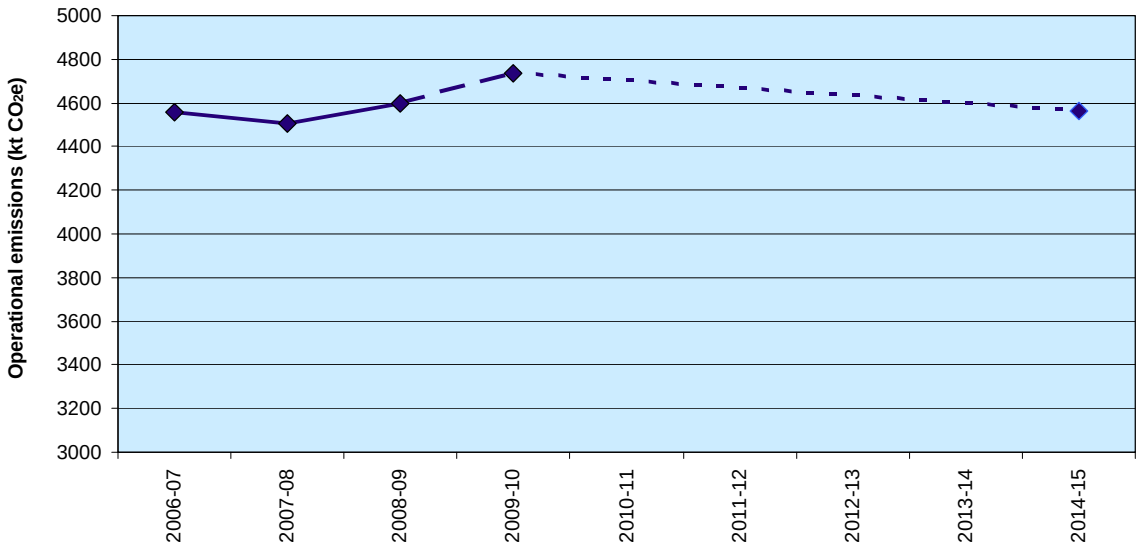
This chapter discusses the annual operational emissions for which the companies are responsible.

It is likely that operational emissions in the sectors have increased over the past ten years and grown significantly since privatisation. Although historically there is not much reliable data, the information that WaterUK has collected suggests strongly that this is the case.

Water UK has estimated that energy use, the key driver of operational emissions, has doubled since 1989. Some companies have estimated an increase of more than 40% in energy use since 1996-97. This can be attributed mainly to demand growth and more energy-intensive sewerage treatment processes. However, this trend seems to have slowed in recent years – increasing by approximately 6% since 2002[7].

Figure 3 shows the estimated emissions in the water and sewerage sectors since 2006-07 compared with the business plan projections for 2009-10 and 2014-15.

Figure 3 Operational greenhouse gas emissions of the sectors (historic and projected)



[7] From data collected and published by Water UK, available at: http://www.water.org.uk/home/policy/reports/sustainability

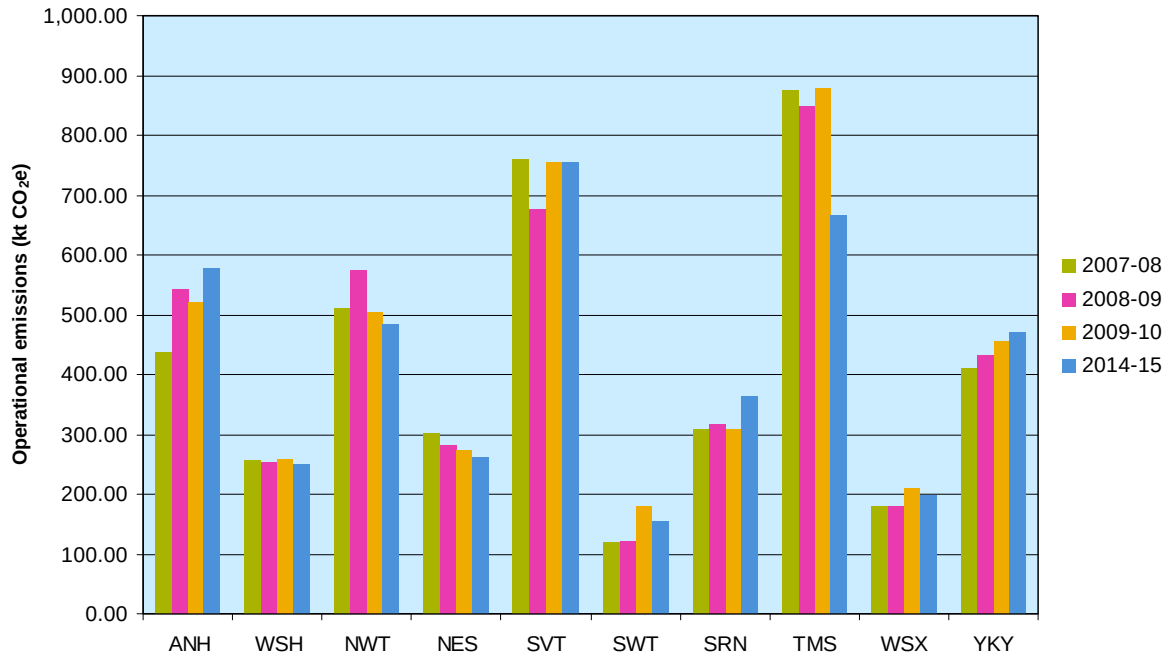
The data suggests that overall operational emissions in the sectors have remained broadly stable (that is, within 5%) over the last four years. This is the period over which we have relatively comparable and reliable data.

This is in a context of falling national greenhouse emissions. The UK's total emissions, as reported under the Kyoto protocol, have been reduced by over 18% since 1990[8].

5.1 Company projections

Figures 4a and 4b below show the actual total annual operational emissions reported by each company for the past two years compared with the projections reported by companies for the start (2009-10) and the end (2014-15) of the AMP5 period. This is the first time these projections have been shown and set alongside the data on actual operational emissions associated with each company.

Figure 4a Annual operational emissions as reported and projected by water and sewerage companies



[8] DECC Statistics on results for UK greenhouse gas emissions and progress towards Kyoto targets available at: http://www.decc.gov.uk/en/content/cms/statistics/climate_change/gg_emissions/uk_emissions/2008_final/2008_final.aspx

Comparison between the ‘actual’ emissions data of 2008-09 and the projected emissions at the end of AMP5 shows that six of the water and sewerage companies have projected an increase. Only three companies project a decrease and one remains relatively stable.

The most significant projected increases over the five years of AMP5 relative to 2008-09 are for Southern Water and Severn Trent Water.

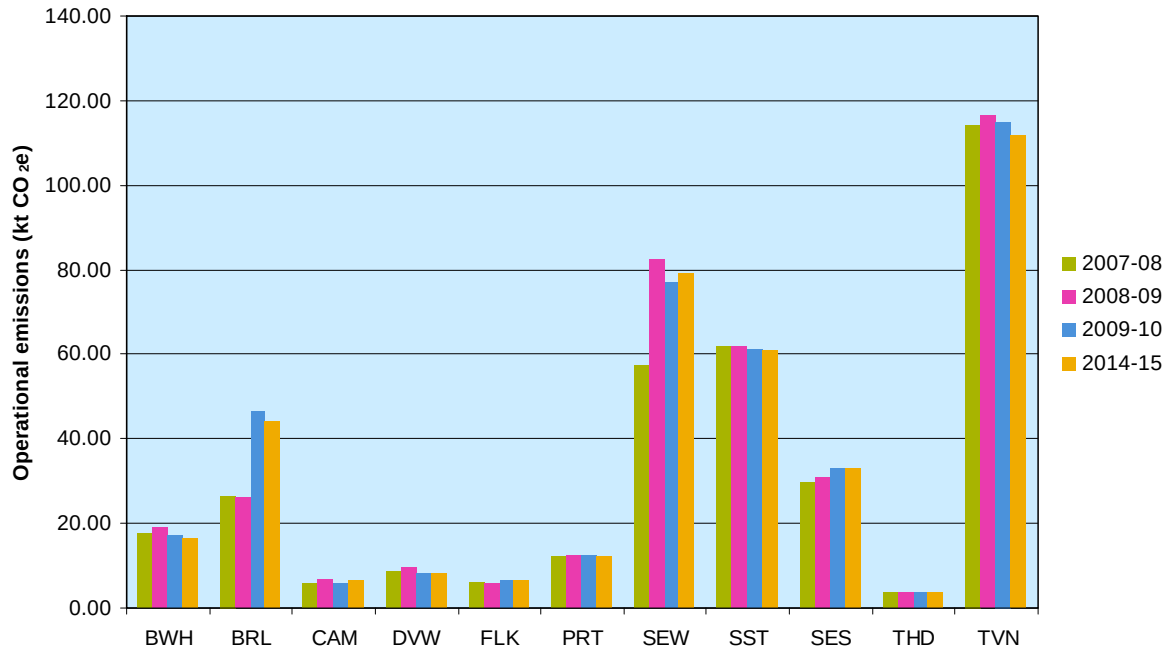
Southern Water expected to see a large increase in its operational emissions associated with its sewage treatment processes, to such an extent that its mitigation programme only reduces the scale of the increase.

Severn Trent Water actually projected stable emissions compared with 2007-08. However, the company’s more recent actual performance suggests that its annual emissions have reduced more quickly than previously forecast.

Similarly, United Utilities projected a significant decrease compared with the most recent actual data. However, the expected increase is actually smaller when compared with its results for 2007-08 and its own projections for 2009-10.

Thames Water projected the most significant decrease. The main reason for this is the company’s plan to buy electricity from a low-emissions source and report this as a decrease. Purchasing ‘greener’ energy in this way is less preferable than reducing emissions directly. This is because the responsibility (and hence benefit) for those reductions really belongs to another organisation. For this reason, reporting requirements do not usually allow the companies to present a reduction in their emissions associated with these types of ‘indirect’ mitigation.

Figure 4b Annual operational emissions as reported and projected by water only companies



Of the water only companies, five projected a minor decrease and two projected a small increase. The emissions of three water only companies are projected to remain stable. Bristol Water projected a significant increase in its operational emissions over the five years. This is because of the large increase in investment and activity over historic levels that the company proposed in its business plan for the period 2010-15.

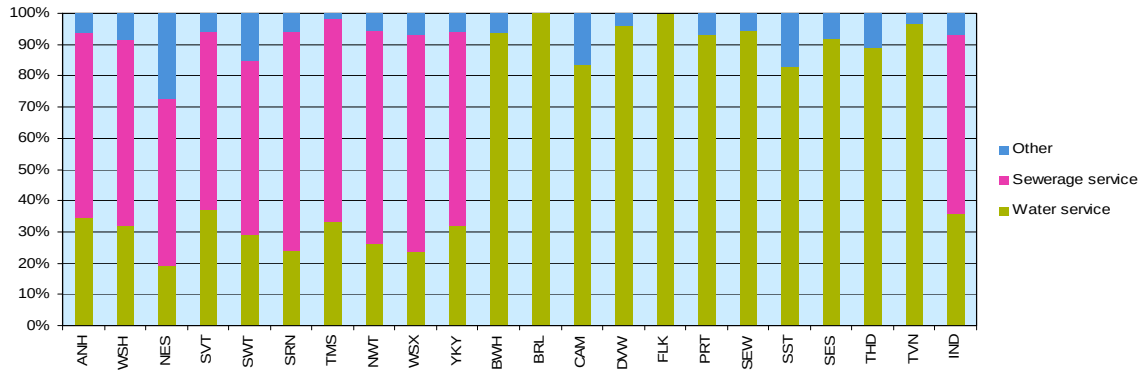
As the figures show, there is no clear trend across the sectors. Overall emissions are projected to fall by a small amount in total (approximately 0.75% from 2008-09 levels). However, this is only the net effect of a number of increases and decreases of varying intensity across companies.

Nine companies project an upwards or downwards change from current levels of more than 10%. This appears to be a significant change in operational practices over a short space of time for any company given that this is in the context of a national annual reduction target of 1.4%. However, we have seen changes of this magnitude between emissions data reported for consecutive years in the June returns. These changes can be largely because of variations in external factors, such as the weather.

5.2 The relative contributions of parts of the sectors

We can establish the proportion of emissions that are associated with water activity and the proportion associated with sewerage activity. Figure 5 shows the proportion of operational emissions associated with water service activities, sewerage service activities and 'other' activity for each company. 'Other' activity can include, for example, emissions from transport and administrative buildings. We have calculated this from the data the companies report in their June returns on emissions intensity.

Figure 5 Breakdown of greenhouse gas emissions assigned to water, sewerage and other activity



The data shows that for water and sewerage companies, the greater proportion of their operational emissions are associated with the sewerage service. This includes the methane and nitrous oxide emissions that result from disposing of sewage sludge to land[9].

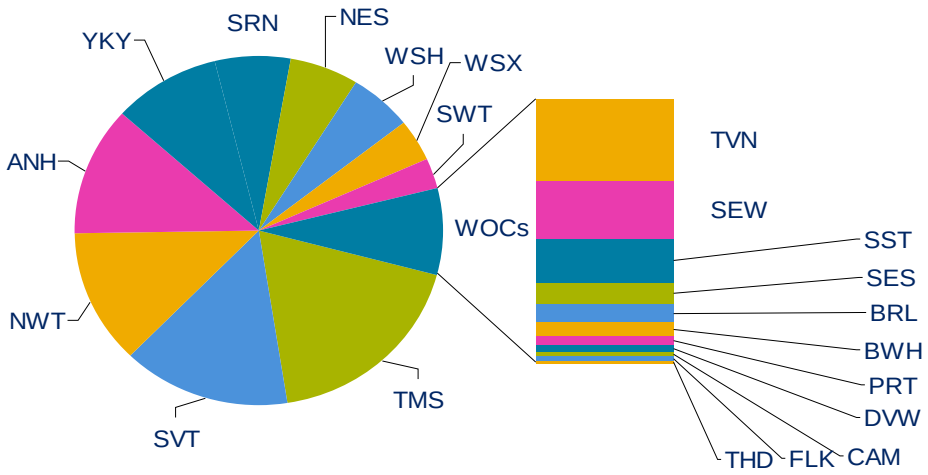
Across the sectors, 'other' activities account for approximately 7% of the total annual operational emissions. However, it is clear from our analysis that different companies have assigned emissions to this category differently. This demonstrates that allocation remains a significant issue in emissions accounting.

The rules for allocating emissions to different drivers and parts of the business are often open to interpretation. For example, Northumbrian Water appears to have assigned a relatively greater proportion of its emissions to the 'other' category. This means that the company appears to have relatively less intensive water and sewerage services than would otherwise be the case.

[9] It is important to note that most of the emissions from disposing treated sludge to land will not be included within a company's operational emissions from 2009-10. In most cases, these emissions are only the indirect responsibility of the water and sewerage companies.

The amount of emissions from each company varies widely across the sectors. Figure 6 shows the relative proportions of the total operational emissions that can be attributed to each company.

Figure 6 Company proportions of total industry operational greenhouse gas emissions 2008-09



Water and sewerage companies are responsible for most operational emissions. Taken together, all of the water only companies account for approximately 8% of the total operational emissions in the sectors. Just four companies are responsible for more than 50% of the total operational emissions for the sectors.

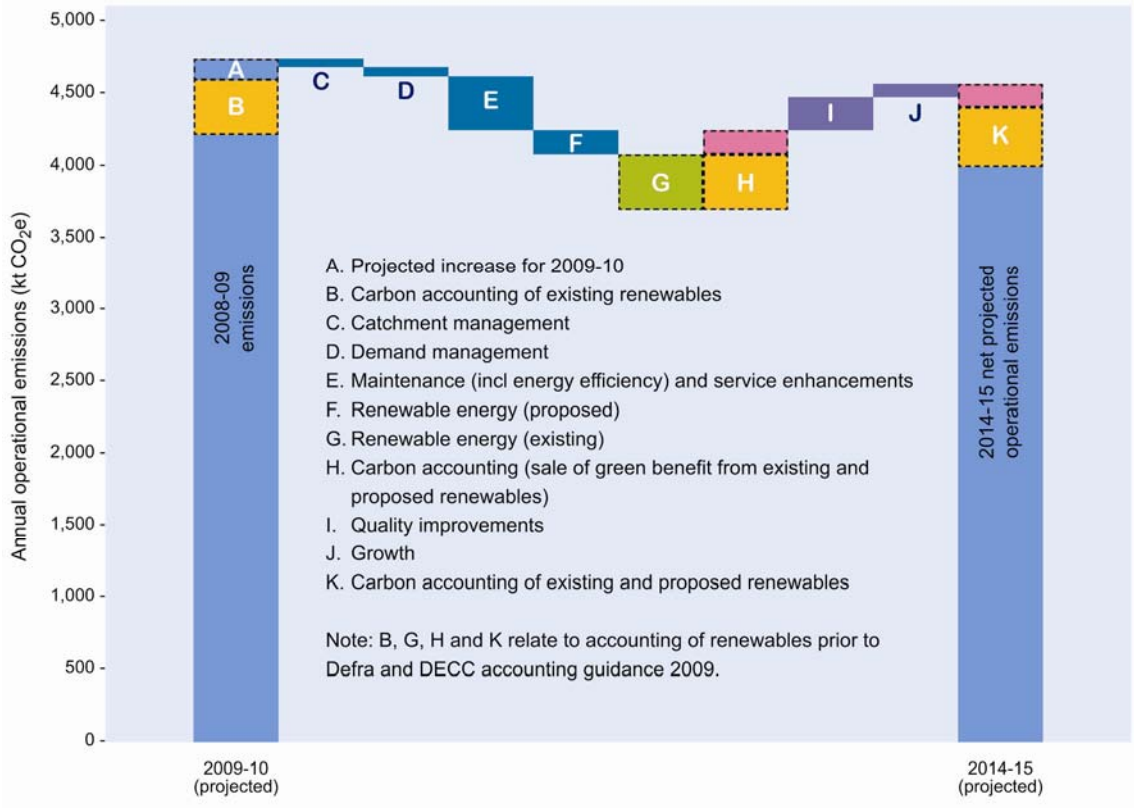
This aligns closely with other measures of size, such as turnover and operating expenditure. Operational emissions are aligned closely with operating expenditure. There is also a relationship between emissions and total population served; but each company's different circumstances (primarily between geographic features) tends to disrupt this relationship substantially.

Based on the projections that the companies made in their business plans, we can conclude that this general picture is not likely to change.

5.3 Drivers

There are a number of key drivers for changes in operational emissions over the period 2010-15. Figure 7 shows the net effects of the competing drivers on total operational emissions during this time. This uses the information presented to us in the companies' business plans. We have made some general assumptions about the effectiveness of planned energy efficiency measures and demand management.

Figure 7 Upwards and downwards drivers of operational emissions 2010-15



As we can see, there is more potential movement in the total emissions value than the difference between current actual and projected emissions for 2014-15 suggests.

For all companies, energy use is the primary driver of operational emissions. On average, we estimate that approximately 85% of the sectors' operational emissions arise from energy use. Most of this is related to electricity purchased from the grid. The proportion of operational emissions that the companies have attributed to grid electricity use varies, but ranges between 65% and 99%.

Therefore, in most cases an increase in energy use equates directly to an increase in emissions. As figure 7 shows, the companies have projected increases in energy use resulting from improvements to treatment processes and growth in demand.

To offset this, many of the companies have begun introducing or are planning to introduce energy efficiency measures that will decrease operational emissions over the AMP5 period. Companies are already incentivised to do this in order to reduce their costs. As a result, the projections indicate that there will be only a small net increase in emissions relating to energy use.

The local versus global environment

We support environmental improvements where they can be achieved equitably and efficiently. And we must maintain the high quality standards which exist today. However, we must strike the correct balance between local environmental improvement and long-term sustainability.

In the past, continually improving quality standards have been assumed to be an unquestionably good thing. It has been the job of the companies and us to find the most cost-effective way of meeting the standards. However, it is clear that incremental improvements to the aquatic environment can come at the cost of significant increases in emissions that damage the whole environment.

For example, implementing the Water Framework Directive is likely to require major activity on the part of the water and sewerage companies. Potentially, this could require a significant increase in energy consumption and embedded emissions. We need to try to find the best balance for a sustainable future.

To do this, we all have to examine the evidence to identify where there is the scope for flexibility. This will involve collaboration and a deeper understanding than we currently have of the real value of different improvements.

The companies' self-generation of renewable energy could have a big impact on their emissions. They have continued to increase the proportion of their energy use that they generate themselves from renewable sources. Some companies generate a greater proportion than others and some companies also export the energy or gas they produce.

The companies in England and Wales currently generate more than 600GWh of renewable electricity a year. This equates to approximately 8% of the sectors' annual energy usage. The companies also generate over 400GWh of renewable heat from combined heat and power processes, much of which is used by the companies. In line with the outputs we set out in our PR09 final determinations, the companies' generation of renewable energy is expected to grow by at least 30% over the next five years.

However, previously, the companies were unable to include in their projections any decrease in emissions associated with their own generation of renewable energy. This is because they usually take advantage of available monetary incentives, thus effectively 'selling the emissions benefit' to another organisation.

This has changed for this year's June return. Our revised reporting requirements allow the companies to report a benefit associated with renewable energy generation in future regardless of whether they receive financial incentives to generate this energy. This is in line with the most recent national guidance.

Because the companies will continue to rely on electricity from the grid, the means by which that electricity is generated is a key factor in determining their total emissions. In its 'Low carbon transition plan', the Government has projected that meeting national targets will require a decrease in emissions of 22% from the power and heavy industry sectors together. This involves changing the grid mix significantly to increase the proportion of the UK's energy generated from renewable sources. Our projections show that if these changes occur by 2020 and translate directly into a revised grid emissions factor, this could directly reduce the sectors' emissions by approximately 20% from current levels.

Combined with the companies' projected increase in their own renewable energy generation, total emissions in the sectors might reduce by 30% or more by 2020, compared to the total emissions presented in this document, where the benefit from companies' renewable energy generation becomes included in the figures.

The data available from companies' annual returns over the past two years indicates that there can be significant variations in annual operational emissions for companies from year to year. Much of this results from external factors, such as:

- rainfall patterns;
- new assets coming on-stream; or
- the availability of different disposal routes for sludge.

We need to better understand and consider how external drivers affect operational emissions. It is clear that both yearly and long-term changes can drive the companies' emissions. Other changes that have not been included in the companies' projections include the transfer of private sewers, and the impacts of the 2009 price review. We will continue to consider these factors as we track the companies' performance over time.

5.4 Company targets

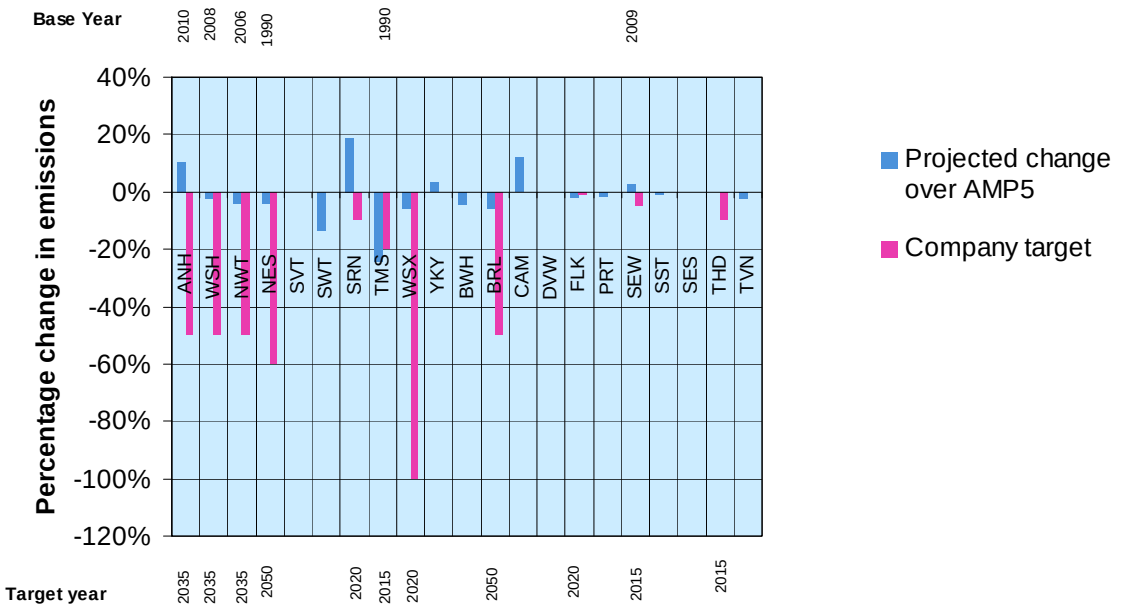
Despite the contribution the sectors make to national emissions, the companies are not subject to specific reduction targets.

However, as part of their 25-year strategic direction statements, some companies have set out voluntary, long-term, emissions reduction targets. Others have reiterated or stated new targets as part of their June return submissions.

Eleven companies have not set out any specific emissions reduction targets. Eleven have set themselves specific emission reduction targets with varying levels of ambition and over differing timescales. Four companies have also set their own targets relating to the generation and use of renewable energy.

These targets are set out in figure 8 and are compared with the companies' projected change in emissions during the next five years. Such targets remain entirely voluntary. Our current position is that companies should reduce their emissions economically.

Figure 8 Companies' voluntary reduction targets



The companies have used a variety of different base years and target dates. Some do not specify a base year, which renders their aim ambiguous. Others have set annual year-on-year reduction targets. We have also seen various interim targets in addition to those shown in the graph.

Using the projections that the companies provided, it is clear that most are unlikely to meet their own targets in the short term. Two companies that have put forward targets to reduce their emissions during the period 2010-15 actually project an increase in their emissions by 2015.

Most companies did not demonstrate clearly in their business plans how they would achieve these reductions. While we saw mitigation proposals and action plans in the companies' submissions, the net effect of these measures on emissions was not always related to any national or voluntary company targets.

For example, in its strategic direction statement, Wessex Water set out an aim to be 'carbon neutral' by 2020. Since its activities will still require energy, meeting this will require the company to either drastically increase its own generation of renewable energy or carry out significant carbon sequestration work. The company projected that it would reduce its emissions by 6% by the end of AMP5. This is in the right direction, but casts doubt on the assumption that a target of carbon neutrality is realistically attainable in the near future.

Several companies, such as Thames Water, did identify a specific mitigation strategy that was in some way tied to the ambitious targets they had set. Those companies explained the measures they planned to take to reduce their operational emissions, and the contribution that each measure made.

External factors, such as future water quality regulations, will influence greatly if the companies are able to meet the ambitious targets they have set themselves. As we discussed above, large external changes, such as in the way grid electricity is generated, could make companies' targets more achievable in future.

5.5 Key conclusions on operational emissions

We can draw a number of key conclusions on operational emissions in the sectors.

- Without significant step changes in external factors or operational practices companies' operational emissions are unlikely to change significantly over the next five years at the industry level.

- Continuing growth and improving quality standards will drive increases in energy demand over the next five years.

- While we have seen the companies propose significant investment to increase their generation of renewable energy, deploy more efficient technology and processes and institute other energy efficiency measures, the reductions resulting from these measures are likely to be offset by other drivers.

- Although the companies generate a significant, and growing, amount of renewable energy, this does not currently appear as a reduction their emissions. This is because the benefit has effectively been sold to other organisations. This has changed for the 2010 June return and will mean the emissions data we collect in future will not be directly comparable with the data presented here.

- The actions of external agencies (primarily the extent to which the electricity grid mix changes) have a large part to play in determining the future size of the companies' operational emissions.

6. Embedded emissions

Embedded emissions result from construction and maintenance activity. They are the emissions which result from extracting and processing raw materials, product manufacture and transportation to site. These should not be counted as part of a water and sewerage company's operational emissions as they are usually the primary responsibility of other companies. However, asset construction and maintenance is a large and important component of day-to-day activity in the sectors. It is for this reason that we asked companies to quantify the embedded emissions associated with their activity over the next five years. This chapter discusses the projections that they made.

6.1 Projections

The information collected from the companies on projected embedded emissions represents an important new data source. For every capital project included in their business plans, the companies were required to calculate and report the quantity of greenhouse gas in CO_2 equivalent that will be emitted up to the point where the asset is built. Emissions from asset disposal are very difficult to quantify and were excluded. For that reason, the figures we present here exclude any emissions resulting from asset disposal.

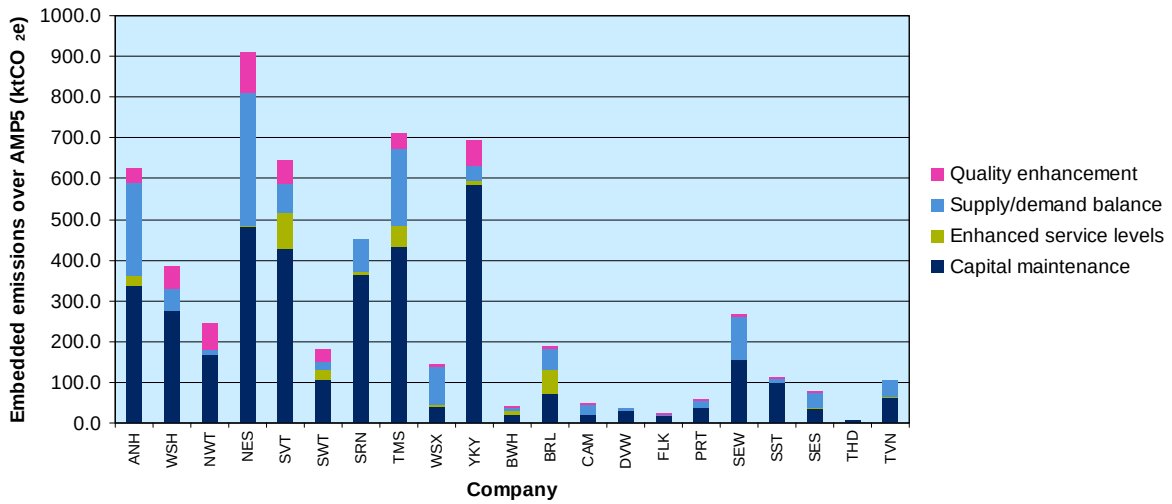
The data shows that the embedded emissions resulting from the companies' investment proposals for the period 2010-15 are in the same order of magnitude as annual operational emissions. The total embedded emissions attributed to the sectors is estimated to be approximately 11.6 million tonnes CO_2e, over the period. This is the equivalent of adding an additional 50% to the companies' annual operational emissions each year.

If we factor in the contribution from embedded emissions in the sectors, the companies are responsible for approximately 1.1% of the UK's emissions.

We present the companies' projections for embedded emissions over the next five years in the graphs below. It is important to bear in mind that we assign relatively low confidence to these projections. The potential extent of this inaccuracy is apparent when we come to compare companies of similar sizes.

Figure 9a shows the embedded emissions attributed to each company and each capital expenditure category for the water service.

Figure 9a Embedded emissions over AMP5 – water service



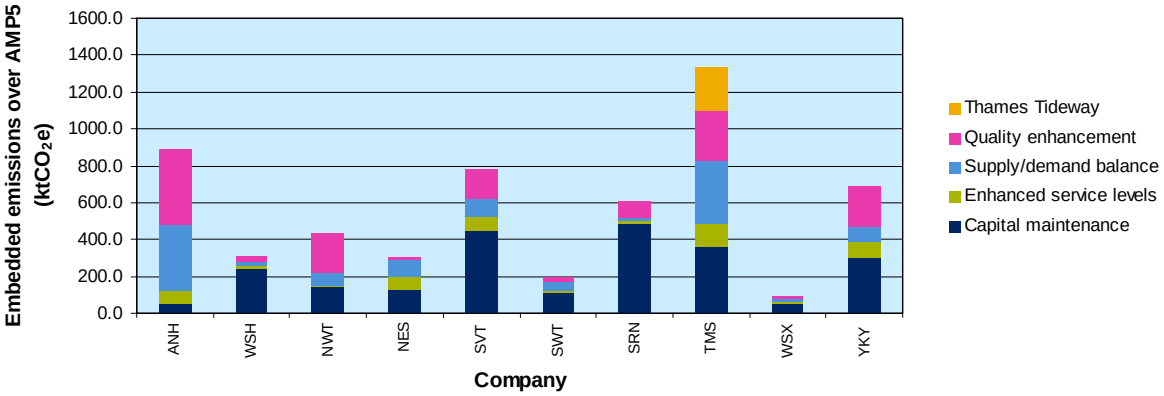
As the graph shows, most embedded emissions in the water service for all companies are associated with capital maintenance activity. This is largely predictable when we consider the scope and types of activity that are involved, particularly mains laying and replacement, and asset construction. All companies have to carry out this sort of activity, and usually to broadly similar degrees relative to the size of their asset base.

Activity to maintain the balance of water supply and demand is the second biggest cause of embedded emissions. However, this is much more variable across the companies. This is a result of the different circumstances and requirements related to the balance of supply and demand across the sectors.

Relatively fewer embedded emissions are projected to result from activity in the quality programme. This is likely to be because of the nature of the investment in this category, which tends to focus more on investigative activity, changes to existing treatment assets and process change rather than on asset construction. For some companies, emissions-intensive activity, such as proactively replacing lead communication pipes as Northumbrian Water proposed, results in a higher than usual level of embedded emissions associated with this category.

Figure 9b shows the embedded emissions attributed to each company and each capital expenditure category for the sewerage service.

Figure 9b Embedded emissions over AMP5 – sewerage service



For the sewerage service, the proportions of embedded emissions associated with each type of activity are much more variable than for water. A significant proportion of the embedded emissions for most companies are still associated with maintenance. However, the range across companies is much wider.

This could be because of the less proactive nature of maintenance regimes for sewerage infrastructure. There is a much lower rate of proactive sewer renewal than for water mains since service levels are usually less likely to suffer from a fix-on-fail approach to maintenance. The result of this is that there is more reactive capital maintenance activity in the sewerage service.

Accurately estimating the embedded emissions associated with uncertain reactive maintenance work is even more difficult then for planned work. As a result, the embedded emissions associated with reactive activity are likely to be even more inaccurate than the projections for planned work. This could mean substantial under or over estimation in some companies' projections.

For some companies, changes to strategies for dealing with sewage sludge are projected to entail a large quantity of embedded emissions. The total £1.5 billion expenditure that companies proposed to deal with sludge, and hence the associated embedded emissions, were allocated across capital maintenance and enhancement categories, depending on an individual company's particular issues.

For both water and sewerage services, expenditure to enhance service levels is expected to result in relatively few embedded emissions. The companies that projected high emissions associated with this category were invariably those who proposed large network resilience schemes to reduce the risk of supply interruptions.

These schemes involve laying new pipes and building other associated assets in order to develop network interconnection. These types of construction activity are intensive in terms of embedded emissions. For example, Wessex Water's 'integrated grid' scheme has high associated emissions since it involves laying a significant quantity of new mains and associated assets.

The Lee tunnel

Thames Water's construction of the Lee tunnel is the single most significant scheme in terms of embedded emissions proposed in the companies' business plans. It is projected to result in more than twice the amount of embedded emissions as the next biggest single scheme proposed in business plans.

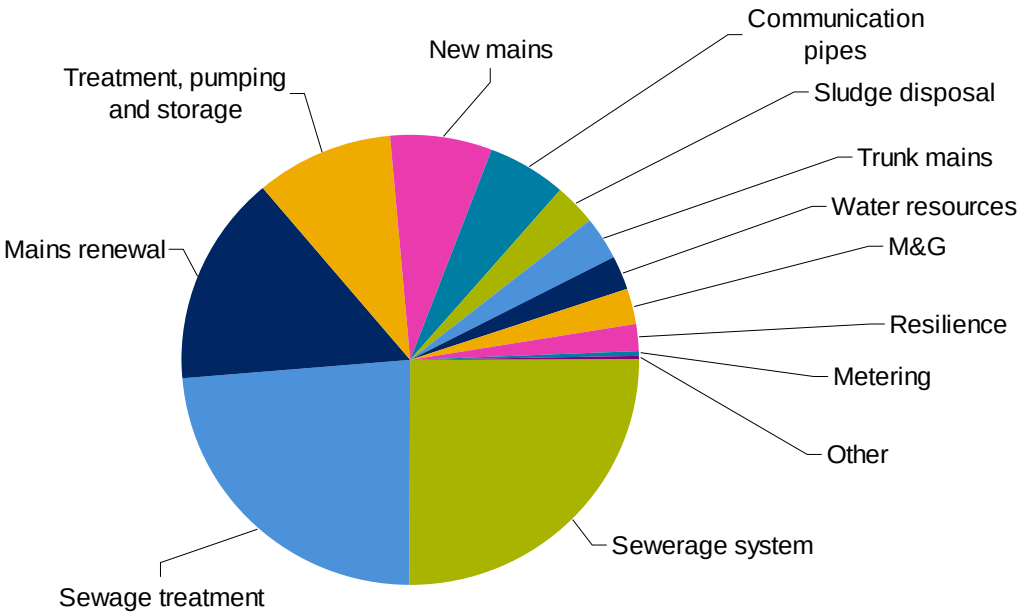
The project involves the construction of a 7.2 metre internal diameter tunnel with a total length of approximately 7 km. The scheme is projected to result in approximately 233 kt CO_2e of embedded emissions over the next five years, which represents 2% of the total embedded emissions in the sectors.

6.2 Activity types

Figure 10 below shows the proportion of embedded emissions over the next five years associated with each of 13 activity categories.

To derive this information, we used a sample of the project-specific data that the companies provided. Their submissions on emissions associated with individual projects were often inconsistent and incomplete. Some companies did not report reliable project level data. For these reasons, we have used only a sample of the information that excludes anomalous entries. The sample is broadly representative of the mix of activity types occurring across the companies. We have excluded the Thames Tideway scheme from this dataset since it is so significant on its own.

Figure 10 Proportion of embedded emissions associated with activity types



Activity types

- **Mains renewal** – includes mains replacement, relining and cleaning activity. This category also includes some other activity types associated with the distribution system, for example, valve replacement and flow monitoring and control.
- **Communication pipes** – includes all activity on pipes to customer properties. Significant activity in this area is related predominantly to replacing lead pipes to meet quality standards.
- **Trunk mains** – includes all renewal and cleaning projects associated with large diameter trunk mains.
- **New mains** – includes all projects where the laying of pipes is in a new location, as opposed to projects aimed at replacing, cleaning or repairing existing pipes. This category includes activity to serve new developments, as well as diversions, 'duplication' and new network linkages. New trunk mains and network resilience schemes are also included in this category. In some cases, this category also includes the emissions from construction of associated pumping assets where these have been bundled together.
- **Treatment, pumping and storage** – includes all activity associated with constructing and maintaining water treatment works, water pumping stations and service reservoirs.
- **Water resources** – includes activity such as raising reservoirs, new boreholes and other measures to increase the available water supply.

- **Metering** – includes activity associated with installing and renewing revenue meters. This category does not include activity associated with district meters or telemetry.
- **Sewerage system** – includes all activity associated with sewer systems, including sewer repair and refurbishment, building detention tanks, and refurbishing and building pumping stations. This category includes activity to improve drainage and mitigate sewer flooding risks.
- **Sewerage treatment** – includes activity associated with treating and discharging wastewater. Sludge disposal activity is separated but there is inevitably some overlap between these two categories where information is unclear.
- **Sludge disposal** – includes activity associated with sludge treatment and disposal. This category includes activity to develop advanced digestion and combined heat and power (CHP) assets.
- **Resilience** – includes all activity to protect individual water and sewerage assets from external hazards. This category does not include water network resilience schemes, which have been classified as 'new mains' activities.
- **M&G** (management and general) – includes all activity relating to offices, site security, IT systems, billing, data monitoring and analysis and vehicles associated with both the water and sewerage sides of the business. In some cases, this expenditure includes telemetry and district metering activity and therefore may overlap with 'other mains'. We have also included investigations in this activity group since emissions associated with this type of activity are negligible.
- **Other** – includes all activity that does not fall into any of the above categories, for example small-scale local environmental improvements.

The data shows that the most emissions-intensive activities in the sectors are:

- renewing and laying new water mains;
- constructing and repairing sewers; and
- developing sewage treatment, particularly to enhance effluent quality.

Enhancements to the sewerage system are particularly intensive in terms of emissions. Four of the five most emissions-intensive construction schemes in the sample involve upsizing sewers and building detention tanks. This suggests strongly that simply upsizing the sewer network to deal with drainage and sewer flooding issues is not sustainable.

All companies renew a significant amount of their infrastructure every year. In their business plans, most have also argued that the rate of asset renewal must increase over time in order to maintain levels of service in the circumstances of a large and ageing asset base. Whether or not this is the case, it is highly likely that maintenance activity across the sectors is likely to remain at least at the same order of magnitude over the coming years.

For all companies, management and general activity, activity specifically to increase the resilience of assets and metering activity result in relatively few embedded emissions.

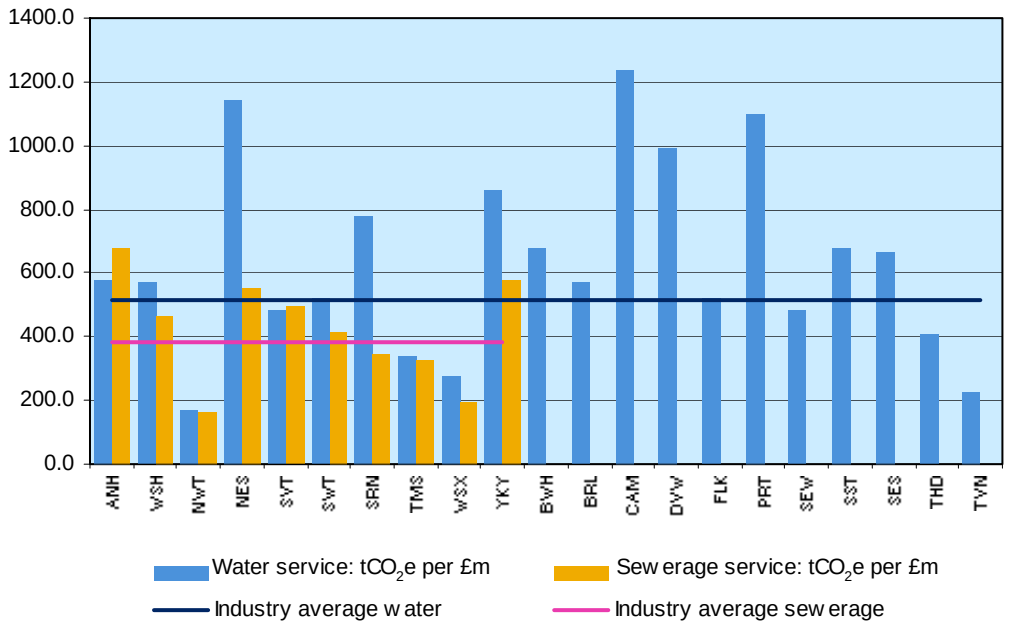
Figure 10 above shows a representation of the water and sewerage companies. However, it is clear from our sample that the proportions allocated to each category differ widely across companies dependent on proposed capital programmes and investment priorities.

6.3 Embedded emissions intensity

Normalising the embedded emissions data enables us to draw conclusions about the relative emissions intensity of different companies' activities. The most appropriate normalising factor is projected capital expenditure. This is the primary factor that many companies have used, directly or indirectly, to determine the embedded emissions for most of their projects.

Figure 11 shows the total company projected embedded emissions per pound of proposed gross capital expenditure for water and sewerage services.

Figure 11 Embedded emissions in tCO_2 per £m of proposed capex



The data shows that there are sizeable differences between companies in terms of emissions intensity. It appears that, in general, water only companies are more embedded-emissions intensive than water and sewerage companies. In addition, activity in the sewerage service is relatively less embedded emissions intensive than water service activity.

The mean emissions intensity is about a third lower for the sewerage service than the water service. This does not hold true for all companies, however. For example, Anglian Water projected more emissions-intensive work in the sewerage service than in the water service.

Clearly, the embedded emissions associated with each company are largely dependent on company-specific programmes, circumstances and the estimation methodologies used. This is shown most clearly by the large differences between intensity of some companies. Thames Water, Wessex Water and United Utilities are clear outliers in that their activities look relatively less intensive in terms of emissions. Conversely, Northumbrian Water, Cambridge Water, Dee Valley Water and Portsmouth Water look relatively much more intensive in terms of emissions.

These differences could be because of any of the following reasons.

- Outlying companies are more or less efficient in procuring in an emissions-efficient way.
- Outlying companies are more or less efficient in cost terms.
- Some companies have under or over estimated their emissions.
- Planned activity and company circumstances are sufficiently different to mean that there is little correlation between cost and embedded emissions at this level of granularity.

The most likely explanation is a combination of the factors outlined above. Statistical testing shows that there is a reasonably strong relationship between expenditure and emissions, but there are significant deviations from this trend. This suggests there are a number of important factors other than expenditure that are driving embedded emissions.

We can conclude that the differences are unlikely to be the result of some companies selecting consistently and significantly more emissions-efficient means of delivery than others. We know this because it is clear from business plans that the role of emissions in the companies' optioneering processes has to date been a marginal one.

The main causes are likely to be the inevitable differences between the companies' programmes and the inherent inaccuracies in projecting embedded emissions. As we explained in chapter 4, the degrees of uncertainty assigned to this data are large for all companies. This greatly limits the extent to which we can offer robust, comparative judgments.

6.4 Conclusions on embedded emissions

There are a number of conclusions we can draw on embedded emissions in the sectors.

- The embedded emissions resulting from the companies' activity over the next five years are significant. They are equal to an additional 50% on top of companies' annual operational emissions.

- Maintaining infrastructure assets is the biggest source of embedded emissions. Improving and maintaining sewage treatment processes also cause significant embedded emissions.

- Given the large asset base and the nature of activity and investment in the sectors, we can conclude that embedded emissions are likely to remain significant in the future.

- The levels of uncertainty associated with these estimates are much higher than for operational emissions. For this reason, actual embedded emissions produced over the next five years might be substantially different to the projections.

- Our scrutiny of company submissions has shown that there are many inconsistencies, errors and anomalies in the reported datasets. There is clearly large room for improvement in this area.

- Since the embedded emissions are the responsibility of the manufacturing, transport and construction companies that create them, the actions of those companies will be a key determinant of companies' future embedded emissions.

- However, the water and sewerage companies have a significant influence over their embedded emissions through their business planning and procurement processes and through the investment decisions they make.

7. Effects of the 2009 price review final determinations

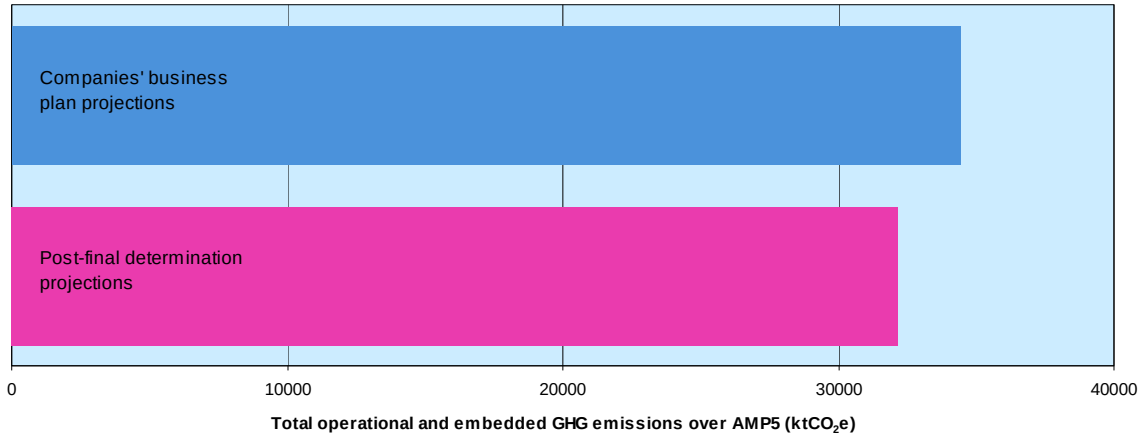
This document has focused on the projections that the companies made in their business plans for the next five years. It is highly likely that our final determinations will have a significant impact on the accuracy of those projections.

The flexible and output-centred nature of the price review means that the companies can reprioritise and modify their proposed investment schemes. We can expect them to look again at their business plan proposals and change or reprioritise activity in order to meet outputs we have set. Some of the proposed schemes will not occur at all during the next five years.

On aggregate, the 2009 price review assumed lower levels of expenditure than the companies had proposed. Therefore, it is reasonable to assume that the sectors' actual emissions will be lower than originally projected. We have also incentivised the companies to find efficiencies that were not included in their original assumptions.

We can make some attempt to project what this difference will be using the differences in capital and operating expenditure assumptions between the companies' plans and our final baseline. Our broad projections are set out in figure 12. We suggest that the impact of our final determinations could reduce the projections for embedded and operational emissions over the five years by up to 9%.

Figure 12 Projections of total operational and embedded emissions over AMP5



This relies on broad assumptions, and is dependent on a close general relationship between expenditure and emissions. It is clear we cannot assume this relationship holds true in all cases since cost savings might be made without necessarily reducing resource consumption or activity. In fact, cost reductions are often made at the expense of environmental improvement.

We must also remember that the margins of error associated with the companies' original projections are much larger than the 9% decrease we project here.

There will be other changes over the next five years that have not been included in the projections shown here. For example, the transfer of private sewers to the appointed water and sewerage companies will mean more greenhouse gas emissions will become the responsibility of the companies. We may also see more quality improvement schemes arising from Water Framework Directive obligations. Arising challenges and changes such as these are likely to add further to the actual operational and embedded emissions attributed to the companies over the next five years.

8. Next steps

It is clear to us that the issue of emissions is likely to increase in importance over the coming years. Efforts to reduce emissions across the economy are likely to have impacts on water customers and will continue to influence the way that we regulate. That is why we incorporated consideration of emissions into the price review process by enabling the companies to value and consider them in decision-making. We will continue to consider the best way for the companies to consider and value emissions for the next price review.

We have shown that the companies are working to maintain their operational emissions at a stable level. Although they are increasing the amount of renewable energy they generate and implementing efficiency measures, we consider that without significant step-changes, these will be offset by other factors, such as growth and the requirements of local environmental improvements. As a result, we are likely to see a relatively flat profile of operational emissions in the sectors over the next five years.

The information we have collected shows that embedded emissions associated with the sectors are large. This issue is not often discussed. In most cases, it is only operational emissions that are highlighted. There needs to be a more open debate about embedded emissions and we all need to continue to develop our understanding over the next few years.

This document has not focused on emissions from using water use in the home. These are significantly bigger than the emissions arising directly from the companies' activities. However, it is clear that it cannot and should not be the primary responsibility of the companies to control customers' use of water in the home. But there is already a need for them to incentivise their customers better to reduce the amount of water they waste. This should be done in a way that maximises a reduction in emissions, where this brings value. We are looking at this issue in detail as part of our review of the way the companies meter and charge their customers. For more detail see 'Waste not, want not – making the best use of our water', which we published in June 2010.

We have shown how the understanding of emissions in the sectors has come a long way. But there is clearly room for improvement. We have demonstrated that there are many uncertainties in projecting greenhouse gas emissions into the future. This is particularly true of embedded emissions, which are very difficult to quantify accurately. This places an emphasis on monitoring and improving our understanding. That is why we have supported UKWIR's work to develop a common understanding of these issues.

Accounting rules and guidelines also play a very important part in enabling a robust and understandable measure of emissions for which an organisation is responsible. National guidelines have changed numerous times over recent years and have not always been clear. This has created confusion for us and the companies in understanding true performance and making long-term decisions. That is why we have worked hard over the past two years to find the best way for the companies to show their performance on reducing the emissions for which they are responsible.

For the 2010 June return, we changed our emissions reporting requirements to align with the updated emissions reporting guidelines from Government. The resultant reporting requirements aim to be more informative in terms of revealing the efforts that the companies are making to manage their emissions. For example, the changes allow them to show how much renewable energy they generate regardless of the incentives they receive. The information we have collected in this year's June Return will be published in our service and delivery report for 2009-10.

Embedded emissions, however, will not be monitored over the next five years in the same way. Because these emissions are significant, we think that the wider water and sewerage sectors need to consider some means of monitoring the actual emissions associated with construction activity in the future. Given their importance, we are likely to expect the companies to understand and consider embedded emissions as part of the next price review.

We will continue to monitor the companies' progress in future from the 2009-10 baseline. We will also continue to refer to the projections and targets set out in this document.

Existing incentives to reduce greenhouse gas emissions

The companies are subject to a range of direct and indirect incentives to reduce emissions. Indirect incentives include the inherent savings from reducing the amount of energy that they purchase and regulatory drivers to improve efficiency across all their activities.

The companies can also accrue significant income from the sale of 'renewable obligation certificates' and may gain in the future from 'feed-in-tariffs' for generating renewable energy. Most of these financial incentives are guaranteed for a set period and will remain available to companies for the foreseeable future.

Direct incentives include the UK carbon reduction commitment (CRC) energy efficiency scheme. This is a mandatory cap and trade scheme covering emissions from energy use, which started in April 2010. All 21 regulated water and sewerage and water only companies are part of this. Defra and DECC run the CRC jointly and it is administered by the Environment Agency.

However, because the CRC does not cover process emissions or transport, it potentially does not capture between 5% and 30% of a company's operational emissions.

Other schemes include the EU Emissions Trading Scheme (EU ETS). This is a Europe-wide cap and trade scheme where companies are obliged to purchase allowances for the emissions for which they are responsible. A small number of the largest water companies' assets are subject to this.

Tangibly reducing emissions in the sectors will require the companies to change the way they operate. We have already seen some of these changes occurring, including a number of innovative schemes proposed through the price review process. This shows that current incentives are, to some extent, working to drive low-emissions behaviour.

But the incentives are incomplete. There are currently very few incentives to reduce embedded emissions. The companies are not incentivised to procure in a way that minimises emissions resulting from the construction process unless these directly align with cost savings. But tangibly reducing the amount of embedded emissions that are produced in the sectors will require radical change.

We are pleased that some water and sewerage companies have begun to engage with their supply chain on this issue. All companies need to do this as a crucial step towards operating a sustainable business. But it is for Government to ensure that all sectors of the economy are adequately incentivised to reduce their emissions. This is necessary to achieve the most efficient reductions across the economy.

We recognise that the regulatory system may need to change to better enable efficient emissions reductions. For example, we know that there a perceived bias in the sectors for intensive capital solutions over lower-emissions operational solutions. Our work on future price limits looks closely at issues such as these.

Ultimately, the issue of reducing global emissions requires collective action. But this does not mean reductions must be the same everywhere. Emissions should be reduced in the most efficient way.

It is not up to us as the economic regulator of the water and sewerage sectors to make sweeping decisions on this issue. That is why we work to align information with national standards, to embed a true value for emissions and consider the range of existing incentives. It is also why we have not sought to impose emissions targets on the companies, or hold them to the voluntary targets they have set themselves.

But this means that the Government must send clear signals that the sectors can act upon. And we are prepared to act in the future if we think that the companies are not playing their part in reducing emissions, for whatever reason.

We expect the companies to show they are doing this and we will take action if we consider they are lagging. We think that the sectors have great potential to reduce their emissions alongside the rest of the economy in an efficient way that brings multiple benefits.

9. Further information

Primary data sources

The companies' strategic direction statements are available on their individual websites.

Company business plans are submitted in confidence. Summaries and public domain versions are available on our website:
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July 2010

Sustainable water.