

13 December 2017

Trust in water

Delivering Water 2020: Our methodology for the 2019 price review Appendix 6: Bioresources control

**Appendix to Chapter 6:
Targeted controls, markets
and innovation: wholesale
controls**

www.ofwat.gov.uk

o f w a t

Contents

1	Summary	2
2	Overview of our approach	13
3	Decisions already taken to support our price control approach	20
4	Decisions based on our PR19 methodology consultation	33
	Annex: Calibrating the triggers for the volume forecasting incentive	59

1. Summary

Applicability to England and Wales

Our final methodology for bioresources **applies to both** companies whose areas are wholly or mainly in England and companies whose areas are wholly or mainly in Wales.



The UK Government recognises that promoting effective competition to treat and sell on energy and nutrient-rich bioresources will achieve innovation and efficiency. The Welsh Government considers that companies should be incentivised to seek solutions which deliver wider benefits to society and the environment, where this is justified by sound evidence.

1.1 Purpose and structure

This appendix sets out our final methodology and the reasons for our policy for the 2019 price review (PR19) for the bioresources control. We have determined this methodology after fully considering the views expressed by respondents to our [draft methodology proposals](#), published in July 2017.

This appendix provides more information about the final form of the bioresources control as set out in chapter 6 of our final methodology, ‘Targeted controls, markets and innovation: wholesale controls’, and in our overview of respondents’ views and our responses, which you can find in [appendix 15, ‘Responses to our draft methodology’](#).

Our overall approach to bioresources is based on decisions taken both before and as a result of our [draft methodology proposals](#). In our May 2016 decision document, ‘[Water 2020: Our regulatory approach for water and wastewater in England and Wales](#)’, we set out the high-level framework for our approach to the bioresources control. This was supported by our impact assessment, which we summarise and update in section 1.3. Since May 2016, we have kept developing our approach by engaging with stakeholders. This appendix draws all the decisions together to provide a composite overview. It is structured as follows:

- high-level summary (section 1);
- overview of our approach (section 2);
- decisions already taken to support our price control approach (section 3); and
- decisions taken as a result of our draft methodology consultation (section 4).

This appendix does not cover all aspects of how the bioresources price control will be implemented. Our approach to assessing the efficient cost of providing bioresources services, for example, is covered in chapter 9, 'Securing cost efficiency', while issues related to the cost of capital are covered in chapter 10, 'Aligning risk and return', and our approach to assessing pay-as-you-go (PAYG) and regulatory capital value (RCV) run-off is in chapter 11, 'Aligning risk and return: financeability'. We reflect this throughout the appendix by cross-referencing other sections of our final methodology.

1.2 Context and summary of approach

Our final methodology for bioresources reflects the four key themes of PR19.

It enables better targeted regulation and encourages markets to help address the challenges and opportunities for bioresources services. It also provides a framework to protect customers' interests and to enable greater collaboration between companies and other bioresources service providers.

This will maximise the value of existing resources and incentivise the efficient provision of bioresources services. It applies to the ten water and wastewater companies.

Our approach has four strands:

- **Establishing a separate control:** A separate control for bioresources enables better targeted regulation and will encourage management to focus more on this key area of the value chain. The price control will also facilitate further development of markets for the treatment of organic waste. The boundary of the price control is aligned with the definitions used in our regulatory accounts (RAG4.06) and will be confirmed with the final determinations. We will take a focused approach to allocating the pre-2020 RCV as the starting basis for the control. In setting up the control, we defined some of its key characteristics, including a five-year duration and annual adjustments to the price control to allow for inflation.
- **Managing the separate control:** The bioresources control will be an average revenue control, with a revenue adjustment factor (see managing uncertainty and ensuring legitimacy below). We will use tonnes of dry solids (TDS) as our volume metric for the purposes of the revenue control. We are maintaining the proven building-block approach to the control. Present protections will be retained for the RCV allocated at 31 March 2020 for the 2020-2025 period. After 2020, new investment will be exposed to the market for bioresources services. There will be an in-period revenue correction mechanism to allow

water and wastewater companies to manage the under or over-recovery of revenues over the 2020-25 period.

- Encouraging markets:** Our approach supports markets in the transport, treatment, disposal and recycling of sewage sludge. This enables third parties to provide these services where it is more efficient for them to do so. To support this, we have updated our guidelines for transfer prices between appointed and non-appointed businesses. Companies must comply with these guidelines when setting up trading agreements, making sure profits are shared appropriately between appointed and non-appointed businesses. We have also said that companies must share the profits from imported trades with their customers within period. This will ensure customers benefit, such as from lower overall bills. Overall, we expect the use of markets to bring significant opportunities for innovation and efficiency and to help deliver resilience. It should allow companies to plan better for future capacity needs and to use existing capacity more efficiently.
- Managing uncertainty and ensuring legitimacy:** It is important to incentivise companies to effectively plan and deliver bioresources services in a developing market and to support the legitimacy of the market as it develops over time. Companies will need to demonstrate effective planning by taking current and possible future opportunities to trade into account in their bioresources strategies. To protect customers from large price impacts caused by uncertain sludge forecasts, we will apply a mechanistic revenue adjustment factor to the average revenue. The revenue adjustment factor is designed to better align incremental allowed revenues from changes in volumes with the incremental costs of an efficient company. To encourage accurate forecasting, we have introduced a symmetrical volume forecasting incentive. This will be adjusted at the end of the price control period. To improve the legitimacy of the way prices reflect sludge volumes, we expect all companies to be using instrumentation to measure sludge production.

Our approach recognises and reflects the UK and Welsh Governments’ policy objectives. We have set out how our decisions reflect the different policy objectives in Tables 1 and 2.

Table 1 – How our bioresources approach helps us deliver the UK Government’s priorities

<p>Priority</p>	<p>Ofwat should challenge the water sector to plan, invest and operate to meet the needs of current and future customers, in</p>	<p>Ofwat should promote markets to drive innovation and achieve efficiencies in a way that takes account of the need to further the long-term resilience of water</p>
------------------------	---	--

	a way which offers best value for money over the long term	and wastewater systems and services
Establishing the separate control	<p>A separate control for bioresources enables better targeted regulation and will encourage management to focus on this area. It will reveal better quality information and help identify efficiencies, ensuring value for money over the long term.</p> <p>Focused RCV allocation provides an appropriate starting base for the control. It will support a level playing field between third parties and existing undertakers. This will send appropriate price signals to third party suppliers and avoid distorting competition in wider waste markets</p> <p>The control will be for five years. It will retain annual adjustments to reflect the consumer price index including housing (CPIH).</p>	<p>The separate control will facilitate the development of a range of markets for bioresources and of related markets in other organic wastes.</p> <p>The design of the control will encourage companies to trade with third parties, delivering greater innovation and efficiency. It will also deliver greater connectivity, and a more resilient network overall.</p>
Managing the separate control	<p>A building-block approach provides consistency, while allowing the approach to evolve for post-2020 investment.</p> <p>Investment before April 2020 will receive similar protection to now, which provides investors with the required certainty. Investment after April 2020 will be exposed to the market for bioresources services, through volume risk.</p> <p>The separate bioresources control means that companies are not able to cross-subsidise their bioresources activities using revenue collected for network plus activities. Their success is dependent on providing bioresources services efficiently.</p> <p>Setting the average revenue control using TDS will reveal the prices of bioresources services. Our approach supports the transition towards a 'gate fee' based approach used in other organic waste markets.</p>	
Encouraging markets	<p>Markets should incentivise companies to choose the supplier with the lowest long-term costs, regardless of company boundary to deliver best value for customers.</p> <p>Customers will benefit within the period from market trades where the non-appointed business is using the assets of the appointed business.</p>	<p>The bioresources markets should result in efficiency gains, thanks to an increased focus on bioresources costs, innovation and more efficient use of assets, arising from optimisation and trading across company boundaries and with the wider organic waste market.</p>

<p>Managing uncertainty and ensuring legitimacy</p>	<p>Companies' bioresources strategies will make sure they plan for future capacity needs, taking into account opportunities outside their own boundaries. This will lead to a more resilient and better value service in the long term.</p> <p>The revenue adjustment factor in the average revenue control will better align revenues with costs, protecting customers against forecasting errors. This will lead to better value services.</p> <p>Accurate measurement of sludge production will support the development of the market and reveal cost information, which may enable us to use gate prices in future regulation.</p>
---	--

Table 2 – How our bioresources approach helps us deliver the Welsh Government's priorities

Priority	How our methodology addresses the priority
Affordability	<p>The separate control supports better targeted regulation and management focus to ensure value for money.</p> <p>The trading market should lead to more optimal use of assets, leading to cost efficiency.</p>
Innovation	<p>Bioresources services have a relatively high level of innovation compared to other parts of the value chain in the water sector. Markets will encourage more innovation by allowing companies with innovative approaches to access the market and by encouraging innovation within companies themselves.</p>
Long-term	<p>Each company's bioresources strategy will support long-term planning that will take into account current and future trading opportunities.</p>
Markets and competition	<p>Our market approach enables English and Welsh companies to participate in the bioresources markets under the current regulatory framework, ensuring that all companies can benefit from potential trading opportunities.</p> <p>A separate price control with a focused allocation of RCV will support a level playing field between third parties and existing undertakers.</p>
Resilience	<p>The companies' bioresources strategies will enable them to plan how to deliver a resilient system over the long term.</p> <p>Markets in bioresources services should result in more interaction between water and sewerage companies and other organic waste businesses, giving companies the scope to use alternative services when required.</p>
Strong customer focus	<p>Our trading policy means customers will benefit immediately from the development of the market. Appointed companies must share profits they receive through the transfer price from importing sludge from another company with their customers within the same period.</p>

Sustainable management of natural resources	Markets could result in third parties specialising in providing certain bioresources services. This should result in a better quality of sludge product being recycled to land, providing essential nutrients and soil conditioning, as well as more efficient production of renewable energy.
---	--

1.3 Our impact assessment

Our decision to introduce a separate control was part of a package of measures we introduced to address the problems and opportunities we had identified in bioresources. These measures were supported by a range of evidence and analysis compiled over a period of time.

In our [December 2015 Water 2020 consultation](#), we identified a number of opportunities where water and wastewater companies could trade with third parties – such as other companies or the organic waste sector. We also set out the main issues preventing markets from functioning effectively in this area. Our December 2015 consultation built on an [organic waste market study](#), carried out by the Office of Fair Trading in 2011, exploring the barriers preventing the bioresources market from functioning effectively. This in turn, prevented companies from maximising value from the services they provide. Details of our analysis can be found in [appendix 1](#) of the December 2015 consultation.

In our May 2016 decision document, we built on the evidence in the December 2015 consultation. We considered both top-down and bottom-up evidence for the likely benefits from our proposals.

The bottom-up analysis considered the benefit of potential operating cost savings from trading with third parties. We also analysed the likely benefit of more efficient timing of investment in new assets.

Our top-down model considered dynamic and productive efficiency gains, based on regulatory precedent for introducing markets in areas with monopoly economic regulation. We estimated that our proposals could lead to benefits between £372 million and £1,386 million (2015-16 prices, net present value over 30 years).

We also engaged with companies to understand the costs of implementing our proposals. This included the cost to companies of providing market information, the additional regulatory burden of a separate control and one-off costs of revaluing bioresources assets. We also considered how much more it would cost us to run a separate price control. We estimated the costs at between £29 million and £58 million (2015-16 prices, net present value over 30 years).

Since May 2016, we have reviewed the assumptions underlying our assessment of the benefits of introducing this package. We consider that the net benefits remain within the ranges we set out in our decision document.

For example, in May 2016 we based our bottom-up analysis of the benefits of trading between companies on unit operating expenditure (opex) differences between neighbouring companies in 2013-14. Based on the opex information companies reported for 2016-17, the difference between the highest and lowest unit opex is greater than in 2013-14, suggesting that the potential savings from trading between companies are even higher than we assumed in May 2016.

Our calculated benefits assumed, at least initially, that most benefits would arise from trades taking place between water companies. Since publishing our decision document, we have been pleased to see a high level of interest from water companies exploring trading opportunities.

In October 2017, we announced what [market information companies will publish for bioresources](#). Companies have started to publish this information on a voluntary basis on their websites. This information suggests that we may begin to see the benefits from trading during the next price control period.

We also estimated that some of the benefits would be delivered through trading with other organic waste businesses. During the sludge working group meetings¹, we discussed the framework of environmental regulations covering these activities. Environmental regulators have stated that co-treatment of different materials is not prohibited. However, the regulations that apply to treating and recycling co-treated bioresources with other organic waste have different requirements and this is likely to reduce the likelihood of water companies and other organic waste operators entering into trades. There is no current programme of work to align the environmental regulatory regime, but this may change in the future. These changes may occur at different times in Wales and England.

Table 3 summarises the benefits and costs we identified. Wherever possible, we have assessed the benefits and costs separately for England and Wales to reflect the different policy positions of the UK and Welsh governments. In so doing, our assessment reflects, where appropriate, the current legal framework and the allocation of executive powers between the UK and Welsh governments on the basis of company boundaries, rather than the border between England and Wales.

¹ We publish the [terms of reference and materials from working group meetings](#) on our website.

Table 3 – Summary of estimated costs and benefits for the final preferred policy package against the ‘do nothing’ option²

	Benefits		Costs	
Elements that have been quantified	Productive efficiencies (greater management focus and trading between water and wastewater companies and other organic waste operators will result in improved performance, reducing overall costs)	£230 million to £690 million	Market set-up costs	£6 million to £15 million
			Ongoing costs of the sludge market	£12 million to £18 million
	Ongoing efficiencies (over time, costs are likely to decrease even more due to increased uptake of innovative solutions and new technologies)	£142 million to £697 million	Cost of the sludge price control	£7 million to £11 million
			Our regulatory costs	£4 million to £14 million
	Total scope of quantified benefits	£372 million to £1,386 million	Total costs for England and Wales	£29 million to £58 million
	Wales	£13 million to £48 million	Wales	£3 million to £6 million
England	£359 million to £1,338 million	England	£26 million to £52 million	
Elements that cannot be quantified	Increased utilisation of advanced anaerobic digestion (AAD) technology and increased sludge biomethane to the grid will contribute to a reduction in the UK’s greenhouse gas emissions (partly negated if transport of sludge increases)		Companies’ and third parties’ transaction costs associated with individual trades	

² All figures in table 3 are based on 2015-16 prices, net present value over 30 years.

	Benefits	Costs
	<p>Greater resilience by integrating with other organic waste operators and creating more value from sludge</p> <p>Increased resilience of the sector to unplanned outages</p>	<p>To maximise the environmental benefits, more steps may be needed to make sure all providers dispose of sludge safely</p>

This quantitative impact assessment supports our approach to setting the revenue control in bioresources. We have carried out a further qualitative assessment of new policy areas throughout section 4, in line with our approach to assessing the impacts of our decisions (see [appendix 14](#)).

1.4 Summary of our decisions for the bioresources control

Table 4 summarises our decisions for the bioresources control and indicates where to look for more details about each one.

Table 4 – Summary of our decisions for the bioresources control

Area	Topic	Final position	More detail
Establishing a separate control	Separate control for bioresources	We will introduce a separate control for bioresources activities.	Section 2.1 Section 3.1.1 Section 3.1.2
	Boundary of control	See regulatory accounting guideline (RAG) 4.06 and paragraph 2 of companies' licence condition B for definitions of the activities that could be covered by the bioresources price control.	Section 2.1 Section 3.1.3
	Pre-2020 RCV allocation	We will determine the bioresources RCV based on forward-looking economic value of the assets. We will determine allocation of RCV to the bioresources and network plus wastewater control (the remainder) as part of PR19 determinations, drawing on our April 2017 approach.	Section 2.1 Section 3.1.4
	Length of control	Five years.	Section 2.1 Section 3.1.6
	Inflation indexation	Annual adjustment to reflect any percentage change in the consumer price index including housing (CPIH).	Section 3.1.7 Chapter 11
	Type of control	Separate average revenue control to be set for each company; this will reflect the volume	Section 2.2 Section 3.2.1

Managing the separate control		of sludge produced by water and sewerage companies.	Section 3.2.2
	Allowed average revenue	Modified average revenue approach in £/TDS. This is based on the expected unit revenue based on forecast volumes (we define this as 'allowed standard average revenue'). We will apply a revenue adjustment factor, where outturn sludge volumes differ from forecast volumes (see managing uncertainty and ensuring legitimacy section below). The allowed standard average revenue is the revenue allowance that we determine to efficiently treat and recycle a given forecast volume of sludge produced, expressed as a unit revenue (in £/TDS). The revenue allowance is determined using a building block approach. This will be net present value neutral and indexed using CPIH over the price control period.	Section 2.2 Section 4.4.1
	In-period revenue correction	A company should collect the revenue associated with the volume of sludge it produces through treating wastewater. Where required, the revenue allowance will be altered in subsequent years to correct for any under or over-recovery in an earlier year.	Section 2.2 Section 4.2.1
	Midnight adjustment for RCV	We will not apply an adjustment to bioresources RCV, only to network plus wastewater RCV.	Section 3.1.5
	Protecting the pre-2020 RCV	We will extend the protection of efficiently-incurred past investments, included in the wholesale wastewater RCV, up to 31 March 2020.	Section 2.2 Section 3.2.4 Section 4.4.1
	Post-2020 investment	Building-block approach. The return and depreciation on efficiently incurred investment will be recoverable in the 2020-2025 period. Post-2020 investment incorporates all investment. We will not make a distinction between investment for maintaining existing bioresources treatment capacity and for building new capacity.	Section 2.2 Section 3.2.5
Encouraging the evolution of markets	Accounting for income from bioresources trading	A company will set a transfer price where non-appointed companies are using appointed company assets. The transfer price should include at least the incremental cost and a proportion of profit. A company will share profits they receive from transfer pricing with customers in period.	Section 2.3 Section 3.3.1 Section 4.3.1
	Trading incentives	We will not introduce explicit sludge trading incentives at PR19.	Section 3.3.2

Managing uncertainty and ensuring legitimacy	Revenue adjustment factor	<p>We will apply a revenue adjustment factor to the standard average revenue allowance to align incremental revenues with incremental costs of sludge treatment and recycling.</p> <p>The revenue adjustment factor acts to spread the fixed costs of sludge treatment and recycling over the outturn volume rather than the expected volume. The rest of revenue allowance will vary according to measured bioresources volumes.</p>	<p>Section 2.2 Section 2.4 Section 4.4.1</p>
	Bioresources strategy	<p>We expect companies to include a well-evidenced long-term sludge strategy to ensure customers get better value for money.</p>	<p>Section 2.4 Section 3.4.1</p>
	Measure sludge production	<p>We expect companies to be measuring sludge production continuously, using instrumentation, by the start of the price control – and at the latest, by the beginning of the second year of the price control.</p>	<p>Section 2.4 Section 3.4.2</p>
	Forecasting accuracy incentive	<p>We will apply a penalty to the difference between actual and forecast sludge production, when the variation is greater than $\pm 6\%$.</p> <p>The symmetrical penalty will be 10% of the standard average revenue, applied to the difference between forecast and actual sludge volumes, with no cap or collar on allowed revenues.</p>	<p>Section 2.4 Section 4.4.1</p>

2. Overview of our approach

This section summarises our overall approach against the four strands set out above:

- establishing a separate control;
- managing the separate control;
- encouraging markets; and
- managing uncertainty and ensuring legitimacy.

2.1 Establishing a separate control

A separate price control for bioresources enables better targeted regulation and will encourage management to focus more on this key area of the value chain. It will also increase the accuracy and consistency of cost reporting. We expect that, combined with a bigger role for markets, the control will help deliver resilient bioresources services for customers and the environment in the long term.

We have implemented our decision to introduce a separate control for bioresources by changing condition B of the licences of each of the ten water and wastewater companies in England and Wales. The licence change defined some of the key characteristics of the control, including a five-year duration and the inclusion of annual adjustments, which will be applied to reflect appropriate inflation indices.

We propose the boundary of the control to start at the point where locally produced sludge is discharged from holding tanks or treatment processes into either pipelines or road vehicles for transport. We expect it to include all sludge treatment and disposal activities, as we define in '[Regulatory accounting guideline \(RAG\) 4.06](#)'.

To calculate the revenue allowance for the bioresources control, the pre-2020 wastewater RCV needs to be allocated between the network plus and bioresources controls. We will determine the allocation to bioresources using a focused approach, based on the concept of forward-looking economic value of assets. We have asked companies to propose an allocation of RCV between the controls and we will confirm the allocation of RCV to the bioresources control and network plus wastewater control when we publish our PR19 final determinations.

2.2 Managing the separate control

The bioresources control will be a modified average revenue control. The average revenue control will include a revenue adjustment factor (see section 2.4), which will apply only when there are differences between the forecast and measured quantities of sludge. This is to better align the incremental revenues associated with the incremental costs from changes in the volume of sludge produced.

We will use tonnes of dry solids (TDS) as our volume metric for the purposes of the revenue control. This will be cross-checked with population equivalent served by wastewater treatment works.

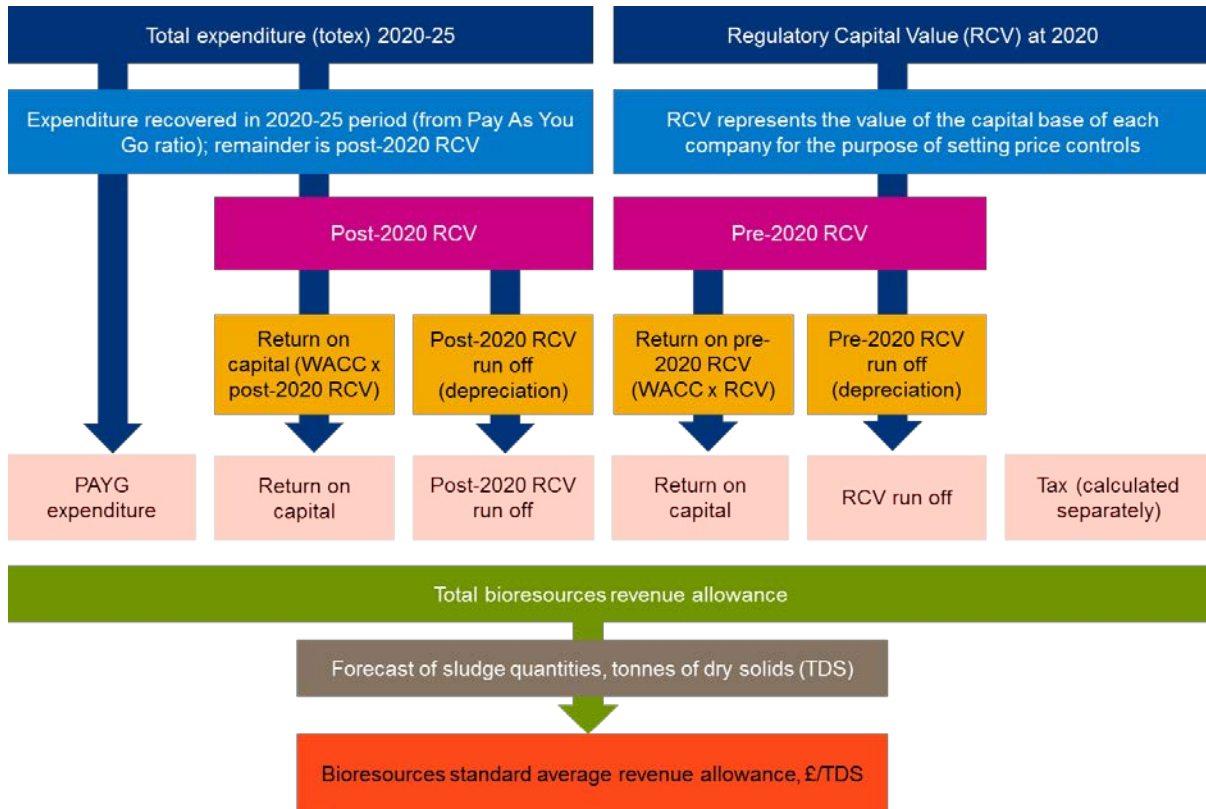
There will be an in-period revenue correction mechanism to allow companies to manage any under or over-recovery of revenues over 2020-25. We will include trading profit received from use of appointed assets to make sure customers benefit from the profit companies make by using assets customers paid for to treat sludge on others' behalf.

We are maintaining the traditional building-block approach to the control for PR19. For the RCV allocated to bioresources at 31 March 2020, we will provide the same type and degree of regulatory protection as the 2014 price review (PR14). For post-2020 investment, allowed revenues will be exposed to some volume risk.

2.2.1 The building-block approach to determining companies' average revenue allowance

We will determine expected unit revenue based on forecast volumes (we define this as 'allowed standard average revenue') using the building-block approach. This is the revenue allowance that we determine is needed to efficiently transport, treat and recycle a company's forecast volume of sludge it will produce over the 2020-25 period, expressed as a unit revenue (in £/TDS). Figure 1 summarises the building-block approach to determine the allowed standard average revenue.

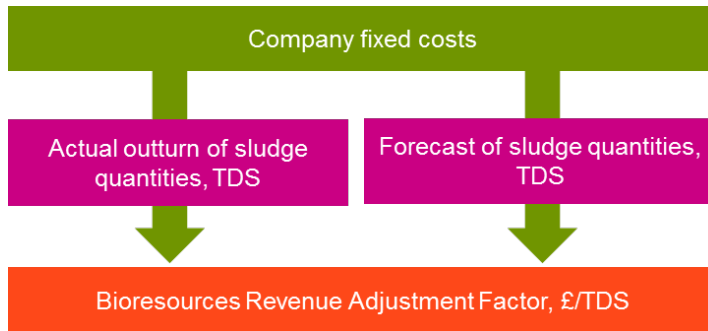
Figure 1 – Building-block approach to the standard revenue control



If measured outturn volumes of bioresources are different from the forecast, we will apply a revenue adjustment factor to the standard average revenue allowance to better align incremental revenues and incremental costs. The adjustment acts to spread the fixed costs of bioresources services over the measured outturn volume of bioresources. We will make this as a mechanistic adjustment to the allowed revenue per TDS.

Figure 2 shows the elements used to calculate the revenue adjustment factor. The revenue adjustment mechanism itself is explained in section 4.4.1.

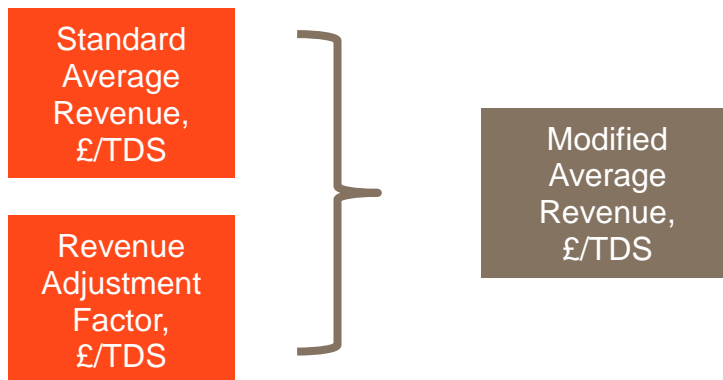
Figure 2 – The revenue adjustment factor



In our final determinations we will set the standard average revenue (£/TDS) and confirm the fixed cost and forecast of volume of sludge production used to determine the revenue adjustment factor.

The standard average revenue and the revenue adjustment factor combine to give the modified average revenue, as shown in figure 3. We provide further details of the calculation of the modified average revenue in section 4.4.1.

Figure 3 – The modified average revenue (MAR)



The modified average revenue control aligns allowed revenues and costs more accurately. It is explained in section 4.4.1. The revenue adjustment factor reduces the risk of unintended consequences from volume forecasting errors, by ensuring that fixed costs are not over or undercompensated as volumes change. This approach will protect customers by removing incentives for companies to under forecast sludge production.

2.3 Encouraging markets

We have identified a number of opportunities where water and wastewater companies could trade with third parties – including other water and wastewater companies and the organic waste sector. We expect that the benefits of acting to remove the barriers preventing markets from functioning effectively will outweigh the costs.

Our price control framework encourages markets to develop. We expect that creating a separate control and measuring sludge quantities will stimulate the market. Our approach incentivises companies to optimise the processing of bioresources within and outside their own facilities, so they can derive the benefits.

As the market develops, we expect contract-based commodity prices to develop. This would be similar to gate prices the organic waste sector sets to treat different materials.³ We intend to explore setting price limits based on ‘gate fees’ for bioresources services at the 2024 price review (PR24) as an alternative to the regulatory building-block approach.

To support the development of markets, we have updated the transfer pricing guidelines in the [Regulatory accounting guidelines \(RAG\) 5.07](#) to provide specific guidance on bioresources trades. These guidelines tell companies how to treat the income from trading activities in bioresources.

Where a non-appointed business is using an appointed business’s assets to process bioresources or organic waste, the guidelines require there to be a transfer price. The transfer price should include at least the incremental costs and an appropriate share of the margin. This margin share should reflect the risks incurred by the appointed and non-appointed businesses respectively.

We consider that customers should share any benefits the appointed business gains from imported trades, within the same period. Companies must pass on all profit received by the appointed business through the transfer price to their customers. This reflects the fact that companies will benefit from trades through their non-appointed businesses. We expect that this will offer companies enough benefits through their non-appointed businesses to stimulate the market.

³ Gate fees are the charges for providing a range of waste treatment, recovery and disposal services.

2.4 Managing uncertainty and ensuring legitimacy

Our price control framework is designed to support the development of markets, leading to a better and more resilient network at lower costs, which will deliver benefits for customers.

To deliver this, companies will need to consider the long-term development of the network in a more connective environment. Companies will also need a good understanding of the volume of sludge they produce at the boundary of the control, taking external uncertainties into account. We need to make sure that, as the market develops, companies bear those risks that they are best placed to manage. We have developed a number of mechanisms to apportion risk appropriately.

Companies are required to develop long-term bioresources strategies. In these strategies, companies need to consider how bioresources will be delivered in both the short and long term. We will expect to see evidence that companies have considered current and future trading opportunities.

To ensure the legitimacy of the market, companies will need accurate measurements of their raw sludge production. Where companies are not already doing so, we expect them to start using instrumentation to accurately measure sludge production, preferably by April 2020 and by no later than the second year of the price control. We will take into account the extent to which companies are measuring this at PR24.

To protect customers from excessive variations in their bills, and to support the development of markets, we have introduced a forecasting accuracy incentive. Inaccurate forecasting, beyond a reasonable deadband, will result in a meaningful penalty, based on differences between the central estimate and the actual outturn of sludge volumes.

We will consider adjusting the way the forecasting accuracy incentive is applied where a company can provide evidence, within the first two years of the price control period, of material variations between forecast and recorded volumes. We will consider this in cases where measurement improvements, or uncertainties around the Water Industry National Environment Programme's requirements for phosphorus removal, cause significant impacts.

To protect customers from large bill impacts due to forecasting errors, we have introduced a revenue adjustment factor to the average revenue control, creating a modified average revenue control. It removes the incentive to companies to under-forecast sludge production to gain windfall profits, ensuring that customers' bills better reflect the cost of providing bioresources services (see section 4.4.1).

The revenue adjustment factor removes the influence of companies' fixed costs from incremental changes in sludge volumes, which has the effect of better aligning incremental revenues to the expected incremental costs at a company average level. We demonstrate in boxes 4 and 5 in section 4.4.1 how it is calculated and present a worked example.

3. Decisions already taken to support our price control approach

In this section we summarise the decisions we made prior to our draft methodology consultation to support our price control approach in bioresources, and map them against the four strands of the control. These decisions reflect our May 2016 decision document and our continued engagement with companies, third parties and other stakeholders. We engaged through formal consultation, discussions in the bioresources working group meetings and company workshops on the form of control. Slides and notes of the working group discussions and company workshops are published on [our website](#).

3.1 Establishing a separate control

Our May 2016 decision document focused on establishing the rationale and framework for the separate control.

3.1.1. The rationale for a separate control

A separate control should increase transparency and reveal more information about companies' bioresources operations. This will help strengthen the incentives under our regulatory framework and encourage companies' boards to focus on this area.

It should also help support the development of bioresources markets over time. Our experience of setting separate retail controls at PR14 suggests that having a separate bioresources control could foster an increased commercial focus in this area. A separate control will delineate the costs and revenues associated with bioresources activities from other wastewater activities.

The potential overlap with the wider organic waste markets means that the risk of cross-subsidy is a particular concern as we look further ahead. A separate price control should provide confidence for third parties entering the market that there are strict boundaries between the bioresources and network plus businesses, ensuring that there is no cross-subsidy.

The binding nature of the price control means that companies will not be able to subsidise their bioresources activities from the network plus revenue controls. This places bioresources activities on a similar footing to other organic waste operations. Water and wastewater companies will need to demonstrate compliance with the average revenue control in their annual reports throughout the five year control period.

3.1.2 The licence change to enable a separate control

We have made changes to condition B of the conditions of appointment ('licence') of each of the ten water and wastewater companies in England and Wales. All ten water and wastewater companies agreed to the modification.

The modification allowed us to set separate binding controls for wastewater companies' bioresources and network plus wastewater activities, for periods starting on or after 1 April 2020. The licence condition set out:

- how the activities which could be covered by each control are defined and the extent to which this can be changed;
- the form of the controls and the extent to which we can determine this when we set the controls; and
- the duration and indexation of the controls.

The modification did not specify the detailed form of the bioresources control. This was to allow us flexibility to develop and refine our thinking on how the price control would work in practice and how we might define key parameters, taking stakeholders' feedback into account. This licence modification came into effect from 15 April 2017.

3.1.3 The activities in the control

In this section, we set out the activities we are able to designate as bioresources activities. We will set the bioresources control at a company level rather than a site level.

We have worked with stakeholders, through the sludge working group and the regulatory accounting guidelines (RAG) consultation process, to review which activities should be within the scope of the bioresources control. Following this engagement process, we propose the bioresources control will cover the assets and activities within the definitions of sludge transport, sludge treatment, and sludge disposal in [RAG 4.06](#). When sludge liquors are returned to a wastewater treatment works, the activity of treating the liquors is a network plus wastewater activity.

The broad envelope of activities that could be designated as falling under the bioresources control and those remaining under the wastewater network plus control has been decided through the licence change process. All ten water and wastewater companies in England and Wales agreed to the licence change through a formal consultation process. The activities that can be designated as bioresources activities are defined in paragraphs 2 and 3 of companies' licence condition B, and [RAG 4.06](#).

Future changes to the RAGs will not change the scope of price control activities. Companies should prepare business plans on the basis that these boundaries will not change from the detailed definitions in RAG 4.06.

We have applied these same definitions to the assets and activities in our April 2017 document, '[Economic asset valuation for the bioresources RCV allocation at PR19](#)', where we explain the approach we expect companies to take to determine the proportion of the wastewater RCV to allocate to the bioresources control.

Figure 4 shows the general boundary between those activities we expect to be covered under the bioresources control and those which would remain part of the wastewater network plus control.

Figure 4 – General bioresources boundary

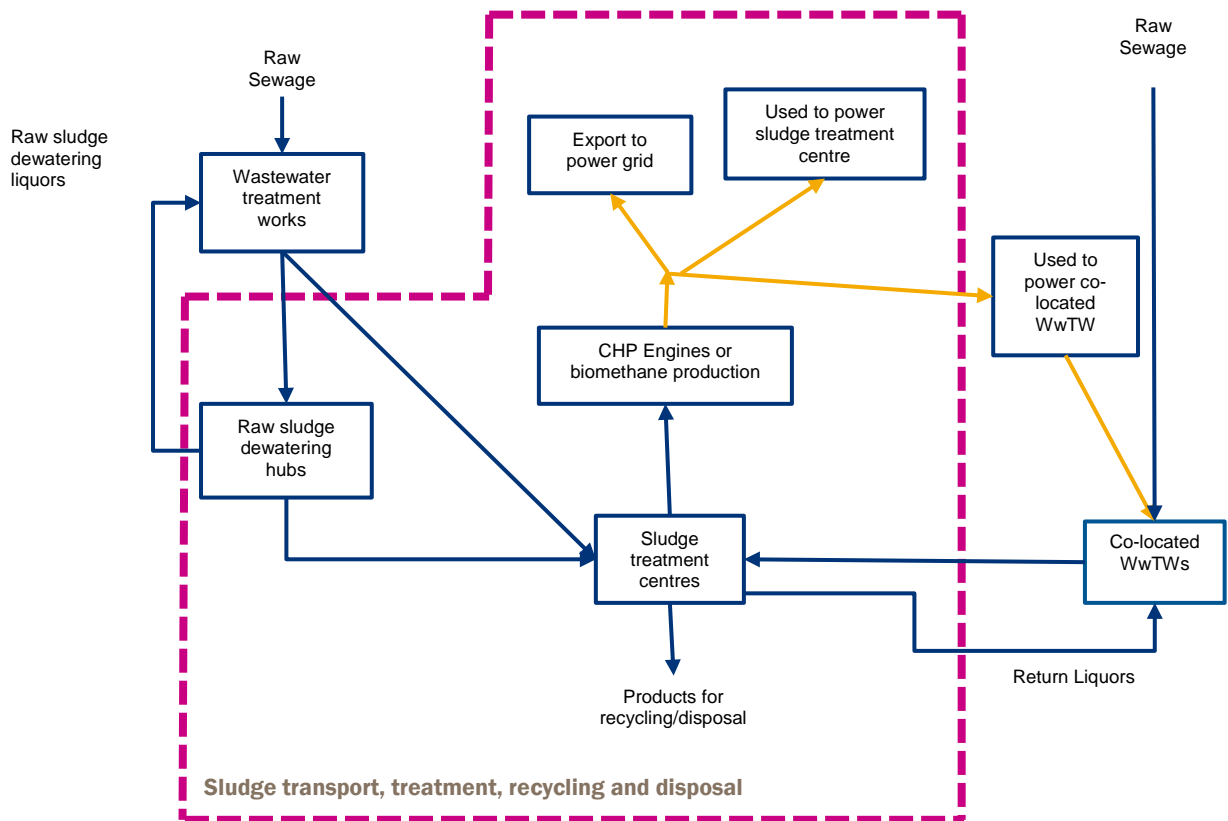


Table 5 summarises the activities we expect to be covered by the bioresources control and its boundary points.

Table 5 – Activities to be included in the bioresources control

Activity	Description	Boundary point
Sludge transport	This service includes the transport of sludge from the wastewater treatment plant to the sludge treatment plant. All types of transport, and associated fuel costs, are included within this service. However, transport within the sludge treatment plant or between sludge treatment plants is not included in this service, which is instead an activity of the 'sludge treatment' service.	Start: point of discharge of sludge from indigenous thickening processes, indigenous sludge holding tanks or directly from wastewater treatment process into pumps and pipework or tankers for transport to sludge treatment processes. End: input of sludge into sludge treatment works.
Sludge treatment	This service includes all the activities related to sludge treatment. While different technologies exist for sludge treatment, sludge treatment is defined as a technology-neutral service for the purposes of accounting separation. Includes incineration of non-treated sludge. Any thickening or dewatering of treated sludge is a sludge treatment activity.	Start: storage of sewage sludge in blending or holding tanks and input into sludge treatment sites. End: point at which the treated sludge is collected for disposal.
Sludge disposal	This service includes the collection of treated sludge from a collection point, onward transport, and disposal to landfill, agricultural land, land reclamation sites and other end users in various forms including: <ul style="list-style-type: none"> • treated sludge; • incinerated sewage sludge ash (ISSA); • composted sludge; and • sludge cake. If incineration of completely treated sludge takes place, then this should be included in 'sludge disposal'.	Start: collection from treated sludge holding tanks or cake storage facilities at sludge treatment works; or collection of untreated sludge that is taken directly for disposal, such as via landfill sites. End: Sludge disposed of or recycled to land.

We also need to consider costs and revenues crossing the network plus control. We cover this under section 3.2.3.

3.1.4 The allocation of pre-2020 RCV

We currently have a single value for each company's RCV for wastewater assets, including bioresources assets. The RCV captures the amount companies have invested and not recovered in the five year control period and forms part of our building-block approach to price controls. It is used in price controls to determine the level of revenue that a company is allowed to recover.

In our May 2016 decision document we decided to allocate the RCV to the bioresources control using a focused approach. This means the allocation of the RCV to bioresources will be based on the economic value of the assets employed.

Following a targeted review of the companies' sludge and water resources accounting separation data, [published in March 2016](#), we consulted on the detailed approach to allocating RCV to bioresources. This was developed with input and challenge from companies and other stakeholders at the sludge working group. Copies of the slides and minutes of this group are available on our [website](#).

In April 2017, we published '[Economic asset valuation for the bioresources RCV allocation at PR19](#)', where we set out how we expect companies to value their bioresources assets and to inform their proposed allocation of the legacy wastewater RCV to the bioresources control.

We asked companies to provide information on their 2020 RCV allocations in September 2017 so that we could provide feedback in advance of companies submitting business plans. We did this because:

- It will help avoid issues in business plans that could not easily be foreseen by companies which if they existed would reduce the quality of the business plan which would not be in the interests of customers; and
- Asking for this information that we require for price setting early helps to reduce the demands on both companies and us in the peak of the PR19 process.

We are asking companies to submit updated summary RCV information in the business plan tables, together with a reconciliation to the information they provided in September 2017 and information to check any potential impact on customer bills. We are limiting the information we are requesting for business plans on the basis that we expect to have confidence that companies are able to adequately address any points we make in our feedback and that company business plans will give us confidence they have done so.

If this is not the case, we may ask a company to update the full set of detailed RCV tables either before or after it submits its business plan. In addition, if a company makes significant changes to its valuation, or otherwise does not have confidence we will be able to understand the changes it has made from its business plan tables, it should also submit the full set of detailed RCV tables alongside its business plan.

We will confirm the allocation of RCV to the bioresources control and wastewater network plus control (the remainder) as part of PR19 determinations.

3.1.5 RCV midnight adjustment

Generally, when we set revenue controls at each price review, we make an adjustment to the value of a company's RCV to reflect its performance in the previous period. This is known as a midnight adjustment. The adjustment can create

a step change between the closing RCV at the end of the previous control period and the opening RCV for the new control period.

However, the opening RCV for the bioresources control is being set on a focused basis, and will reflect the outcome of the companies' economic valuation of their bioresources assets. For this reason, past performance is not a relevant consideration and it would be inappropriate to distort these opening values by applying a midnight adjustment. Therefore, midnight adjustments relating to performance against the wholesale wastewater control will only be applied to the network plus wastewater RCV.

3.1.6 Length of the control

In our May 2016 decision document, we decided to set the bioresources control on a five-year basis at PR19. We will revisit this as we develop our approach at PR24.

3.1.7 Reflecting inflation in the bioresources control

The average revenue control will be indexed by inflation. Chapter 11 of our final methodology confirms that we will be using the consumer price index including housing (CPIH) as our inflation index.

3.2 Managing the separate control

In this subsection we discuss key aspects of our management of the control.

3.2.1 What is controlled: sludge production in tonnes of dry solids

We have considered the measure of sludge quantity that would form the basis for the bioresources average revenue control. We considered two measures:

- tonnes of dry solids (TDS); and
- population equivalent served by sewage treatment works.

In our May 2016 decision document, we set out our preferred option to link allowed revenues in bioresources to sludge volumes, measured in TDS. However, we explained concerns about the robustness of TDS data in terms of consistency between companies and over time. Currently, TDS is not directly measured by instrumentation in all locations; it is often estimated. For example, it is sometimes

calculated from other measurements, using assumptions about the impact of the treatment process on volumes. This creates challenges to the way in which we might set our average revenue control at PR19.

We set out that we will use population equivalent served by sewage treatment works as a cross-check. This check would be used to compare TDS per head across the industry, and could be used to moderate the data used to set the average revenue control.

Since May 2016, we have developed our definition of TDS in consultation with stakeholders – in particular the sludge working group. We set out our final definition in the April 2017 information notice, '[IN 17/04 Preparing for wholesale markets](#)'. For clarity, this definition is repeated in box 1.

Box 1 – Definition of tonnes of dry solids

Sludge production in tonnes dry solids for the PR19 average revenue control:

- is a measure of untreated sludge (primary, secondary and tertiary) produced by in-area wastewater treatment processes in a year;
- does not include the grit and screenings removed through preliminary wastewater treatment processes; and
- is measured preferably at the boundary between network plus and bioresources as defined in RAG 4.06, or if not at the point of treatment. There should be continuous measurement via instrumentation rather than by composite or spot sampling.

We expect companies to measure sludge volumes from the beginning of the control period, consistent with our definition of sludge volumes (set out in box 1 above). As a result, we expect companies to improve the accuracy of their measurement of sludge volumes, which will enable better operational decisions, facilitate trading between companies on a comparable basis and protect customers from excessive bill variation. Companies will need to set out how they measure sludge volumes as part of their business plans.

Companies will need to set out the basis for their central forecast estimates of sludge production over the 2020-25 period. They should include details of any areas where they are not compliant with the definition of TDS in box 1 and the potential impact on their forecast data. They should include details of the key assumptions and uncertainties underlying these estimates. They should explain the assurance processes for both direct sludge volume measurement data, as well as any related

data they may use to calculate sludge production volumes, such as measured sewage loads. We expect companies to provide an appropriate level of external assurance on their approach to determining forecast TDS over the 2020-25 period

We will assess these forecasts using relevant sources of information – for example, comparisons with historical data, comparisons between companies, and population equivalent cross-checks. We will take account of the quality of companies' evidence for their forecasts as part of our initial assessment of plans.

3.2.2 How it is controlled – the average revenue control

In our May 2016 decision document, we decided to set an average revenue control related to the volume of sludge produced by wastewater treatment, to provide a link between the bioresources control and the wider market.

We decided we would use the same form of control for both Welsh and English companies. This will enable Dŵr Cymru to work effectively with other providers of sludge transport, treatment and recycling services. We also set out that we would use a building-block approach to calculate the average revenue control, based on expected total expenditure (totex), funding for the RCV and expected sludge volumes.

Since May 2016, we have further analysed how we set the average revenue control. In the case of a difference between forecast and outturn sludge volumes we have decided to apply a revenue adjustment factor to reflect the incremental costs associated with incremental changes in the volume of sludge produced. This offers better protection for customers against the impact of forecasting errors. This revenue adjustment factor is set out in section 4.4.1.

We set out the building-block approach for setting the average revenue allowance in section 2.2. We provide worked examples of how this and the revenue adjustment factor are calculated in section 4.4.1. In early 2018 we also plan to publish a spreadsheet model to illustrate how the revenue adjustment factor will work in practice for stakeholders to review.

3.2.3 Managing flows across the boundary

In [appendix 2](#) of our May 2016 decision document we discussed sludge liquors, which represent the most material flow across the boundary between the network plus and bioresources controls. When sludge liquors are returned to a wastewater treatment works, the activity of treating the liquors is a network plus wastewater activity. The cost of treating liquors should be paid for by the bioresources business.

We proposed that companies use an appropriate method for calculating liquor treatment charges, using the characteristics of the liquor in their calculations. These calculations should be cost-reflective and transparent, and should provide a level playing field with third parties.

There are other significant flows of costs and revenues crossing the boundary between wastewater network plus and bioresources. Companies will need to account for these in a similarly cost-reflective, open and transparent manner. We would expect companies to set out these costs and revenues through their annual regulatory accounting data, using the principles and guidance set out in our RAGs. These items include:

- energy, particularly if wastewater network plus uses energy generated through sludge processing on a co-located site; and
- any grit or screenings removed as part of sludge processing, which network plus may treat or dispose of alongside the grit and screenings removed in the preliminary wastewater treatment process.

Such costs and revenues will need to be accounted for in a similarly transparent way if they are transferred to other parties, such as associate companies, and should comply with the transfer pricing principles in [RAG 5.07](#). We expect to develop guidance on reporting these issues through future RAG consultation processes.

3.2.4 Treatment of the pre-2020 RCV

Prior to 2020, water and wastewater companies have made operational and investment decisions within a price control framework, whereby new investment or proportion of totex not recovered in the price review period was added to the RCV, and this is carried forward to future periods.

In order to promote regulatory certainty, in our May 2016 decision framework we decided not to expose investment made prior to 2020 under the existing framework to new risk from opening bioresource markets. This approach benefits companies and investors by enhancing predictability of our regulation and so will help maintain a low cost of capital, even as elements of the value chain are opened to markets.

3.2.5 Treatment of the post-2020 RCV

In May 2016 we said that:

- investment incurred efficiently on or after 1 April 2020 would not receive the same regulatory protection as the pre-2020 RCV; and
- the revenue allowance to fund the post-2020 RCV would need to be recovered on a standalone basis from bioresources activities.

Post-2020 investments will be exposed to the market for bioresources services. It would not be appropriate to provide explicit regulatory protection. However, our building block approach allows a reasonable return on efficient investment in the 2020-25 period, without fettering our discretion about how we undertake any future price reviews.

Companies will face some risk around the volume of sludge produced from treating wastewater. The volume risk comes from variations in volumes of sludge produced by treating wastewater from domestic and business customers, which historical evidence suggests will be modest. Companies will be able to generate value from potential trading opportunities. Our approach should therefore ensure that companies can earn a reasonable return on their RCV. It should be noted that our price control approach before 2010 exposed companies to volume risks.

3.3 Encouraging markets

The thrust of our methodology is to promote markets in bioresources services. Our analysis throughout the Water 2020 programme has shown that when companies make the best use of the sludge generated by treating domestic and business wastewater, there are considerable benefits to be had for customers, companies, the environment and other stakeholders.

3.3.1 Accounting for income from bioresources trading

As the market in bioresources develops, we expect companies to optimise their activities by trading across boundaries. Companies may contract with third parties to provide bioresources services, at a lower cost to the company than providing the same services in-house. Where a company forms such an arrangement and exports sludge, the company will retain all of the efficiency savings it makes until we reassess costs for efficient bioresources services in 2024. Those efficiencies will then be passed on to customers through our next price review process.

In November 2017, we published [RAG 5.07](#) for transfer pricing for bioresources trades. This sets out the guidelines companies must follow if their appointed assets are used to provide services to other companies.

If a company treats (imports) another company's sludge, or other organic waste, this activity is open to competition and falls outside our scope of price controls. As such, the treatment activities, costs and revenues fall within the non-appointed business.

A company may wish to use the assets of the appointed business to treat imported sludge or other organic waste. This would mean that the appointed business would be acting on behalf of the non-appointed business. Company licences stipulate that such transactions between the appointed and non-appointed business are carried out at arm's length, so that the non-appointed business neither gives nor receives any cross-subsidy to or from the appointed business.

Where the non-appointed business is using the assets of the appointed business for processing bioresources or organic waste, the non-appointed business must agree a transfer price with the appointed business. A transfer price is the price set internally to remunerate the appointed business for the costs that it incurs. The transfer price should include at least the incremental costs and an appropriate share of the margin. This margin share should reflect the risks incurred by the appointed and non-appointed business respectively. It should also ensure that customers of the appointed business share in the benefits of trades.

The income from the transfer price is treated as a negative cost to the appointed business. The net profit of the transfer price is therefore a cost saving for the company. Because it is a volumetric control, we are not applying cost-sharing arrangements to the bioresources control. As a result, without accounting for this net profit when calculating the revenues they receive, companies would retain the benefits of trades in the short term and customers would wait until PR24 to share in the efficiency savings.

Our initial assessment of business plans test on bioresources will consider the evidence companies provide about third party delivery of their bioresources services. We will also consider evidence where companies are planning to provide third party bioresources services to others using existing assets paid for by customers. Our assessment will consider how companies share some of the benefits of using such assets with customers. We would expect the benefit sharing to lead to lower revenue requirements, and thus lower bills, than if services to third parties using existing assets were not proposed.

We consider in more detail how customers should benefit from bioresources imported trades. This is set out in section 4.3.1.

3.3.2 Trading incentives

At PR19, we are not introducing explicit trading incentives to encourage companies to engage in bioresources trading. It will be up to each company whether it engages in trading. Using the annual information companies will provide to us about bioresources contract activity, we will monitor the market as it develops to assess how well it is working.

3.4 Managing uncertainty and ensuring legitimacy

Companies may not be able to accurately predict how the market will evolve. They will need to consider their plans in the light of these market uncertainties.

3.4.1 Bioresources strategy

It is important for all companies to demonstrate they are procuring best value bioresources services, both over the next five years (2020-25) and over the long term, taking into account future demand, opportunities and risks.

We note companies submitted sludge strategy documents to support their business plans at previous price reviews. We will assess the extent to which a company has a well evidenced long-term strategy for bioresources as part of our initial assessment of plans.

We expect companies to demonstrate the role of market testing of their bioresources services and how their proposed balance of in-house and external provider solutions provide best value to their customers. The development of the bioresources markets provides a significant opportunity for companies to assess the efficiency of their in-house provision against market options and we would expect companies to be taking advantage of this in the development and delivery of their business plans.

In regard to the case for any enhancement expenditure, we would expect companies to demonstrate they have fully considered market options and that any new capacity in the appointed business is not being developed primarily to provide capacity for the non-appointed business.

3.4.2 Accurate measurement of sludge

Companies may have broadly reliable historical data on the total costs associated with bioresources activities, but uncertainties over historical volume measurement mean that meaningful data on unit costs may not be available. Even where it is available, it is unlikely to be consistent across companies. Consistent and accurate

measurement of sludge volumes will enable better operational decisions and facilitate trading between companies on a comparable basis.

We expect companies to be using instrumentation to measure sludge production accurately at the start of the control period, or at the latest by the beginning of the second year of the control. Accurate measurement of sludge production will be required for the operation of the market and is likely to form the basis of contracts. It will also be needed if we move to setting gate prices at PR24.

For any company that does not currently measure its sludge production, we expect to see comprehensive plans for installing meters set out in its business plan. We will take into account how companies have complied with this requirement at PR24.

4. Decisions based on our PR19 methodology consultation

In this section, we map our decisions based on our PR19 methodology consultation against the four strands of our approach. For each policy decision, we set out:

- the issue we were seeking to address;
- our preferred option, as indicated in our draft methodology;
- stakeholders' responses;
- our review and analysis; and
- how our final decision will be applied.

Section 5 (Wholesale controls) of [appendix 15](#) outlines respondents' views on the question we posed about the bioresources control in our draft methodology consultation. In appendix 15 we provide or reference our responses to the issues raised by respondents in more detail.

We carried out a qualitative impact assessment in each of these policy areas. These are set out under 'Our review, analysis and final decision' for each policy area. This ensures that the impact of our decisions is incorporated into our decision-making. This assessment used the following three criteria:

1. Achieving our objectives: Does the proposed option meet our legal duties? Is it consistent with the UK and Welsh Governments' strategic policy statements and our vision and strategy?
2. How our objectives are achieved: Is the proposed option consistent with our regulatory model?
3. Practicality: Is the proposed option practical and implementable?

There are more details about our approach to impact assessments in [appendix 14](#).

4.1 Establishing a separate control

The measures to establish the separate control were implemented based on our May 2016 consultation. We proposed no new measures in our draft methodology.

4.2 Managing the separate control

In establishing the separate control in our May 2016 decision document, we set an approach we would further develop through our price review methodology.

4.2.1 In-period revenue correction mechanism

The issue we were seeking to address

Companies will set wastewater charges before the start of the year, based on the best information available, to align their expected average revenues from charges with their allowed average revenue under the bioresources control. Nevertheless, at the end of the year, the actual average revenues wastewater companies collect for bioresources may, depending on the design of companies' charging schemes, vary from the allowed modified average revenue allowance. For example charges may be based on rateable value for properties that do not have meters, but rateable value does not change with occupancy whereas bioresources quantities do. This could result in companies either under or over-recover revenue.

In deciding on the design of the control, we also need to take account of customers sharing the profits the appointed business receives from bioresources trade imports, as set out in section 3.3.1, and the need to adjust companies' allowed revenue to reflect any payments relating to their in-period outcome delivery incentives (ODIs).

It is important to address these variations to make sure customers are protected within the control and companies comply with the revenue limits.

Our preferred option in the draft methodology

In our draft methodology we considered two options:

Option 1 – Revenue correction mechanism: adjusting future allowed average revenue limits to correct for past variations between revenues earned and revenue limits in those years.

Option 2 – Revenue correction mechanism with a forecasting incentive: similar to the PR14 wholesale revenue forecasting incentive, applying a financial disincentive for large variations in collected revenues. The mechanism also adjusts future allowed average revenue limits to correct for past variations between revenues earned and revenue limits.

We said that our preferred option was option one, because this would return benefits from trades near to when they are realised, and the phasing would limit the impact on the market. Also, the interaction between a revenue forecasting incentive and the volume forecasting incentive could create complexity and lead to penalising a company twice for not accurately forecasting its volume of sludge accurately.

Stakeholders' responses

A small number of respondents commented on our approach to recovering revenues. No respondents disagreed and two supported it. One respondent commented that option two, having a revenue forecasting incentive would be disproportionate.

One respondent also commented on our timescales for consulting on the detail of the mechanism. It asked if we could issue details about how the revenue adjustment mechanism will operate by the draft determinations at the latest, to give companies time to comment.

Our review and analysis

We have decided to use a simple revenue correction mechanism. We set out our appraisal of the options in table 6. We consider the simple revenue adjustment mechanism to be consistent with our focus on affordable bills and resilience, because it adjusts a company's allowed revenue in subsequent years, correcting for any under or over-recovery of revenue in an earlier year.

The revenue correction mechanism will work in a similar way to the revenue forecasting incentive mechanism used for other wholesale controls, excluding the incentive penalties. We expect to publish a model of how this mechanism would work in early 2018.

Table 6 – Revenue adjustment options

	Option 1: Revenue correction mechanism Preferred option	Option 2: Revenue correction mechanism with forecasting incentive
Achieving our objectives	<p>Allows companies to make sure that, after reconciliation, revenues collected for bioresources match those allowed under the modified average revenue control.</p> <p>Recognises that volumes are a key driver and that the volume forecasting incentive covers this, making a correction more appropriate.</p> <p>✓✓</p>	<p>Provide incentives to forecast revenues accurately although this will already incentivised to some extent through the volume forecasting accuracy incentive</p> <p>✗</p>
How our objectives are achieved	<p>The average revenue control reflects the average revenue required to treat, transport, and</p>	<p>The average revenue control reflects the average revenue required to treat, transport, and recycle a unit of sludge.</p>

	<p>recycle a unit of sludge. It encourages companies to set volumetric charges for bioresources services aligned to unit cost structures.</p> <p>✓✓</p>	<p>Adjusting the allowed revenues in the name of revenue accuracy is likely to distort volumetric charges for bioresources services. This distortion will not be significant in the short term, but could become more significant as markets develop.</p> <p>✓</p>
Practicality	<p>Requires companies to show how they adjust charges from those allowed in the determination, but this should be straightforward. Ownership sits with the companies.</p> <p>✓</p>	<p>Complexity from the interaction with the volume forecasting accuracy incentive. Companies may be penalised twice for adjustments in revenues driven by volume changes.</p> <p>✗</p>

How our final decision will be applied

The in-period revenue correction mechanism adjusts a company's allowed average revenue in one year, to correct for any under or over-recovery of average revenue in an earlier year. This is similar to the revenue correction within the wholesale revenue forecasting incentive mechanism (WRFIM) at PR14, although unlike the WRFIM, we will not apply a financial incentive for large variations between revenues collected and revenues allowed.

In box 2, we set out the basic formulae for the in-period revenue correction mechanism.

At the end of each charging year, we will compare that year's allowed revenue for bioresources with the bioresources revenues companies recovered in that year. We will take into account the difference between the allowed revenue determined by the modified average revenue control, any trading profit received by the appointed business, and any other adjustments (that is, any in-period ODIs). These adjustments will be determined as a lump sum, rather than as an average revenue. This ensures it the companies do not under- or over- recover revenue from these adjustments.

The adjustments we make based on comparing the allowed and actual bioresources revenues in the charging year (t-2) will first be reflected in charges set in the charging year (t). This means that adjustments arising from deviations in 2023-24 and 2024-25 will still need to be reconciled in the way we set revenues at the price review in 2024.

Box 2: In-period revenue correction mechanism

The in-period revenue correction mechanism is made up of two components:

- the allowed revenue in each year taking account of in-period adjustments; and
- adjustment to bioresources revenue, which reflects that the revenue a company collects in a charging year may be different from its allowed revenue.

Adjusted allowed revenue:

The **adjusted allowed revenue** in year t is based on the following formula.

$$AR_t = MAR_t \times ATDS_t - ABR_t - T_{t-2} + OA_{t-2}$$

AR_t **Adjusted allowed revenue** for bioresources in year t. This reflects the average revenue allowance and in-period adjustments. The allowed revenue is given as a monetary value.

MAR_t **Modified average revenue**. The allowed average revenue per tonne of dry solid (£/TDS); see section 3.2.1 for more information.

ATDS_t **Actual volume of sludge (TDS)** produced in year t, which will be determined at the end of the financial year. This is the specific annual sludge production in year t.

ABR_t **Bioresources revenue adjustment**. This is the difference between a company's allowed revenue and the revenue collected in a charging year, given as a monetary value in year t. We provide details for the calculation of this term below.

T_{t-2} **Profit from bioresources trading** in year t-2. This is the profit element of the revenue, passed to the appointed business through the transfer price when appointed assets are used for non-appointed business, adjusted for inflation.

OA_{t-2} Other adjustments to revenue resulting from year t-2, such as in-period ODIs adjusted for inflation.

In the first year of the control we would expect that the allowed revenue will reflect the modified average revenue multiplied by the volume of sludge produced in that year.

Adjustment to bioresources revenue

For each charging year of AMP7, the bioresources revenue adjustment (ABR) in year t will be based on the following formula.

$$ABR_t = \left\{ (RR_{t-2} - AR_{t-2}) \times \left[1 + \frac{i_{t-1}}{100} \right] \times \left[1 + \frac{i_{t-2}}{100} \right] \right\} \times (1 + CPIH_{t-2}) \times (1 + CPIH_{t-1})$$

AR_{t-2} Adjusted allowed revenue for bioresources in year t-2, based on the formula at the top of box 2 reflecting the modified average revenue and other adjustments. This is given as a monetary value.

RR_{t-2} Recovered revenue for bioresources in year t-2. Companies revenue collected in each charging year should reflect the adjusted allowed revenue. This is given as a monetary value.

i_t Discount rate in year t. This will be based on our assumptions for the weighted average cost of capital over the period. For the purposes of the revenue correction mechanism, we will apply a constant discount rate over the period.

CPIH_t Inflation index in year t. The household consumer prices index; see [appendix 12](#) for more information.

To ensure the revenue adjustments are NPV neutral we need a discount rate to ensure we take account of the time value of money. At PR14 we used the allowed WACC as a discount rate in calculating in-period revenue reconciliation, and we assumed it remained constant overtime. We considered this was the most reliable rate to discount allowed revenues. We still consider this to be the case. Therefore we will use the WACC at the start of the control period as the discount rate in the revenue correction model. This is in line with our approach in the revenue forecasting incentive model for other wholesale controls which is explained in [appendix 7](#).

Box 3 presents a worked example of the in-period revenue correction incentive.

Box 3 – In-period revenue correction – worked example

Assumed scenario

In 2020-21, year t-2, a company's allowed bioresources revenue is £90 million, while the actual revenue recovered for bioresources is £93 million. This implies a £3 million over-recovery for the year.

In this scenario, the non-appointed business is using the appointed business's assets to treat sludge for a neighbouring water and wastewater company. A transfer price has been agreed with 50% of the profit margin (£0.5 million) on these trades has been transferred over to the appointed business. This revenue needs to be passed through to customers.

We have assumed no other adjustments from in-period ODIs.

For the purposes of this illustration, we assume a discount rate of 3.7% (that is the discount rate applied to the WRFIM at PR14) and an inflation rate of 2%.

Calculation of the adjustment to the bioresources revenue (ABR)

The total adjustment is calculated as:

$$ABR_t = \left\{ (RR_{t-2} - AR_{t-2}) \times \left[1 + \frac{i_{t-1}}{100} \right] \times \left[1 + \frac{i_{t-2}}{100} \right] \right\} \times (1 + CPIH_{t-2}) \times (1 + CPIH_{t-1})$$

$$ABR_t = \left\{ (93 - 90) \times \left[1 + \frac{3.7}{100} \right] \times \left[1 + \frac{3.7}{100} \right] \right\} \times \left(1 + \frac{2}{100} \right) \times \left(1 + \frac{2}{100} \right)$$

$$ABR_t = \text{£}3.36 \text{ million}$$

So in the 2022-23 allowed revenue calculation, the company effectively refunds customers for the over-recovered amounts in 2020-21 and the associated financing they have provided. This ensures that the refund remains equivalent to the over-recovered amount, in present value terms.

The allowed revenue for 2022-23 is calculated as:

$$AR_t = [MAR_t \times ATDS_t] - ABR_t - T_{t-2} + OA_{t-2}$$

The modified average revenue $[MAR_t \times ATDS_t]$ only becomes known at the end of the charging year, because it is determined by the actual level of sludge production in year t. Although the exact volume of sludge production ($ATDS_t$) is not known at the beginning of year t, we expect companies to update their forecasts

with the latest information. This allows companies to set charges based on their latest information.

The bioresources revenue adjustment will reconcile the difference between companies' estimated and actual allowed revenue for each charging year. This will be calculated through the difference between revenue collected and allowed revenue.

Companies will need to reflect the lump sum adjustments in their charging schemes. This will include any under or over-recovery of revenue, trading revenues to be passed on to customers, and other adjustments (that is, in-period ODIs).

The trading revenues will be adjusted for inflation. This means in this example the revenue from trades that would be passed back to customers would be £520,200 (£500,000 with two years of inflation at 2%).

This means the lump sum adjustment in year t is £3.877 million.

$$AR_t = [MAR_t \times ATDS_t] - £3.356m - £0.520m - 0$$

In year t, the company actually produced 150,000 TDS with a modified average revenue of £500/TDS, resulting in a revenue allowance of £75 million. This means the company's adjusted revenue allowance in year t is £71.12 million.

$$AR_t = £75m - £3.356m - £0.520m - 0$$

$$AR_t = £71.12$$

4.3 Encouraging markets

A driving force behind setting a separate control for bioresources is promoting sludge trading to improve efficiency. This has been a key theme of our Water 2020 programme.

4.3.1 Sharing benefits from bioresources import trading with customers

The issue we were seeking to address

In section 3.3.1, we set out the guidance a company must follow when setting transfer prices for trading arrangements in the bioresources market. A company would need to set a transfer price when using its appointed assets to provide bioresources services to others.

This guidance requires companies to transfer an appropriate share of the profit margin made on the sale of bioresources processing to the appointed business (over and above incremental costs). This profit share should reflect the risks incurred by the appointed and non-appointed businesses respectively.

As customers have paid for these assets being used for non-appointed activities through their bills, we consider they should benefit from such trades. Without an additional mechanism, companies would retain the benefits of trades for the duration of the control period, while customers would have to wait for their share until we reassess costs at PR24.

Our final methodology approach is to allow customers to benefit more immediately from the profit passed to the appointed company in these circumstances.

Our preferred option in the draft methodology

In our draft methodology, we considered two options.

- **Option 1 – End of period profit sharing mechanism:** An end of period adjustment could be applied as part of the end of period reconciliation, minimising the burden on companies while making sure an appropriate share of profits is returned to customers. The downside of this approach is that it might distort future markets in bioresources by applying a single lump sum adjustment in the next price review future period. It also means that customers wait longer to receive benefits.
- **Option 2 – In-period profit sharing mechanism:** An in-period adjustment mechanism is potentially more burdensome and requires companies to return profits on trades in previous years. Phasing of profits returned would minimise the distortion to the future markets.

We said that our preferred option was option 2, because this would return benefits from import trades near to when they are realised, phased to limit the impact on the market.

In this approach, companies that use the assets of the appointed business to treat another company's sludge will need to set transfer prices in line [RAG 5.07](#). This is to

avoid cross-subsidy between the appointed and non-appointed businesses and to share the benefits of trading with customers.

Stakeholders' responses

We received four responses to our proposals for sharing the benefits of trading activities with customers. Respondents were divided. Two respondents considered that sharing benefits with customers could dampen the development of markets. The other two respondents supported our approach and considered that benefits from trades should be shared with customers through an in-period mechanism.

Our review and analysis

We have decided to retain our preferred option (an in-period profit sharing mechanism) in our final methodology.

We understand respondents' concerns that sharing the benefits with customers could dampen the market. RAG5.07 stipulates that, where non-appointed businesses use the appointed business's assets, the transfer price should include at least the incremental cost plus a proportion of the margin (that is, profit). This means the rest of the profit will remain with the non-appointed business. We consider that the profit retained by the non-appointed business should offer sufficient incentives for companies to trade.

It is also fair that customers should gain some benefit from such trades as customers have funded these assets through their bills and therefore should share the efficiency gains. We are therefore **requiring that the appointed business pass on all profit it receives from the transfer price to its customers**. This ensures that both customers and companies benefit from trading arrangements, the customer via the appointed business and the company by the non-appointed business.

We confirm that we require companies to pass on profits from trade imports to their customers within the same period. This requirement was supported by two respondents, and no respondents raised concerns about it. We consider that customers should benefit from trades close to the time the trades occur. This aligns with our outcomes framework. It also ensures that these benefits are unlikely to distort the market at PR24.

Table 7 shows our assessment of the two options we considered for the profit sharing approach.

Table 7 – Profit sharing options

	Option 1: End of period profit sharing	Option 2: In-period profit sharing Preferred option
Achieving our objectives	<p>Furthers customers' interests by making sure they benefit from the use of appointed assets for non-appointed business, but customers have to wait to see that benefit.</p> <p>✓</p>	<p>Furthers customers' interests by making sure they benefit from the use of appointed assets for non-appointed business, and benefits are returned to customers more or less immediately.</p> <p>✓ ✓</p>
How our objectives are achieved	<p>Insufficient focus on customer impacts, as an end of period adjustment risks a step change in bills.</p> <p>✗</p>	<p>Focused on customer impacts using a mechanistic approach risks a lack of flexibility.</p> <p>✓</p>
Practicality	<p>Would delay changes but would not be unduly costly to implement through an end of period reconciliation.</p> <p>✓</p>	<p>Mechanistic approach is straightforward to implement and allows a quick response to market development.</p> <p>✓ ✓</p>

How our final decision will be applied

Companies must follow the rules set out in the transfer pricing guidance in [RAG 5.07](#) (or any subsequent revisions) and demonstrate compliance with the transfer pricing rules.

We will expect companies to report, at an aggregate level in their annual performance reports, the profits the appointed business has received from the non-appointed business through the transfer price, where the non-appointed business has used the appointed business's assets to deliver bioresources services. We expect to develop guidance on reporting profits in transfer prices through future RAG consultation processes.

Companies will share the profits of such trades with their customers within the same period. They will do this through the in-period revenue correction mechanism. Section 4.2.1 explains how the profit element of the transfer price revenue in year t-2 adjusts the allowed revenue in year t.

4.4 Managing uncertainty and ensuring legitimacy

We identified key sources of uncertainties in the estimates of sludge production for the 2020-25 control period. Material under or overestimation of sludge volumes would be likely to distort an average revenue control, which could call into question the legitimacy of the revenues gained as a result of a biased forecast.

4.4.1 Managing uncertainty in sludge forecasts: average revenue control and the forecasting incentive

The issue we are seeking to address

PR19 will be the first time we set a separate control for bioresources, as part of a transition towards a more market-based approach in the longer term. We have previously set out that an average revenue control reflects the commodity characteristics of bioresources services. However, setting an average revenue control requires robust information about both costs and volumes in order to ensure that incremental allowed revenues broadly align with expected incremental costs.

Material under or overestimation of sludge volumes could distort the average revenue control and result in the company either recovering too much revenue relative to its costs (if it underestimates volumes) or too little revenue relative to its costs (if it overestimates volumes).

We expect companies to accurately measure sludge volumes during the 2020-25 period. This may also result in a change in reported sludge volumes when compared to forecasts made in 2018, not because there is a real difference in sludge produced, but because of poor information today and better information during the period. We want to incentivise companies to forecast sludge volumes as accurately as possible.

Our preferred option in the draft methodology

In our draft methodology, we proposed setting an average revenue control based on the revenue allowance over the five-year period required to treat and recycle the forecast sludge produced, expressed as a revenue per tonne of dry solids (£/TDS). We said that this would be based on a NPV approach.

We considered how to ensure that companies forecast sludge production accurately and reduce incentives to under estimate sludge volumes. We considered three options.

- **Option 1 – Do nothing:** We would evaluate the robustness and accuracy of company forecasts of sludge production when setting the bioresources control. We would not incorporate any adjustment mechanism to the unit revenue allowance or incentive for volume forecasting accuracy.
- **Option 2 – End of period reconciliation for measurement changes:** We would reconcile the average revenue control to remove the effects of measurement change on the variation in sludge volumes. This ensures that variations between actual and forecast volumes are assessed on a like-for-like basis. There would be no financial incentive for forecasting accuracy.
- **Option 3 – Volume forecasting accuracy incentive:** We would apply a financial incentive to significant variations between measured and forecast sludge volumes, to incentivise companies to forecast sludge volumes accurately. This would involve setting a deadband around the forecasts, within which variations would not trigger an incentive payment. This option considered whether we would also set a cap to limit revenues for any significant under-forecasts of sludge production.

In our draft methodology consultation, our preferred option was option 3: the volume forecasting accuracy incentive. Under this mechanism, we would apply a penalty for significant inaccuracies in companies' sludge volume forecasts in their business plans. Variations in the total volumes of greater than $\pm 3\%$ from the forecast used to set the revenue control would trigger the penalty. We would also return revenue to customers where five-year total sludge volumes were 7% higher than the forecast sludge production used to set the revenue control.

Stakeholders' responses

In general most respondents agreed with our rationale for choosing the forecasting incentive. Only one respondent thought that the forecasting accuracy incentive was not necessarily required. A number of respondents raised concerns about the mechanics of its operation.

These included concerns over:

- the $\pm 3\%$ deadband being too narrow, given the uncertainties that companies face and the accuracy of measurement equipment;
- the uncertainty around the Water Industry National Environment Programme (WINEP) – which could, for example, result in material increases in production of sludge to meet new phosphorus removal consents. This programme will not be confirmed until 2021 adding to forecasting risk;
- the asymmetry of the 7% cap on volume variation. It was considered that we should also apply a floor to revenues where volumes are 7% lower than forecast,

to make sure volume risk is allocated symmetrically between customers and companies; and

- whether sludge from trading should be included in sludge volume forecasts for the accuracy incentive. One company considered that it should be excluded, so as not to disincentivise companies from trading.

One respondent considered that we needed to take into account the fixed and variable costs in how the incentive applied. It was concerned that if a company over-forecast, then it could risk not fully recovering its fixed costs. Another respondent also raised concerns about the potential for asset stranding from large volume over-forecasting.

Our review and analysis

In our draft methodology, we recognised that an average revenue control could create strong incentives for volume under-forecasting. This could result in higher bills than are necessary for customers. We therefore proposed a financial forecasting incentive and a cap on differences between outturn and forecast volumes. This was to reduce the risk of companies under-forecasting sludge volumes, which could deliver windfall gains to companies by over-compensating fixed costs. This is because the incremental costs of providing bioresources services is smaller than the average costs due to the economies of scale associated with bioresources.

Since publishing our draft methodology proposals, we have carried out more analysis and engaged with companies through a bioresources form of control workshop, held on 4 October 2017. We have published the notes and slides on our [website](#). Both our analysis and the discussions in the workshop highlighted the incentive for companies to under-forecast sludge production at PR24.

At the 4 October 2017 workshop, Anglian Water presented its assessment of the forecasting incentive mechanism. It identified the incentive for companies to under-forecast sludge production at PR19 in order to receive more revenue than was required. It showed, through an illustrated example, that a company could receive windfall revenue gains by under-forecasting sludge production. This view was also supported by other attendees at the workshop, who considered that companies had an incentive to under-forecast sludge production by up to 7%, where the revenue cap would stop further revenue gains.

Our analysis since publishing our draft methodology proposals further supported this assessment. The average revenue control could lead to companies receiving revenues much greater than those required to cover their costs in providing bioresources services. This would result in customers paying too much for bioresources services.

We have considered additional options to reduce the opportunity to game the incentive. In considering these options, we also took into account respondents' other concerns, such as, the asymmetrical risk to companies from the 7% cap.

- **Option 1 (Preferred option in draft methodology) – Standard average revenue control, a symmetrical financial incentive, and cap on volume increases:** Average revenue control to ensure that companies incur volume risk and align the regulatory framework with the volumetric nature of bioresources activities. Retain the proposed penalty incentive rates triggered at $\pm 3\%$ with a cap on revenues above 7%.
- **Option 2 – Standard average revenue control with symmetrical financial incentive with cap and collar:** Retain the same incentive framework but with both a 7% cap and collar on revenues, to limit the impact of large volume variations. Stronger penalty incentive rates for poor forecasting to make the incentive more meaningful.
- **Option 3 – Modified average revenue control with symmetrical financial incentive:** Incorporate a revenue adjustment factor to better align the allowed average revenues to the incremental costs associated with changes in sludge volume. The revenue adjustment factor would be calculated from company fixed costs. It will ensure that revenues companies can recover to remunerate fixed costs are not affected by incremental changes in sludge volumes. Removing the 7% cap and applying stronger symmetrical penalty incentive rates for poor forecasting applied at end of period will make sure companies still face volume risk, which also incentivises them to provide accurate forecasts.

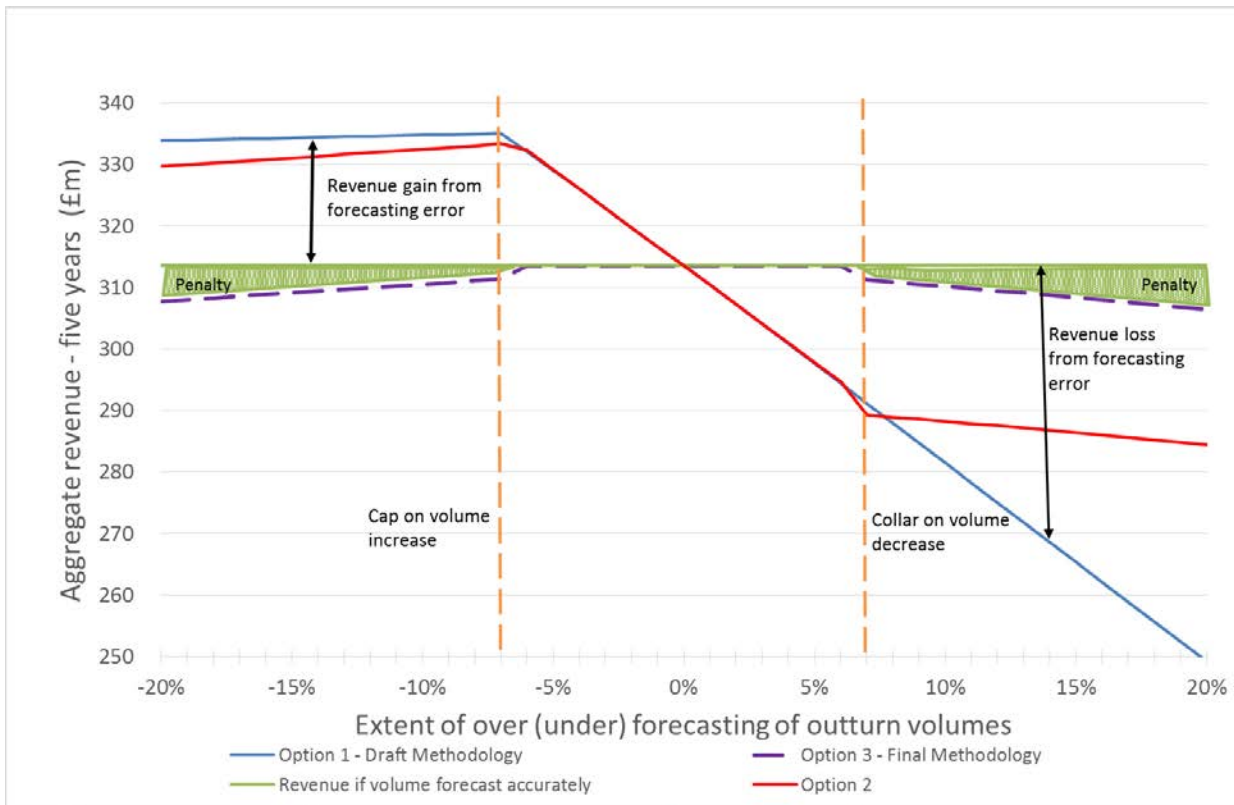
Figure 5 shows the potential gains and losses to revenue from over and under-forecasting under options 1, 2 and 3 under our modelling. Figure 5 assumes that the outturn measured sludge volume was 660,000 TDS. The x-axis shows a range of scenarios where the 660,000 TDS is between a -20% to +20% variance from a company's forecast. At -20% the company had forecast 550,000 TDS, and at +20% the company had forecast 825,000 TDS, but in both cases the outturn remained at 660,000 TDS. The y-axis shows the allowed revenues under the different options we considered. The green line indicates the revenue that a company would be allowed to recover if it had forecast accurately (where the forecasting error is 0%). This is shown as a flat line to aid comparison with the other options we considered.

Our analysis indicates that under options one and two, companies have strong incentives to under-forecast sludge production. Conservative volume forecasts would reduce the likelihood of a company not fully recovering its fixed costs and provide it with additional profit if volumes increased above the forecast.

Under option three, the incentives for companies to under-forecast are greatly reduced from better aligning incremental allowed revenues with incremental costs

from changes in sludge volume as well as applying stronger penalty rates to maintain an incentive to forecast accurately. In our example, where incremental costs are perfectly aligned with revenues, a company would receive the same revenue for a specific volume of sludge no matter the level of forecasting error.

Figure 5 – Comparison between our proposed forecasting incentive options



We also assess the different options against our impact assessment framework in table 8.

Table 8: –Average revenue control and forecasting incentive options

	Option 1: Financial incentive with cap Preferred option in draft methodology	Option 2: Symmetrical financial incentives with cap and collar	Option 3: Modified average control and symmetric forecasting incentive Selected option
Achieving our objectives	Average revenue control ensures that companies bear volume risk and aligns the regulatory framework with the	Maintains the average revenue control, which ensures that companies bear some volume risk. However, the collar	Preserves the average revenue control. However, a modified average revenue control potentially dilutes the

	<p>volumetric nature of bioresources activities. However, it does not address the perverse incentives to under-forecast sludge production which could lead to gaming profits, and higher customer bills.</p> <p>✓</p>	<p>reduces the level of risk that companies bear. This is compensated to some degree by increasing the incentive rate in the forecasting mechanism. It is likely to only partly address the perverse incentive to under-forecast sludge production, which could lead to higher customer bills.</p> <p>✓</p>	<p>volume risk for companies. This is compensated for by increasing the penalty rate in the forecasting incentive, to encourage more accurate sludge production forecasts. It significantly reduces impact of forecasting error, ensuring that customer bills better reflect the costs of providing bioresources services.</p> <p>✓</p>
How our objectives are achieved	<p>Provides some financial incentives to accurately forecast volumes within appropriate limits but does not address the inherent misalignment between allowed revenue changes and cost changes, where fixed costs are proportionately high.</p> <p>✗</p>	<p>Symmetrical sharing of the risks of significantly over-forecasting volumes is likely to reduce incentives to forecast conservatively. However, it does not remove the incentive to under-forecast completely.</p> <p>Does not address the inherent misalignment between revenue changes and cost changes, where fixed costs are proportionately high.</p> <p>✓</p>	<p>Clear financial incentives for companies to accurately forecast outturn volumes.</p> <p>More closely aligns revenue changes with the structure of costs, aligning with our transfer pricing principles; reduces incentives to under-forecast volumes. Offers protection to customers.</p> <p>Minimises the potential for large end-of period adjustments.</p> <p>✓✓</p>
Practicality	<p>Requires revenue clawback which may be complex to implement. There is also scope for large adjustments at end of period.</p> <p>✓</p>	<p>Similar to option one, but with the addition of a collar. Therefore, it will introduce the same level of complexity.</p> <p>✓</p>	<p>Additional complexity in evaluating the incremental adjustment.</p> <p>✓</p>

We have decided to implement option three. Based on our assessment in table 8 we consider option three to be the best at reducing the incentive for companies to under forecast sludge production while maintaining our approach of setting an average revenue.

We have reassessed the level of the forecasting accuracy incentive deadband and penalty rate in light of both stakeholders' feedback and the move to a modified average revenue control. We have taken into account companies' concerns over the

3% deadband being too stringent, given the accuracy of equipment measurement and the uncertainty of the WINEP.

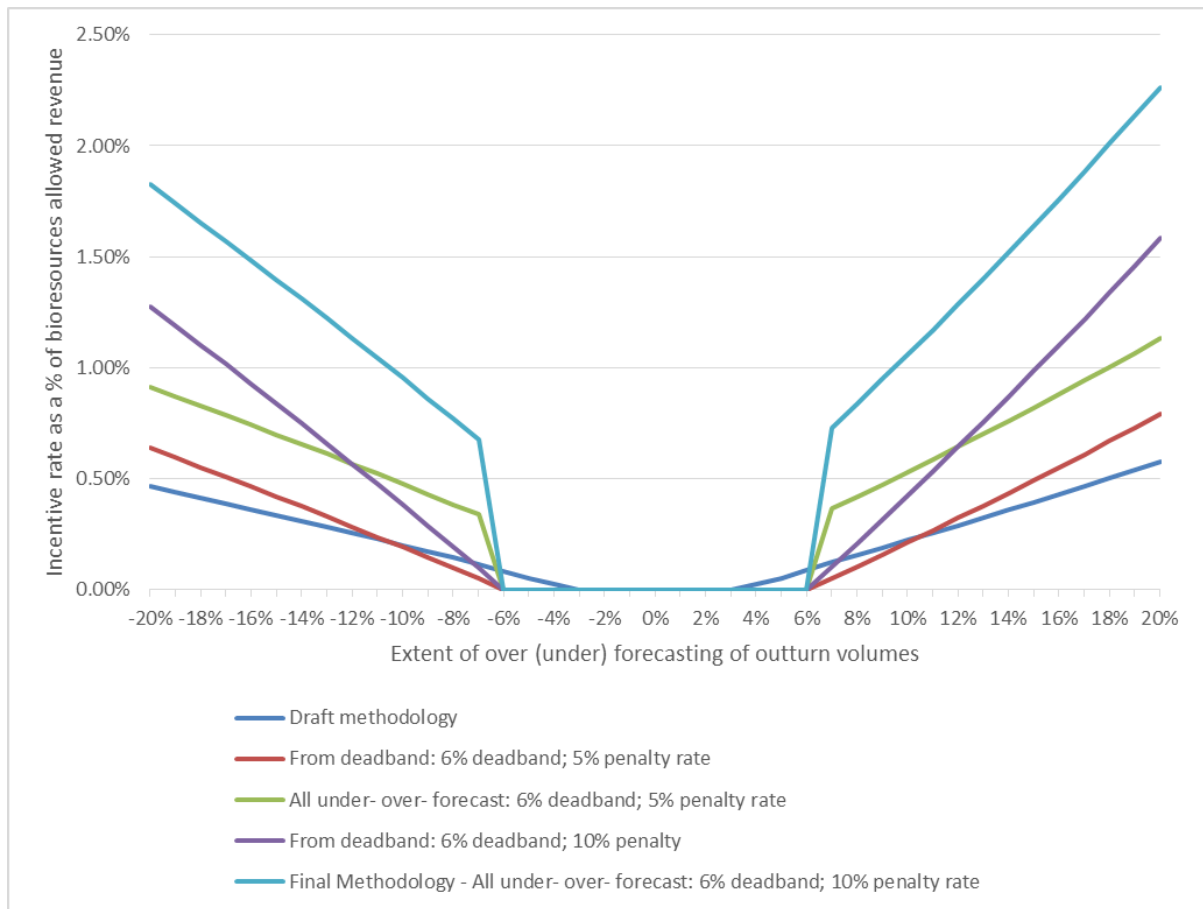
Given that this is the first bioresources control and that companies face some uncertainty over the WINEP, we have decided to increase the deadband to 6%. Our analysis carried out for our draft methodology (set out in annex 1), showed that the annual variations of sludge were within $\pm 6\%$ with the total over the five-year period and broadly in line with the mean. We expect that all companies should be able to achieve this level of accuracy in their forecasts. Accurate forecasts will be important if we move to setting gate prices at PR24. We will review the way we incentivise accurate forecasts at PR24.

In our draft methodology, we proposed a variable penalty rate, which would start at 2% and increase to 3%. This was based on companies bearing volume risk through the average revenue control. Moving to a modified average revenue reduces the volume risk that companies face. Therefore, we consider that a larger penalty rate is required to provide both the volume risk and the incentive to forecast sludge production accurately.

To determine what level of penalty we should apply, we have further analysed the penalty rate. We considered the penalty rate in the draft methodology to be too small to incentivise companies to provide accurate forecasts of sludge production. This assessment was supported by the analysis presented at the 4 October workshop, which indicated that under-forecasting by 10% on a revenue of £387 million would only result in a £2 million penalty.

We have considered calibration of the forecasting accuracy incentive in the light of the introduction of the revenue adjustment factor and removing the 7% cap. We considered the impact of different penalty rates - 5% and 10% of companies' allowed bioresources revenue - and the difference between applying the penalty either to the whole deviation from the central forecast or to the deviation from the deadband.

Figure 6 – Analysis of different penalty rates’ impacts on bioresources revenue



We have decided to apply a 10% penalty rate to all deviations from the central forecast once triggered by the 6% deadband over the whole price control period. The actual lump sum penalty in millions of pounds would be the same for the outturn volume being the same level over or under the forecast.

Companies require strong incentives to move from their current, relatively poor understanding of the volumes of sludge they produce to the better understanding they will need for operating a separate control and active participation in bioresources markets. The higher penalty rate compared to what we proposed in draft methodology sends a strong signal to companies that we expect them to achieve accurate forecasts.

Introducing the adjustment revenue factor has reduced the extent of the volume risk companies face. This higher penalty rate ensures that companies still have an appropriate level of volume risk. Overall it provides a more targeted approach to the bioresources form of control.

How our final decision will be applied

In this section we provide further details on how the modified average revenue control which incorporates the revenue adjustment factor and the volume forecasting incentive will be applied in practice.

Modified average revenue control and revenue adjustment factor

We have modified the average revenue control to incorporate an in-period revenue adjustment factor. This will apply only when measured sludge volumes are different to forecast volumes. In practice, our modified average revenue will be made up of:

a standard average revenue (SAR), based on company allowed revenue divided by the forecast of total sludge production over the control period; and a revenue adjustment factor (RAF), calculated from company fixed costs, to make sure incremental changes in revenues arising from differences between actual and forecast sludge production better reflect the incremental costs of sludge transport, treatment and recycling.

The modified average revenue control will cover costs that companies face when dealing with all sludge they produce from treating their customers' wastewater, as measured at the boundary between the network plus and bioresources controls. This includes costs associated with sludge that may be exported to neighbouring companies or another waste operator. These costs will be treated the same as a company's own cost of processing. It is important to note that the control does not include any volume of sludge treated through the non-appointed business.

We expect to publish a simple spreadsheet in early 2018 illustrating how the modified average revenue will work over the period.

Box 4 shows how the average revenue will be determined.

Box 4 – Modified average revenue

$$MAR_t \left(\frac{\pounds}{TDS} \right) = \frac{TR}{\sum FTDS} - \left[\left(\frac{ATDS_t - FTDS_t}{ATDS_t} \right) \times \frac{R_{Fixed}}{\sum FTDS} \right]$$

Standard average revenue (SAR)
Revenue adjustment factor (RAF)

TR Total revenue requirements calculated at PR19. This is the total efficient revenue allowance determined at PR19 for bioresources and the company

forecast of volumes of sludge, before any in-period adjustments. This is determined using the building blocks set out in figure 1.

FTDS_t Forecast volume of sludge (TDS) produced in year t. This will be based on companies' PR19 submissions.

∑ FTDS Total forecast volume of sludge (TDS) produced by wastewater treatment over the whole of the control period (2020-25).

ATDS_t Actual volume of sludge (TDS) produced in year t. This will be determined at the end of the financial year. This is the specific annual sludge production in year t.

R_{Fixed} Revenue to remunerate fixed costs as determined at PR19 for bioresources

The modified average revenue will be determined on a NPV neutral basis over the control period in the final determinations. This will be inflated each year using CPIH.

The **standard average revenue** is built up using the building block approach in figure 1. We will calculate each company's standard average revenue allowance by determining the total revenues needed to fund the efficient costs of providing bioresources services for a given forecast volume of sludge over the period.

The **revenue adjustment factor** will be based on company fixed costs over the 2020-25 period divided by company forecast of sludge production over this period. This will automatically be adjusted each year by the difference between outturn actual and forecast production of sludge. The formula to determine the revenue adjustment factor is set out in box 4. The adjustment acts to spread the fixed costs of bioresources services over the measured outturn volume of bioresources. The rest of the revenue allowance will vary according to measured bioresources volumes. This ensures that allowed incremental revenues from changes in sludge volumes are better aligned with incremental costs.

In practice, the revenue adjustment factor will be calculated after the year end since it requires knowledge of the outturn sludge volume. We will calculate the revenue adjustment factor after the year end since it requires knowledge of the outturn sludge volume. The revenue adjustment factor will form part of the in-period reconciliation between collected revenues and allowed revenues. Any adjustment in allowed revenues as a result of the revenue adjustment factor will not be implemented until two years after the year when the difference between measured and forecast sludge volumes was realised.

We expect to publish a simple spreadsheet early in 2018 illustrating how the modified average revenue will work over the period. We will welcome feedback about this spreadsheet.

We will determine elements of the revenue adjustment factor for each company individually at PR19. In the final determinations we shall set out the fixed cost we will use in the revenue adjustment factor and forecast volume of sludge over the control period. Companies will need to provide their view of fixed costs in [table Bio4](#) of their business plan submission. This must be supported by evidence, explaining what costs companies have included as fixed costs. This should be based on company average costs rather than site specific costs. In calculating fixed/incremental costs companies should also calculate how their costs change from their central estimate if they produced 10 % more and 10% less than their forecast sludge volume.

Box 5 presents a worked example for the modified average revenue. This example illustrates how companies' allowed revenue changes for the whole control period change if the actual TDS figure is different to company forecasts.

Box 5 – Modified average revenue: worked example

This worked example illustrates the impact that the modified average revenue will have on a company's revenues over the whole control period when a company under- or over-forecasts its volume of sludge.

We have determined the following revenue allowance for a company for the 2020-25 period based on the company's PR19 business plan.

- Total revenue assumed for bioresources at PR19 [**TR**] = £450 million
- Revenue to cover fixed costs [**R_{fixed}**] = £300 million
- Total forecast volume of sludge over the control period [**∑ FTDS**] = 750,000 TDS

$$\text{Standard average revenue (SAR)} = \frac{450m}{750,000} = \text{£}600/\text{TDS}$$

Scenario 1 – Under-forecast

The company's sludge production outturns at 900,000 TDS over the five-year period, although it had forecast 750,000 TDS. The modified average revenue is calculated as follows.

$$MAR = \frac{TR}{FTDS} - \left[\left(\frac{ATDS - FTDS}{ATDS} \right) \times \frac{R_{fixed}}{FTDS} \right] \quad MAR = \frac{450m}{750,000} - \left[\left(\frac{900,000 - 750,000}{900,000} \right) \times \frac{300m}{750,000} \right]$$

$$MAR = 533.33 \text{ £/TDS}$$

$$\text{Allowed revenue} = 533.33 \times 900,000 = \text{£480 million}$$

This results in an additional revenue of £30 million compared with if the outturn had been the same as the forecast volume of sludge. This corresponds to the additional incremental cost required for processing the additional volume of sludge. Our revenue adjustment factor ensures that no additional fixed costs are allowed when outturn volumes are greater than those forecast. The modified average revenue falls because less revenue per unit is now needed to remunerate the expected fixed cost.

Scenario 2 – Over-forecast

The company's sludge production outturns at 600,000 TDS over the five-year period, although it had forecast 750,000 TDS. The modified average revenue is calculated as follows.

$$MAR = \frac{450m}{750,000} - \left[\left(\frac{600,000 - 750,000}{600,000} \right) \times \frac{300m}{750,000} \right]$$

$$MAR = 700.00 \text{ £/TDS}$$

$$\text{Allowed revenue} = 700.00 \times 600,000 \text{ (TDS)} = \text{£420 million}$$

This results in a reduced revenue of £30 million compared with if the outturn had been the same as the forecast volume of sludge. This corresponds to the reduction in incremental cost required for the smaller volume of sludge. Our revenue adjustment factor ensures that fixed costs are still compensated for when outturn volumes are less than those forecast.

We will confirm the allowed revenue that each company should have collected based on its actual sludge production (TDS) for each year as part of the in-period revenue correction mechanism (see section 4.2.1). We would expect companies to use the formulae in box 2 ahead of each charging period to understand what their revenue allowance is likely to be for the coming period, based on their latest forecasts of sludge production.

Bioresources forecasting accuracy incentive

We will incentivise companies to forecast sludge produced by in-area wastewater treatment accurately by applying a forecasting accuracy incentive, using the definition of sludge produced in box 1 in section 3.2.1. We confirm that this does not apply to sludge imported from trading.

The forecasting accuracy incentive will be based on the variation between volumes forecast in companies' business plans and actual volumes over the five-year period. We will apply this end of period incentive as part of the reconciliation of 2020-25 performance. We expect to publish a model of how this reconciliation would work early in 2018.

The penalty rate will be based on the standard average revenue that we will set out in company final determinations. This ensures that companies receive the same lump sum penalty for that same forecasting error, whether it is under or over-forecast. It also gives companies certainty over the incentive rate at the beginning of the period.

We will apply a 10% revenue penalty to all differences between the central forecast and the outturn of sludge production once it is triggered by the $\pm 6\%$ deadband. The difference between forecast and actual volumes will be the total difference over the whole control period (so we will not take annual variations into account).

Box 6 – Calculation of the forecasting accuracy incentive

We will calculate the absolute value of the penalty to apply, once the difference is greater than $\pm 6\%$ of business plan forecasts, using this formula.

$$BFAI = -(PR * SAR) * |(ATDS - FTDS)|$$

BFAI **Bioresources forecast accuracy incentive, £m.** The overall penalty to apply to companies' revenues would be determined at the end of the control period and applied to companies' revenues in the following control period.

PR **Penalty rate** is equal to 10%. The penalty would only occur when the difference between actual tonnes of dry solids (*ATDS*) over the control period is more than 6% greater or less than the company's forecast of tonnes of dry solids (*FTDS*) in its business plan.

$$\left| \frac{ATDS - FTDS}{FTDS} \right| \geq 0.06$$

SAR Standard Average Revenue in £/TDS. The allowance per unit of sludge over the control period derived through the building block approach. We will index this by CPIH.

ATDS Actual tonnes of dry solids produced by wastewater treatment over the whole of the control period (2020-2025).

FTDS Forecast of tonnes of dry solids over the whole of the control period (2020-2025) used to determine the average revenue control.

This financial penalty would apply symmetrically, where the total volume varies from the forecast used to determine the average revenue control. We would apply the penalty as part of the reconciliation of 2020-2025 performance.

We consider that companies should bear risk from forecasting error. We will consider representation from companies within the first two years of the control period, where there are **material changes** as a result of:

- measurement improvements; and/or
- WINEP's phosphorus removal requirements.

We expect that most companies should be able to manage the impact of both these issues. However, we will consider adjusting the way the forecasting accuracy incentive is applied, where companies can provide compelling evidence. We expect to make few adjustments, given our widening of the deadband, which allows for greater variance between forecast and recorded volumes before the penalty applies.

Companies will only be able to make such representations within the first two years of the control. In doing so, companies must consider the combined impacts of both measurement improvements and WINEP's phosphorus removal requirements. Companies must also demonstrate that the impact is materially greater than the deadband.

The transition to more accurately measured volumes of sludge may contribute to variations between measured and forecast volumes due to companies changing how they measure sludge. There is no evidence that this increases the risk under the forecasting accuracy incentive, therefore we will therefore continue to apply the forecasting accuracy incentive, as set out above, to the differences between measured and forecast volumes. For any company that does not currently measure its sludge production, we expect to see comprehensive plans for the installation of meters set out in its business plan. We will take into account how companies have complied with this requirement at PR24.

Box 7 presents a worked example of the forecasting accuracy incentive.

Box 7 – Forecasting accuracy incentive: worked example

Assumed scenario

A company has forecast its sludge production in its PR19 business plan and we have set the PR19 bioresources control on this basis. All capacity figures below are made on the basis of tonnes of dried solids over the 2020-2025 period.

The company's standard average revenue is calculated at £600/TDS. This figure is consistent with the building block approach to the bioresources control and based on the company's forecast sludge production of 750,000 TDS.

In 2025-26, it emerges that the company had under-forecast production. It has produced 825,000 TDS, 10% over its forecast.

Calculations of the volume forecasting accuracy incentive

The end of period financial adjustment for the volume forecasting accuracy incentive is calculated as follows.

$$BFAI = -(PR \times SAR) \times |(ATDS - FTDS)|$$

As the company has overproduced by 10%, which is more than the 6% deadband, we apply a penalty to the absolute difference between the actual and forecast TDS.

$$BFAI = -(10\% \times £600) \times |(825,000 - 750,000)|$$

$$BFAI = -£4.5 \text{ million}$$

Annex: Calibrating the triggers for the volume forecasting incentive

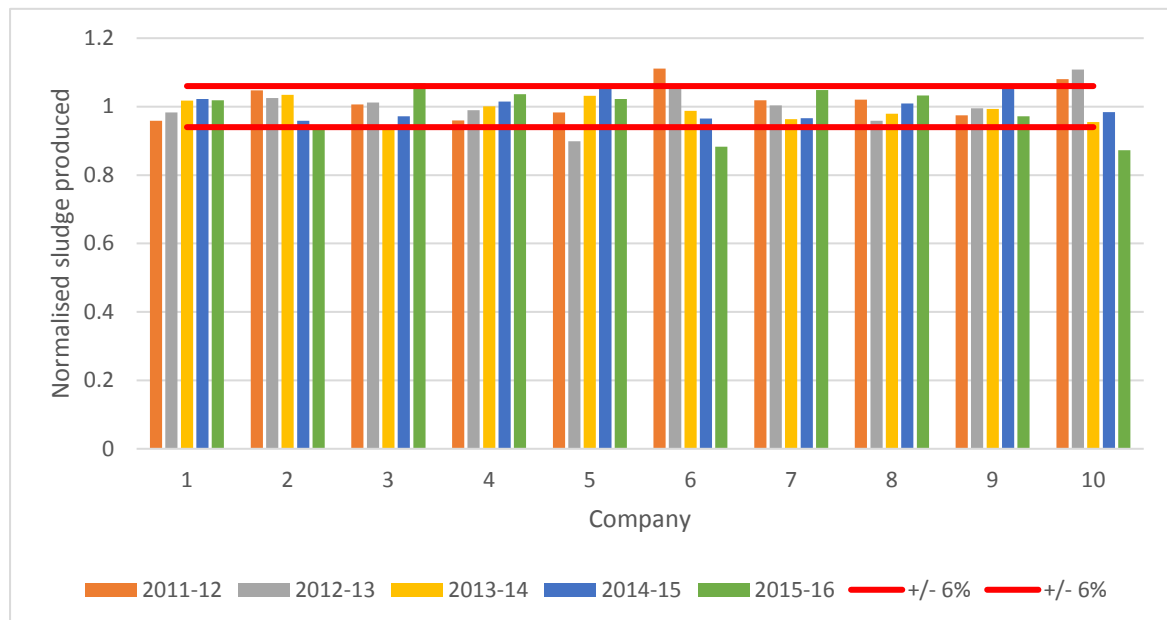
In reaching our decision for the deadband for the forecasting accuracy we considered a range of evidence. This included three sources of bioresources data:

- variance around historical reported sludge produced figures (6%);
- information about current measurement equipment accuracy (7%); and
- historical differences between forecast and actual sludge production (10%).

We expected to see an upward trend in companies' reports of sludge produced because of population growth, but in fact the industry only produced 0.3% more sludge in 2015-16 than reported in 2011-12. The annual variability for each company was typically within $\pm 6\%$ of the mean.

Figure 7 shows normalised sludge produced with the $\pm 6\%$ variation overlaid. Many of the annual data points are within $\pm 6\%$, with the total over the five-year period broadly in line with the mean.

Figure 7 – Variation in reported sludge produced, normalised by company mean



We have compared historical reported information with the potential impacts of shifting to increased measurement of sludge volumes. In a survey of water and wastewater companies, several noted that measurement devices are often certified to a broad accuracy range and that in light of this, sludge volume measurements will be accurate to between 5% and 8%, and typically around 7%. However, we still

expect the implementation of measurement systems to improve the accuracy of volume forecasts.

The key issue is the extent to which measurement data varies from historical calculation processes. We would not expect measurement devices to drive significant variations in volumes.

We have also compared data on the volumes of sludge recycled or disposed of by each company over a five-year period, from 2008-09 to 2012-13, with the forecasts in the same companies' 2009 business plans.

At an industry level, there was a 10% reduction between forecast and actual volumes recycled or disposed – see figure 8. Some of this volume change relates to the economic downturn in the early part of the period, which has driven down the volumes of trade effluent treated. However, other effects, such as the performance of treatment technologies, may also drive down the volume of sludge recycled or disposed of. While it is a useful cross-check around the scope for volume inaccuracy over a five-year period, it is not comparable to the way we intend to set the control at PR19.

Figure 8 – Five-year (2008-09 to 2012-13) total sludge disposed as proportion of PR09 forecast

