

AMP 8 Bioresources Strategy

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Welsh Water

AMP 8 Sludge Strategy
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AMP 8 Bioresources Strategy

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Note

This is a Jacobs report for Welsh Water. It contains a writeup of Welsh Water's AMP 8 strategy for inclusion in its PR24 business plan. It is written from the perspective of Welsh Water to facilitate the edits and amendments needed for inclusion in the plan.

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1. Executive Summary

Welsh Water is the leading sludge treatment provider in Wales. We have actively participated in and led Bioresources market development in Wales, in particular through entering a long-term capacity agreement with Hafren Dyfrdwy and continuing to provide our agricultural and energy customers with high-quality products. Our asset strategy for AMPs 6 and 7 has been stable and incremental, resulting in a strong asset position going into AMP 8.

This Bioresources strategy shows how we have and will continue to provide leadership in the use and development of markets. Our strategy is based on Welsh Water 2050 and shows how markets address our strategic risks and enable us to provide our services.

The greatest strategic risks to our sludge operations are to landbank availability and decarbonisation. Two of the three strategic aims in this Strategy focus on how we will use the market to address these and related risks in AMPs 8 and 9. Our third strategic aim focuses on how we will use the market to support the circular economy and create greater value for our customers. Each of these aims has specific market actions we will do to lead market use and development.

Our operating area covers some of the most iconic river catchments in the UK. Many of these Special Areas of Conservation (SAC) are failing in respect to nutrients. In the River Wye catchment studies have shown that there is an excess of nutrients and even if fertiliser was not applied for a couple of years, we would still see high levels leaching into the river. As a responsible company we need to adapt our Biosolids recycling operation in these sensitive river catchments in order to protect the environment and protect the longer term sustainability of the recycling activity which also provides organic matter which is crucial to soil health.

The greatest opportunity we see in the market for AMP 8 is in creating new products. There are a range of areas we are exploring including carbon dioxide capture and reuse, hydrogen production and fertiliser production. We will also use the potential that exists for suppliers and third parties to create solutions to the issues we will face such as the need for more strategic storage, the need for low-cost drying, and the need to develop alternative outlets for biosolids.

We will also look to the market to help address the reduction in revenue we will incur as our renewable energy incentives expire, through creating alternative energy products and increasing our total energy production with new processes.

We neighbour three water and sewerage companies which presents opportunities for creating joint capacity. We will have need for increased capacity over the next several years and will engage with these companies to develop the business case for joint investments.

We have also looked further afield into other industries and have identified potential industrial synergies which can help us to address our strategic risks while creating market benefits for us and other sectors of the economy.



2. Introduction

We will provide leadership in developing the Bioresources market in Wales and beyond, continuing to provide a reliable outlet for wastewater sludges.

We have identified the risks and opportunities we expect to see during AMPs 8 and 9 and in this document we have set out how we will use the market to address these. We will continue to create a product that is safe and acceptable for onward use and generates renewable energy, but we will also expand our market activity into providing and procuring new products and services.

2.1 Our business

Welsh Water is the dominant player in the Bioresources market in Wales. We treat nearly all the sludge produced by our own wastewater operations. During the current AMP 7, after a competitive procurement process, we entered an agreement with Hafren Dyfrdwy to process sludge from the Powys region, completing our geographical coverage of Wales.

We rely on the services of others for a variety of technical services, treatment, maintenance and transport. We select the most economically advantageous option for each part of the value chain based on market capabilities, technical competence and costs.

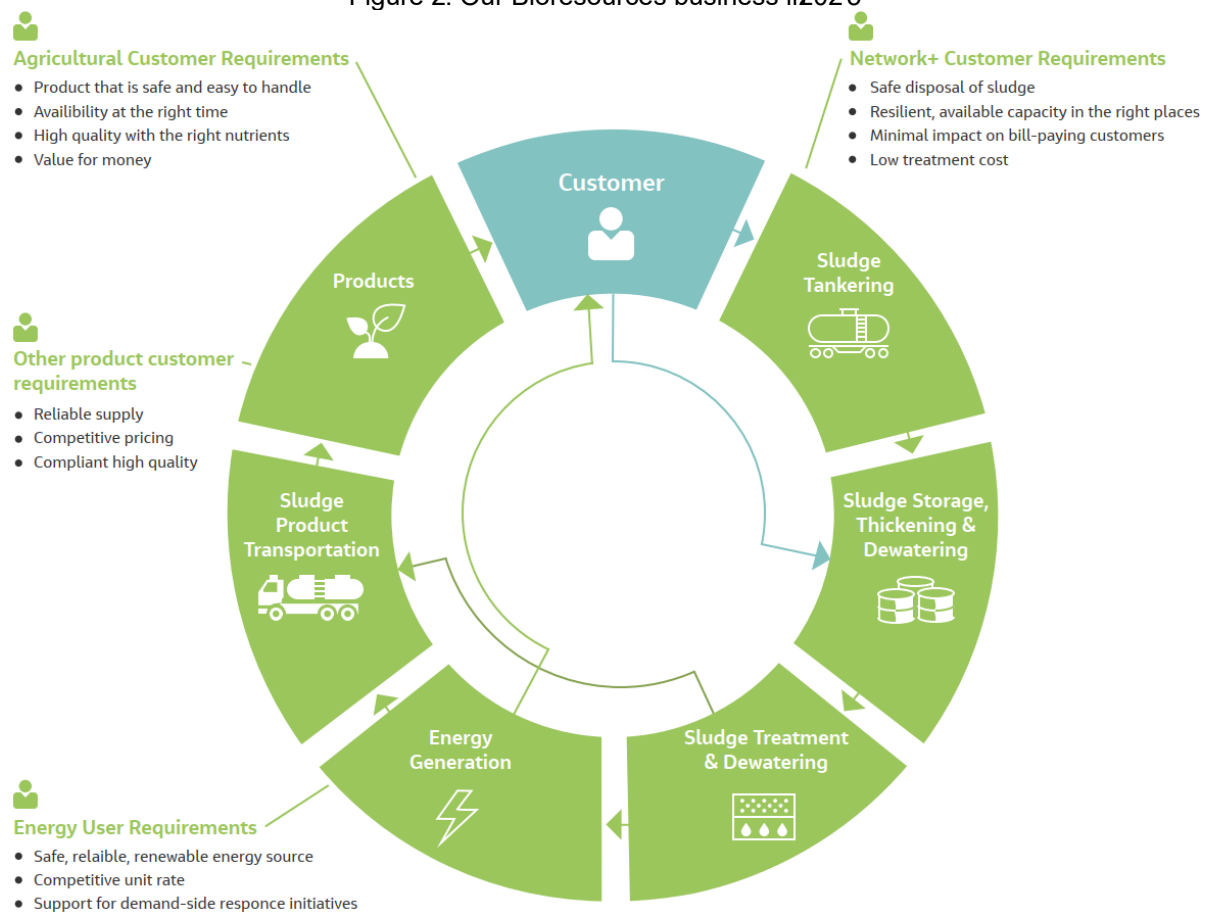
We operate a fleet of four advanced anaerobic digestion sites, at Cardiff, Five Fords, Cog Moors and Afan. Queensferry and Eign provide supplementary conventional digestion as a pre-treatment for some sludge, increasing energy yield and reducing transport costs. Our treatment sites are supplemented by 20 satellite dewatering sites which reduce the water content of sludge to facilitate transport. We operate a fleet of sludge tankers and lorries which we use to dynamically allocate supply and demand within our region and operate the whole as an efficient and resilient system.

Our most important stakeholders in the market are Natural Resources Wales, which sets the environmental standards we adhere to, and the numerous farmers who use our end product. We also have many other important stakeholders such as the users of our treatment services, environmental and community groups, and market service and technology providers.

Our strategy for over ten years has been to meet our obligations under environmental policy and regulation by operating a stable, well-maintained core of advanced anaerobic digestion sites supported by satellite dewatering sites. For environmental, economic and social reasons we have gradually rationalised our asset base to reduce limiting to the minimum required for resilience and now treat almost all sludge through advanced anaerobic digestion.

As well as our crucial environmental service, we create value through the products of the treatment process and see this as an important growth area for ourselves and the market. Our main products are biosolids (soil improver) and energy (Biomethane gas to grid and electricity). We are exploring opportunities into production of hydrogen, carbon dioxide, fertiliser and other innovative products.

Figure 2: Our Bioresources business in 2025



2.2 How our sludge strategy fits with our PR24 business plan

This strategy is a standalone document that explains and contextualises our PR24 Business Plan, including our Long-Term Delivery Strategy and our investment plans for AMP 8.

Development of our Sludge strategy has been guided by our long-term strategy, Welsh Water 2050. Welsh Water 2050 sets the strategic risks and responses for the business. We have aligned our Bioresources strategy with these. We show how in Section 3.

2.3 Regulatory context

Our strategy review has taken place in the context of significant potential changes to the regulation around recycling biosolids to agriculture. The uncertainty that exists at the present time has acted as an inhibitor to large-scale uptake of market options for treatment, including co-digestion. However, we have found that markets exist in alternative areas, and we have led development of these as set out in Section 2.5.

Since our AMP 7 strategy was published, Wales has been designated a Nitrate Vulnerable Zone. The Wye, Dee and Usk catchments have also been identified as vulnerable to phosphate pollution, and we are looking at how we can help to protect other vulnerable catchments. Reduced nutrient requirements can affect the market for biosolids by requiring lighter and less frequent applications.

2.4 Working for our stakeholders

We are always open to engaging with our stakeholders to achieve better outcomes for everyone. In AMP 8 we will catalyse development of a Sludge Strategy for Wales in partnership with Natural Resources Wales and the Welsh Government. This will help to build greater regulatory knowledge and involvement in the developing market for treatment.

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We will continue to work with our biosolids customers to help them meet crop needs and improve soil health through appropriately timed applications of biosolids. During AMP 8 we will transition to a system of selecting and sizing deployments based on precise individualised analysis of crop and soil nutritional needs, with more on-farm support from our team of agronomists.

Since the Bioresources price control was established in 2020 we have worked closely with our colleagues in wastewater treatment to ensure we can always provide them with the service they need. We have continued to successfully implement our Sludge Optimisation Strategy for reducing water in thickened sludges. This has resulted in a reduction of over 15% in tanker movements in the last two years.

2.5 Market development in AMPs 6 and 7

We have led development of markets for sludge treatment and products over the current and previous AMPs:

- We have bid for and won the tender to provide sludge treatment services for Hafren Dyfrdwy. Through this contract we provide out-of-region sludge treatment for 95,000 customers. We use existing headroom capacity in Welsh Water assets, and through this Hafren Dyfrdwy has avoided the need for costly capital investment on its own sites, saving customers around £50,000 per year.
- We have continued to develop and optimise our energy generation capacity. Our Five Fords plant was upgraded at the end of AMP 6 to advanced anaerobic digestion, and through this AMP it has been producing biogas for upgrading and injection to the grid. This is Wales' first sewage gas to grid plant.
- Building on our success at Five Fords we are now in the advanced stages of evaluating a carbon dioxide capture plant to work with our biogas upgrading membranes. Carbon dioxide would otherwise be vented to atmosphere, but this option creates a high-purity product as another source of revenue derived from sludge. It would also represent a step in the right direction of carbon capture in line with our journey to Net Zero.
- We identified an area of weakness in market development of alternatives to recycling biosolids to agriculture. We have sought to support activity in this area through funding collaborative research into sludge carbonisation technology.
- We have also actively sought to provide sludge treatment services to others. We provide frequent access to capacity to Mayglothling, a waste management company. Through our annual market information publication and regular informal conversations, we have shared capacity information with our neighbouring water companies to provide cover for planned and unplanned downtime.

We have also undertaken our own market research into alternative providers of treatment, disposal/ recycling and storage capacity. There is exciting potential for alternative treatment providers including options for co-incineration of sludge with wastes and hire-purchase of innovative thickening and dewatering technologies, and will develop this further in AMP 8.

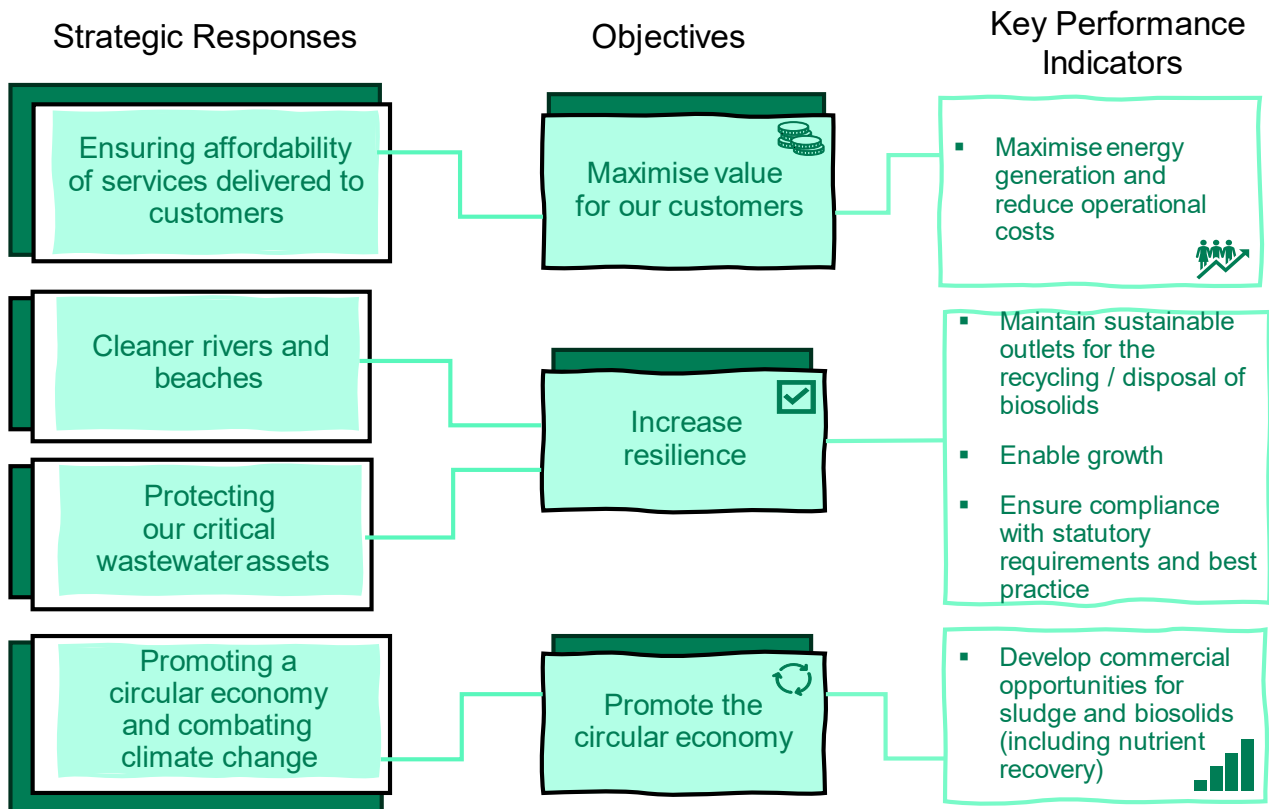


3. Our aims and objectives

3.1 Welsh Water 2050 and the Long-Term Delivery Strategy

As Welsh Water’s Bioresources business, we have aligned our aims to the 2020 update of Welsh Water 2050 and the PR24 Long Term Delivery Strategy.

Four of the strategic responses in Welsh Water 2050 have informed our aims.



More detail on our performance indicators is given in Section 6.1.

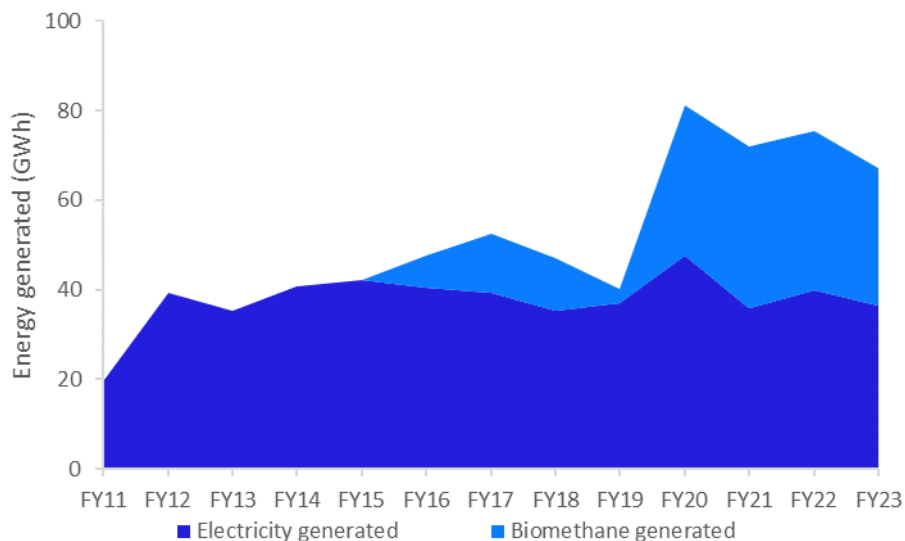
3.2 Our strategic aims

3.2.1 Aim A: Maximise value for customers

3.2.1.1 Performance

Over AMP 7 we have completed our transformation to advanced anaerobic digestion. As a result, our energy generation is at an all-time high. We have created significant value for our customers through exporting gas to the energy market and reducing our exposure to market volatility by increasing our energy self-sufficiency. Our energy revenues are part of our operations budget, and this means customers benefit directly from this through lower bills.

Figure 1. Energy generated in Bioresources and total energy consumed by Welsh Water since 2011 -12



We have maximised value for our customers by ensuring that assets are utilised as fully as possible and entered incoming trades with Hafren Dyfrdwy and Mayglothing for this reason. This has increased throughput with our existing assets, increasing efficiency at a national level. By applying advanced anaerobic treatment for more sludge we have also increased total energy generation.

High fertiliser prices during the AMP have reinforced the importance of biosolids as a soil improver, and farmers have continued to benefit from the ability of biosolids to offset synthetic fertiliser use. There has also been increasing recognition of the importance of adding organic matter to maintain soil health.



3.2.1.2 Future Forecasts

Throughout AMP 8 we expect to continue to make significant revenues from energy. However, by the end of AMP 8 most of our Renewables Obligation Certificates (ROCs) will expire. To date, these have incentivised the

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production of renewable electricity at our sites, and their expiry will reduce the revenue we obtain relative to the amount of energy we produce.

Figure 2 shows the total forecasted revenue from biogas across all of our sludge treatment centres up to 2040. The main points are:

- A. ROCS at Cog Moors expire.
- B. New biomethane production and export at Cog Moors (without subsidy)
- C. ROCS and Afan and Cardiff expire.
- D. ROCS at FiveFords expire.
- E. Renewable Heat Incentive(RHI) at Five Fords expires.

Figure 2 Estimated energy revenues from electricity exports (to Network+ or grid) , biomethane exported to grid, ROCs and RHI

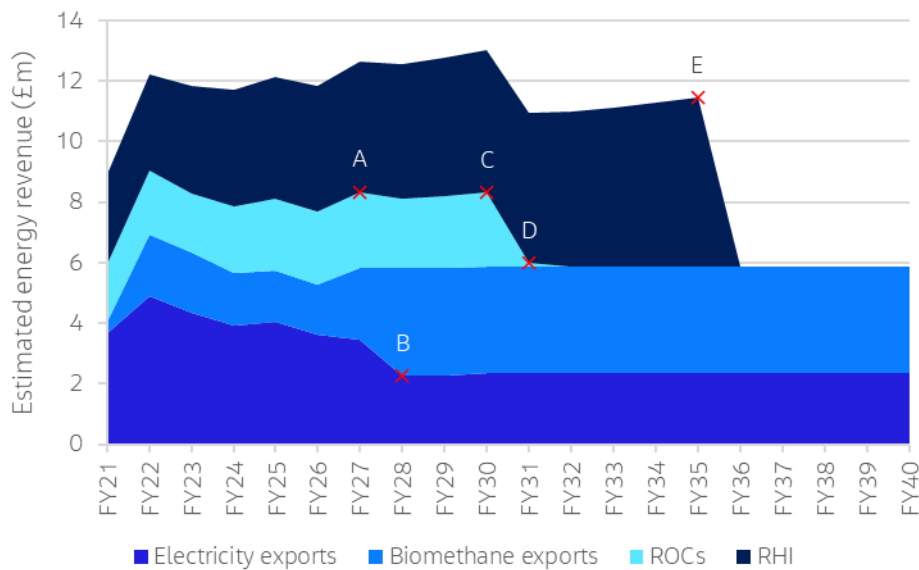


Figure 2 shows what could happen if we take no action to change our activity, but our plan for AMPs 8 and 9 is to proactively seek and implement new options to generate value for our customers.



3.2.1.3 AMP 8 & 9 plan

A1 Energy revenues: During AMP 8 we will plan how to protect customer value in AMP 9 and beyond to compensate for the loss of energy incentive payments. We will engage with the market on technological solutions to resolve this issue, for example through the following:

- Exporting energy to the capacity and flexibility markets.
- New anaerobic digestion capacity under the Green Gas Support Scheme subsidy or, if they are implemented, its successors.
- Alternative uses for biomethane such as renewable vehicle fuels.
- Changes to process configuration to focus on energy self-sufficiency rather than exports.
- Investment in new or emerging technologies to release more of the energy in sludge. These could include new hydrolysis processes or advanced thermal treatments, when combined with low-cost drying.

We will lead market development by seeking suppliers who can partner with us to implement solutions. Where it is economically beneficial, we will use alternative delivery models – as an example, we could sell biogas streams direct to a third parties for processing and use.

A2 Sludge drying innovation : Alongside our investment in energy, we will continue to deliver customer value through innovating within our core value chain. The key area we have identified for innovation is sludge drying. The ability to dry sludge is crucial no matter how regulation and technology develop:

- Low-energy drying has the potential to significantly reduce fugitive emissions and those associated with transport. This can also help to avoid the need for enclosed storage with forced ventilation, significantly reducing costs.
- Most alternative outlets for biosolids rely on sludge being dried.
- Dry sludge has a lower volume, so it requires less space to store, reducing the investment needed in storage.

Current drying technologies are expensive and energy-intensive to operate. This will significantly reduce the potential benefits of drying. During AMP 8 we will invest in research and development of low energy sludge drying technologies which are close to commercial availability.

3.2.2 Aim B: Increase Resilience

3.2.2.1 AMP 7 Performance

At the start of AMP 7 we commissioned the new Cog Moors sludge treatment centre. This has significantly increased our resilience by creating another 22,000 tDS of capacity in our South region, enabling us to continue to treat sludge through maintenance shutdowns of our other large treatment centres in the region.

With our projected increase in sludge production through a large increase in our treatment works requiring phosphate removal (Circa 24 assets in AMP8), this capacity is welcome.

Our ability to continue to treat sludge through advanced anaerobic digestion through shutdowns has further reduced our reliance on liming. This is especially important because 96% of the biosolids we produce goes to grassland. Our enhanced biosolids product integrates with the soil much more quickly and easily than limed sludge, so it requires a much shorter no-grazing period.

During the AMP we invested in strategic storage to enable us to store up to two months' of biosolids. This is primarily to help us to meet voluntary and compulsory no-spread windows where we are not able to spread but can alternatively be used for raw cake to meet widespread treatment capacity outages.

While surveying our digestors for structural integrity we found that thermal imagery can reveal grit in the digestors. Drone surveys are a fraction of the cost of traditional methods for detecting capacity loss, so this discovery will increase our ability to frequently monitor digester health.

The new capacity at Cog Moor has enabled us to take the digestors at Cardiff Bay and Afan offline for maintenance, while maintaining high levels of energy production. This has restored our treatment capacity and allowed us to check and restore the health of the assets.

We have continued to improve the depth of our operational management capabilities through implementing an accredited Competence Management System. This has strengthened our operations through a combination of further training for our operators, enhanced accountability in our planned maintenance cycles, and regulatory reporting. We have also trained our supervisors to be dual skilled, enabling them to work across multiple areas of our sites.

Our largest sites have achieved compliance with the Industrial Emissions Directive. Site and administrative work is ongoing to secure compliance at Afan, Eign and Queensferry. This has reduced the risk of emissions to ground and water.

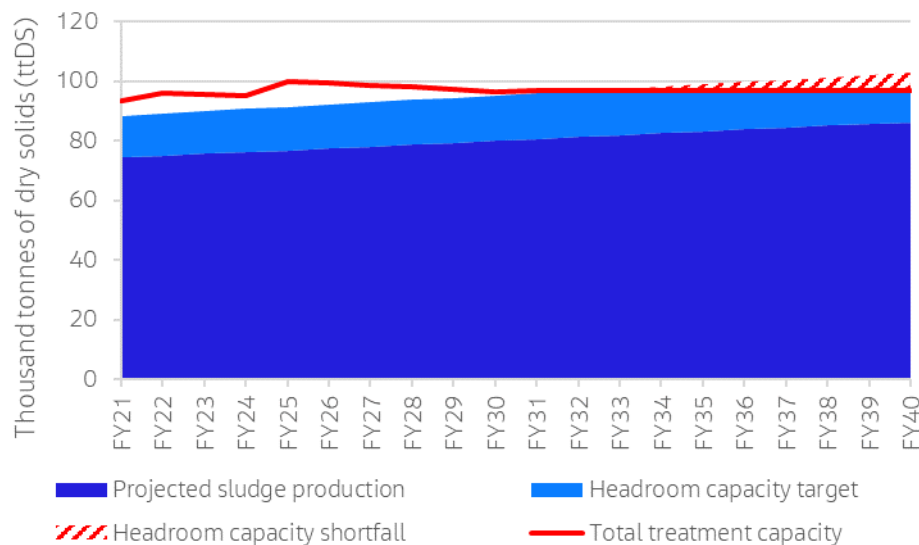
3.2.2.2 Future Forecasts

Figure 3 shows our historic and forecasted sludge production (dark blue area) and treatment capacity (red line) for the financial years for AMPs 7-10.

We are confident that our capacity will be sufficient going into AMP 8. However, much of our capacity is located in our South region and capacity in the North is becoming constrained. Although we operate our treatment centres dynamically, the distance from North to South is too great for sustained large-scale transfers of sludge to be economical. We forecast that without the provision of additional capacity in AMPs 9 and 10, we will not be able to maintain the resilience headroom needed to continue operating at very high levels of advanced treatment. This is essential for our agricultural product users, who rely on having a consistent high-quality product.

There are risks that phosphorus removal schemes could cause greater than expected increases in sludge, and that as remediation of combined sewers progresses it could lead to larger amounts of sludge arriving at our treatment works. We are monitoring this and will continue to through the AMP.

Figure 3 Sludge production and headroom



Our resilience is also reliant on our ability to recycle biosolids to land. Risks include micropollutants and pressures on the ability of the land to accept nutrients.

We work with farming and land management to provide the best stewardship of the land and fields we work on. We recycle to around 6,500 hectares of agricultural land, which is a very small fraction of the total area of Wales. However, many areas of Wales already receive sufficient nutrients from other sources, so it can be difficult to find areas of sufficient demand.

CIWEM's National Bioresources Strategy for England indicates that biosolids to land is likely to be significantly disrupted, increasing transport distance, the demand for storage capacity, and the need for alternative treatments and outlets. We could see similar constraints on landbank availability in Wales due to greater competition with biosolids and other organic materials transported from England, and the implementation of comparable regulatory constraints in Wales.

We do not currently have the information needed to quantify the potential impacts to landbank availability in Wales. We will continue to engage NRW on this issue with the purpose of delivering a similar analysis through a Bioresources Strategy for Wales.

Where we encounter temporary reductions in landbank availability (e.g. prolonged extreme weather events, livestock disease outbreaks or process downtime), part of our current contingency is to store biosolids. To support this approach, we have increased the quantity and quality of our biosolids storage in AMP7.

Given a large proportion of our landbank sits within SAC river catchments, five of the nine are currently failing on nutrients, particularly P, it is anticipated that further reductions will be required which will either see spreading rates reduced or seasonal land application restrictions applied. It is important therefore that more storage is provided to accommodate these measures.



3.2.2.3 AMP 8 Plan

Maintaining resilient Bioresources processing capacity is challenging. Proportionally, our assets are dealing with more corrosive and hazardous substances than the wider business. This means that they may not last as long and may suffer from frequent maintenance shutdowns without proper care. Phosphorous consents and resulting P sludge increases from the NEP are not yet confirmed but are likely to put further pressure on our landbank.

This all means that we need standby capacity to ensure resilient treatment and recycling routes all year round. We aim to do more in AMPs 8 and 9, improving resilience for our customers through:

B1 Increased storage: To protect rivers and streams, it is sometimes necessary to avoid spreading sludge during certain periods. To further increase our ability to temporarily halt biosolids recycling operations, during AMP 8 we will invest in further strategic storage to raise our capacity to six months.

B2 Nutrient recovery: Nutrient recovery is a potential alternative to temporarily halting recycling operations to avoid the risk of excessive nutrients harming the environment. During AMP 8 we will investigate how nutrient recovery could enhance the viability of landspreading in nitrogen and phosphorus sensitive areas, aiming to shift into delivery in AMP 9.

B3 New digestion capacity: During AMP 8 we will obtain capacity in our North region to supplement our existing capacity at Five Fords. We will explore the options for obtaining this, including through joint capacity with neighbouring water companies.

B4 Market Buffers: Despite our best endeavours, there may be short periods of time when we don't have enough capacity. Instead of being reactive in this area, we aim to continue to maintain our routes to market to provide buffers for any capacity shortfalls, including third-party liming. We will continue to offer support to our neighbouring water companies, and will consider opportunities to co-fund new capacity with our neighbours.

To meet the requirements for safety, quality and environmental management, we must meet strict audit requirements that have been set out within the Biosolids Assurance Scheme Standard (BAS).
100% of our product has been BAS compliant since 2018.



B5 Biosolids to land alternatives: During AMP 8 we will continue to engage with providers of alternative outlets for sludge and to develop readiness for this, for example through investing in drying research. We aim to be ready in AMP 9 to switch to alternative treatment if necessary, and will prepare options for this.

3.2.3 Aim C: Promote the circular economy

3.2.3.1 AMP 7 Performance

The effective removal of sludge is crucial to the performance all our wastewater treatment plants. Without effective sludge removal, wastewater treatment works soon fail with harmful consequences to rivers or coastal waters. We have continued to focus on providing a reliable, safe service to protect the environment and public health.

Our energy generation has strongly contributed towards Welsh Water's target to reach net zero carbon emissions by 2040. As well as increasing our total energy output, we have ended the sale of Renewable Gas Guarantees of Origin from our Five Fords site. This has enabled us to retain the carbon benefits of the gas we generate.

Over the current AMP 7 we expect to recycle 600,000 wet tonnes of biosolids to land. This improves soil quality and structure and provides nutrients such as nitrogen, phosphorus, sulphur, magnesium, potassium and other trace elements. It is a sustainable product which helps farmers to avoid the need for manufactured fertilisers, reducing the carbon footprint of food production.

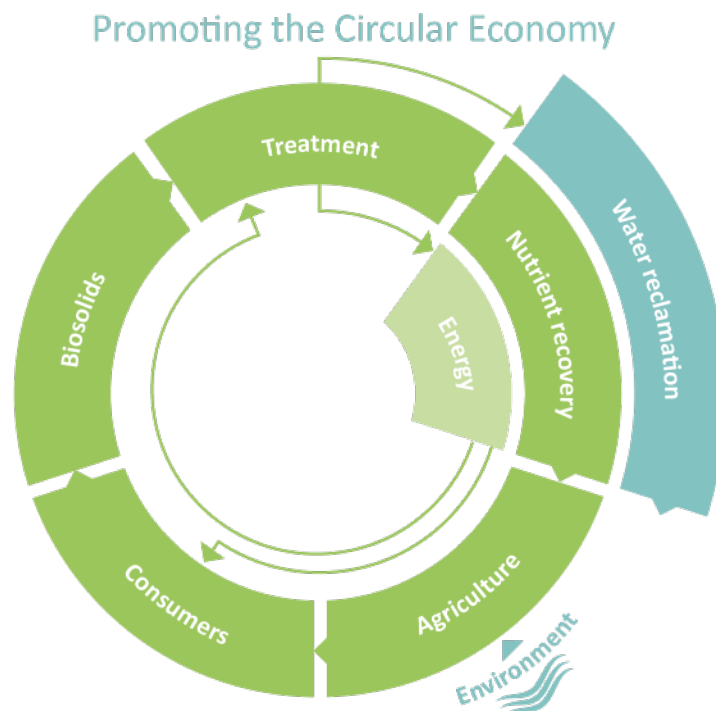
We have enhanced our management of biosolids recycling. We have introduced a new software system for managing deployments of biosolids, which has improved governance and transparency of our operations. This has improved our readiness for further developments in AMP 8.

We have continued to protect the Wye and Usk catchments through lighter spreading of biosolids and closed windows, which has enabled us to continue creating circular economy benefits for the region.

We have also taken steps to enhance biodiversity on all our sites through implementing no-mow areas. Five Fords and Cog Moors now have stringent ecological permits.



Figure 10: Our Circular Economy Contribution



We have moved away from liming as a routine treatment, replacing it with advanced digestion. This has reduced the natural resources that we use. The volume of biosolids has reduced as a greater proportion of volatile solids has been converted to energy, and a larger amount of water is being removed and returned to the environment. The biosolids we produce are also more beneficial to our customers through being easier to handle and spread.

3.2.3.2 AMP 8 Plan

We need to maximise energy generation from sludge and create more value from our products. We also need to use less energy and reduce fugitive emissions. Welsh Water aims to reach Net Zero carbon emissions by 2040, and our Bioresources business has important potential to help meet this. This includes sludge transport, which is a major user of energy within sludge processing. Our Bioresources business can contribute further to the circular economy in the next AMP. We will do this through:

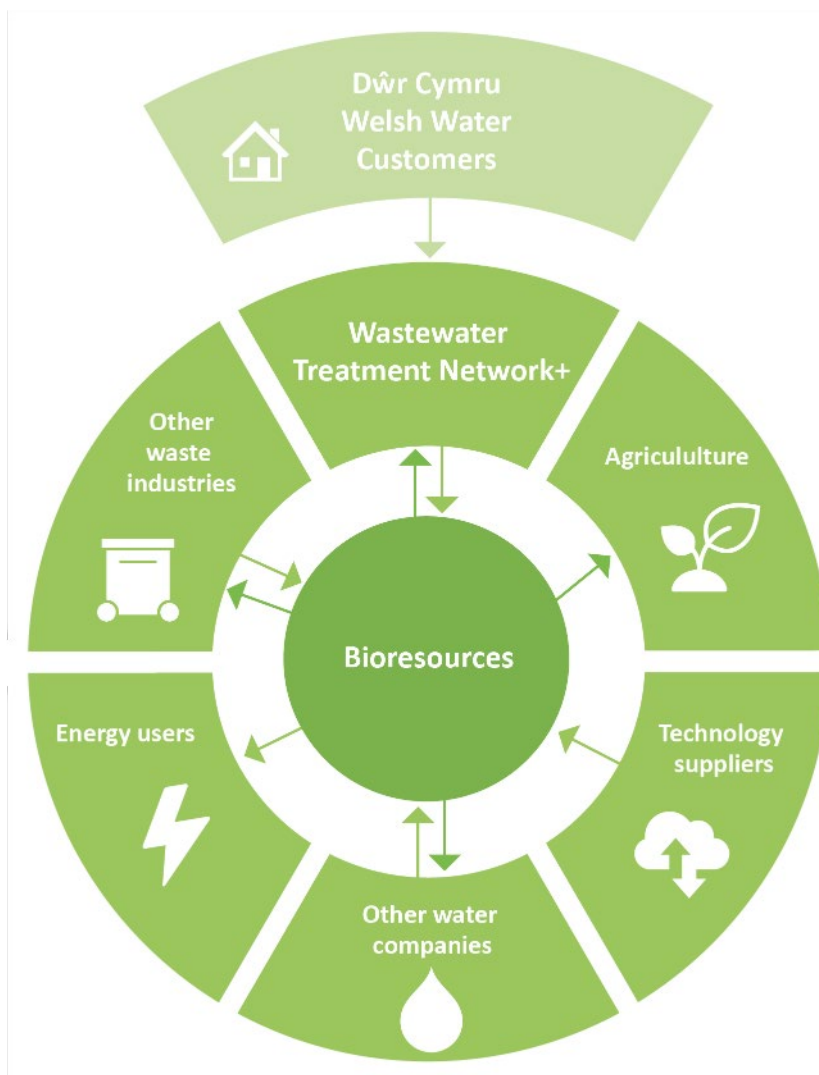
- C1. Carbon dioxide recovery: During AMP 8 we will explore the potential of a carbon dioxide recovery plant at our Five Fords works. Carbon dioxide is currently a waste product from our gas-to-grid energy process, but following a competitive market process we have appointed a supplier to capture and use this product.
- C2. Hydrogen innovation: We have secured innovation funding from the Department of Energy Security and Net Zero to test feasibility of biohydrogen generation at our Cardiff works and will look to progress this in AMP 8.
- C3. New products: We see the opportunities to derive new products from sludge such as biopolymers and other industrial precursors, and will continue to have conversations with market entities to explore the options.
- C4. Biofuels: We will develop the business case for converting our fleet of sludge tankers to biofuels and adapt our operations accordingly.
- C5. Emissions reduction. We will reduce fugitive emissions at all stages of the treatment and recycling process through engaging with market providers of technological solutions including monitoring and mitigation.



4. Market leadership in AMP 8

We operate in multiple markets with multiple customer/supplier relationships. We have drawn out some of our key market relationships in Figure 12.

Figure 12: Some of our key marketplace relationships



Our Customers

- Our bill-paying customers;
- Internal customers for which we provide sewage sludge collection and treatment services;
- Other WaSCs and third-party waste providers who want to make use of our capacity;
- Our energy customers; and
- Customers who use biosolids and other products.

Where we are a customer:

- For the treatment of our by-products (e.g. our wastewater);
- For treatment capacity in or out of region; and
- For new products and services to enhance our business.

A number of our objectives rely on our effective use of markets and on our understanding of our interactions with the market where we are supplier or a customer.

This section covers our participation in the markets (covered by sub-sections below):

1. **Using the capacity of other providers**: Where we could utilise the treatment capacity of other water and sewerage companies, liming providers or thermal treatment providers for best value, or where we can obtain other services we need such as strategic storage.
2. **Market use of our capacity**: Where our capacity could be utilised by others for best value.
3. **Product markets**: Expanding and evolving delivery of new products to market.
4. **Industrial Synergies**: Partnering with other industries to create benefits for both.

4.1 Using the capacity of other providers

During AMP 7 we have worked to identify potential market opportunities to use others' capacity. Building on the knowledge we have gained, during AMP 8 we will focus on building relationships with alternative providers such as:

- Innovative thermal treatment technology providers.
- Co-incineration capacity providers.

We forecast that we will need new capacity around the beginning of AMP 9. Our plan is to continue having informal engagement with the market until the relevant trigger points on our adaptive plan are reached, when we will commence formal engagement and procurement. This will maintain our supplier relationships and protect them from incurring unnecessary costs to engage with us.

4.2 Market use of our capacity

Our successful trading in AMP 7 has committed us to contracts to import sludge from Hafren Dyfrdwy until 2027. This means that we currently have little capacity for new trades. We will continue to monitor our capacity and seek to utilise it to the benefit of our customers. As we will require new capacity in our North region we will explore market opportunities to support new capacity prior to AMP 9.

We will continue to make our unused capacity available on the market to our neighbours who need assistance from time to time with planned and unplanned outages.

4.3 Product market

Our 100% enhanced biosolids product is industry-leading, and we will continue to maintain the quality of our product. In AMP 8, we will add further value by hiring an additional 3 fulltime equivalent agricultural advisors to support farmers in effective and compliant biosolids application.

We will also explore the sale of any potential carbon dioxide we generate from our Five Fords works, and will look to develop the hydrogen innovation project at Cardiff Bay to explore how we can further commercialise hydrogen production.

Nutrient recovery innovations to date have often failed due to the lack of consideration of the commercial aspects of the technology and failure to develop a market to sell the recovered products into. During AMP 8 we will lead or contribute to collaborative innovation, working alongside regulators to develop a market for recovered nutrient products.

4.4 Market synergies

During AMP 7 we have entered conversations with other local industries to explore how we could use synergies to create outcomes which are beneficial to us both. For example, the Port Talbot steelworks creates a large amount of waste heat. We could use this for drying sludge. As another example, some sectors use intermittent incineration of waste. Incinerators are best run continually, so we may be able to utilise the down time in these as an alternative to building new incineration capacity. We will continue to seek these synergies and invest in developing them where we find economic and environmental benefits to doing so.

We actively participate in cross organisational initiatives such as trading opportunities and shared innovation projects.



5. Strategic Risks

Our aims will mitigate against the strategic risks that we face. By taking action throughout AMPs 8 and 9 we will continue to provide a safe, high quality treatment service.

	A. Maximise Value for our Customers		B. Increase Resilience					C. Promote the circular economy				
	A1. Energy Revenues	A2. Sludge Drying Innovation	B1. Increased Storage	B2. Nutrient Recovery	B3. New Digestion capacity	B4. Market Buffers	B5. Alternative outlets	C1. CO ₂ Recovery	C2. Hydrogen Innovation	C3. New Products	C4. Biofuels	C5. Reduce emissions
MITIGATION ACTIONS	Develop plans for future biogas applications. Explore alternative delivery models.	Invest in research and development of low energy sludge drying technologies.	Build additional Strategic Storage. Improve dewatering assets.	Explore nutrient recovery to enhance reliability of landspreading.	Supplement our existing capacity at Five Fords. Conversations with our neighbours.	Open short-term routes to market. Regular discourse with our neighbours.	Prepare for and develop alternative outlets for biosolids.	Implement Carbon capture and recovery at Five Fords	Develop of Biohydrogen generation.	Maximise implementation of new products. Use markets where best placed to implement.	Explore and develop the conversion of sludge to biofuels.	Use technological solutions to reduce fugitive emissions.
External risks	Short term loss of access to the landbank (e.g. weather event)	✓✓	✓✓	✓	✓	✓✓	✓✓					
	Long term loss of most or all of the landbank	✓✓	✓✓	✓✓	✓	✓	✓✓		✓			
	Treatment capacity constraints due to growth			✓✓		✓✓	✓✓					
	Treatment capacity constraints due to production fluctuations		✓	✓✓		✓✓	✓✓					
	Transportation capacity constraints		✓✓	✓✓		✓✓						
	Future soil improvement product prices	✓✓	✓✓		✓✓		✓	✓✓	✓	✓✓		
	Future energy prices	✓✓	✓✓		✓	✓	✓	✓✓	✓	✓✓	✓	✓
Internal	Odour nuisance		✓✓	✓		✓	✓					✓✓
	Sludge management costs increases	✓✓	✓✓	✓✓	✓✓	✓✓	✓	✓		✓		

AMP 8 Bioresources Strategy

	A. Maximise Value for our Customers		B. Increase Resilience					C. Promote the circular economy				
	A1. Energy Revenues	A2. Sludge Drying Innovation	B1. Increased Storage	B2. Nutrient Recovery	B3. New Digestion capacity	B4. Market Buffers	B5. Alternative outlets	C1. CO ₂ Recovery	C2. Hydrogen Innovation	C3. New Products	C4. Biofuels	C5. Reduce emissions
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Ageing asset base leading to capacity shortfalls			✓✓		✓✓	✓✓	✓✓					
Missing energy neutrality or GHG emission targets	✓✓	✓✓		✓	✓	✓	✓	✓✓	✓✓	✓	✓✓	✓✓
Non-compliant product		✓✓	✓	✓✓	✓✓	✓	✓✓			✓		
Not achieving best value	✓✓	✓✓		✓	✓	✓✓	✓✓	✓	✓	✓		✓






6. Delivering the Strategy


Our strategy has ownership and accountability as set out in this section.

6.1 Measures of Success

Our Measures of Success encapsulate our ambitions and align with our strategic objectives.

Strategic Responses	Measures of Success	Description	Driving Activities in AMP 7	2024/25 Target (AMP 7)	2029/ 30 Target (AMP 8)
 <p>10. Protecting our Critical Wastewater Assets. Faced with an increased risk of disruption – for example, from an increase in severe weather as a result of climate change and reduced customer acceptability of pollution events – we will improve the resilience of our critical wastewater assets, which have high environmental and customer impacts of failure.</p>	<p>En8. Bioresources disposal compliance (% sludge recycled in accordance with the Biosolids Assurance Scheme)</p>	<p>The percentage of wastewater sludge disposed of satisfactorily.</p>	<ul style="list-style-type: none"> Investment in resilience of our assets Development of strategic storage Proactive operation & maintenance Using the markets to buffer capacity 	100.0%	100.0%
 <p>16. Cleaner rivers and beaches. With increasing pressure on the natural environment from increased population, changing land use, climate change and new sources of pollution, we will improve our wastewater assets to do our part to help achieve 'good' environmental status for our rivers, lakes and coastal waters.</p>					
 <p>8. Ensuring affordability of services delivered to customers. With inequality, debt, and poverty on the rise we aim to ensure that our services remain affordable for all customers. We will ensure that we continue to provide the best service in increasingly innovative and efficient ways and pass these savings on to our customers.</p>	<p>Ft3. Energy self-sufficiency</p>	<p>Electricity generated and gas injected to grid as a percentage of all electricity and gas consumed (gas expressed as an electricity equivalent)</p>	<ul style="list-style-type: none"> Recovering more useful energy from our products using AAD Operational optimisation using production management techniques 	35%	50%

AMP 8 Bioresources Strategy

Strategic Responses	Measures of Success	Description	Driving Activities in AMP 7	2024/25 Target (AMP 7)	2029/ 30 Target (AMP 8)
 <p>18. Promoting a Circular Economy and Combatting Climate Change. Faced with a changing climate and increased energy costs, we will aim to become an energy neutral business, whilst maximising the opportunities to reuse treated water and other potentially valuable natural materials, contributing to the circular economy in our local region.</p>					
	En7. Bioresources product quality	The percentage of sludge treated to an enhanced standard.	<ul style="list-style-type: none"> Recovering more useful energy from our products using AAD Operational optimisation using production management techniques 	97.3%	100%

6.2 Governance

The overall governing body for this strategy is the Sludge Steering Group (Figure 12). The group meets quarterly to review the implementation of the strategy and its supporting action plan, compliance, major scheme delivery, operational performance / efficiency, regulatory change, innovation and emerging trends. The group actions any items that are identified to impact (positively or negatively) the achievement of our MoS, aims or objectives.

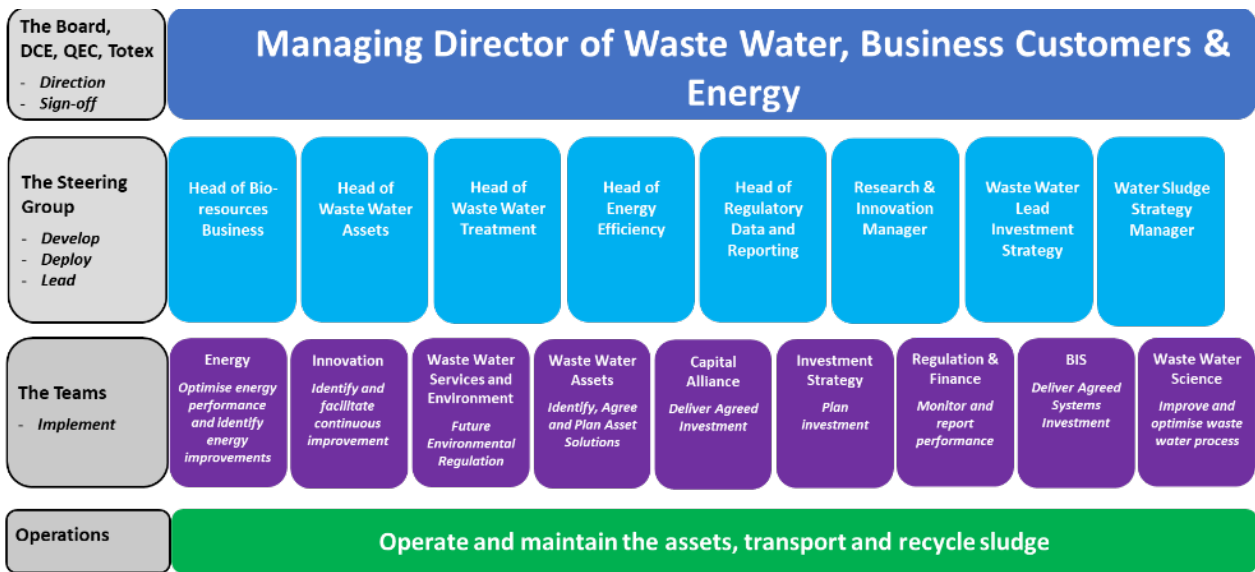


Figure 4 – Governance and composition of the Sludge Steering Group

Wider governance of Sewage Sludge compliance and performance is achieved through the audit and senior management review of adherence to a suite of procedural instructions and completion of official forms, both in response to operational compliance incidents and whilst carrying out normal operational tasks. Issues identified are required to be closed out *via* specified corrective action. Progress up to closure of these actions is tracked and reported to the Head of Bioresources to the Sludge Steering Group where required.

We have a Capital Investment Gateway approval process that all Bioresources capital projects must pass through to ensure there is sufficient scrutiny and challenge from senior management. The approach provides strong governance for approving investment decisions and is transparent and fully auditable.

The Managing Director of Waste Water, Business Customers and Energy will report regularly to D wr Cymru Executive (DCE) and to the Quality and Safety Committee (QSC) on Bioresources, compliance, general performance, incidents, costs and progress / issues with any relevant aspects of the capital programme. The Sewage Sludge Strategy will be reviewed by the Sludge Steering Group at least annually, or with any change in business priorities. The ongoing effectiveness of this strategy will be reviewed quarterly by the group.

The board Environment and social Governance Committee (ESG) will review annually progress around the circular economy and environmental measures of success.