Bioresources
PR24 data tables commentary

October 2023

Bioresources PR24 Table Commentary

BIO1 Bioresources sludge data

Overview

To inform our PR24 plan we engaged Business Modelling Associates (BMA) to expand our capability within our bioresources network tactical (60 week) model. The scope of the model covers all of our bioresources transport, treatment and disposal operations.

We have used the output information from the model to complete the majority of the projections from 2023/24 through to 2029/30 as set out in the line by line commentary.

The figures for 22/23 are taken from our recent Annual Performance Report (APR) submission.

It should be noted that the model scenario used to complete the data tables assumes all raw sludge produced by Network Plus is transported, treated and disposed by the Anglian Water bioresource asset base. Manual adjustments have been made to reflect an amount of raw sludge that may be treated and disposed of by a third party.

The model also assumes the network is operated at the optimum with raw sludge scheduled to sites to give the lowest overall cost of transport, treatment and disposal and it assumes an average Sludge Treatment Centre (STC) uptime of 85% capacity utilisation.

BIO1 Bioresources sludge data Lines 1.1 - 1.19

Line 1.1: Total sewage sludge produced, treated by incumbents

For 21/22 this aligned to our reported APR and represents actual measured sludge produced in the reporting year.

For years 23/34 and 24/25 we have used our forecast sludge production figure, this includes assumed growth (ONS PR19 growth profile) in the period and an increase in sludge production from AMP7 WINEP Phosphorus removal schemes being commissioned and put into service prior to obligation dates. We have assumed a reduced production profile compared to our previous forecasts for 23/24 and 24/25 to account for commissioning and handover that will occur during the reporting year, for example schemes with an end of year obligation are typically completed during quarter three or quarter four of the reporting period. Full year impact of the AMP7 WINEP P programme is then realised in year 1 of AMP8.

For 25/26 to 29/30 we have used ONS forecast growth data and overlaid additional sludge arising from the proposed AMP8 WINEP profile, in the period 2025/26 through to 2029/30 this is calculated to have a full year increase production of 3.093tDS (tonnes of dry solid) by the end of AMP8. We have then used this profile as input data into the BMA tactical (60 week) model for the forecast TTDS (thousand tonnes of dry solid) raw sludge produced.

Additional sludge volumes generated from sites with new phosphorus consents and tightening of existing phosphorus consents estimates to total 8.211TTDS in the AMP8 period. We have phased this additional sludge into the last two years with the full year impact of 8.221TTDS being realised in year 1 of AMP8. For 23/24 we assume 13 % of the 8.221TTDS materialises, circa 1TTDS, in 24/25 we forecast 58% of 8.221TTDS materialised, circa 4.77TTDS in 24/25. We have used this combined this TTDS with the population growth forecast TTDS (above) as the input profile into the BMA tactical 60 week model.

Line 1.2: Total sewage sludge produced, treated by third party sludge service provider

In line with our strategy to explore and exploit viable trades of sludge with neighbouring Water and Sewerage Companies (WASCs) and third parties, we have made an assumption that all raw sludge produced is treated by Anglian Water and not via third parties.

From our regular discussions with neighbouring WASCs, whilst there is limited opportunity for short term non-committal cross border trades these are assessed on a case by case opportunity.

We also anticipate that the trades will be reciprocal and therefore we have assumed trading out will balance with trading in from neighbouring WASCs.

Line 1.4: Total sewage sludge produced from non-appointed liquid waste treatment

Sludge arising from septic waste tankered into wastewater treatment works inlets is included in our line 1 total. The proportion calculated in 2021/22 and reported in our APR arising from cess pit and septic tank waste is 2.9 TTDS. For the future forecast we have assumed the annual average of the TTDS received over the forecast period through to 29/30 will be maintained.

Line 1.5: Percentage of sludge produced and treated at a site of STW and STC co-location

We have included the percentage of sludge produced on an STW (Sewage Treatment Works) and STC co-location only whensludge treatment is present (not raw dewatering sites). We have therefore counted our nine advanced anaerobic digestion (AD) sites, one conventional AD site . The projection from 2023/4 has been taken from the BMA (60 week) tactical model but this is consistent with our actual data previously reported in the APR with no significant change.

There is a discrepancy between the 2022-23 data submitted in the PR19 early submission and that in the PR24 BIO1 table. The PR19 table is a model predicted value while the PR24 table has been updated with the post verified value from the APR.

Line 1.6: Total sewage sludge disposed by incumbents

The projection from 23/24 has been taken from the BMA model. Data for 21/22 is taken from our APR. The model assumes the majority of sludge is treated to produce a treated advanced digested cake, or conventional cake at our ten STC's with any balance treated by in-house mobile liming operations. The breakdown is reported by type in BIO 4.

Line 1.7: Total sewage sludge disposed by third party sludge service provider

Our assumption is that the vast majority of biosolids produced will be disposed of by Anglian Water asthe incumbent. Data for 22/23 is taken from our reported APR, we have added a minor manual adjustment in 23/24 to reflect a similar amount to that reported in 22/23 to account for a small stock of contaminated sludge that will be disposed of via a third party to land reclamation. We assume that for the remaining years this does not continue as the issue that caused contamination has been resolved.

Line 1.9: Total measure of intersiting 'work' done by pipeline

We no longer have any intersiting of sludge by pipeline.

Line 1.10: Total measure of intersiting 'work' done by tanker

From 23/24 the projections are taken from the BMA tactical (60 week) model.

There is a variance between future forecast and what we have reported historically. In practice the model optimises the networks to drive to a lowest end to end cost of treatment and, as a general rule of thumb, this would preference liquid sludge to be tankered direct to an STC rather than through an interim dewatering hub site. In reality we have to make day to day or week by week operational planning decisions that change the actual ratio of sludge transported as liquid direct to a STC for treatment or via a dewatering hub for dewatering, storage and then on to treatment.

Line 1.11: Total measure of intersiting 'work' done by truck

From 23/24 the projections are taken from the BMA tactical (60 week) model.

We have used our tactical bioresources model to forecast work done by sludge truck for dewatered cake sludges. There is a variance between future forecast and what we have reported historically. In practice the model optimises the networks to drive to a lowest end to end cost of treatment and, as a general rule of thumb, this would preference liquid sludge to be tankered direct to an STC rather than through and interim dewatering hub site. In reality we have to make day to day or week by week operational planning decisions that change the actual ratio of sludge transported as liquid direct to a STC for treatment or via a dewatering hub for dewatering, storage and then on to treatment.

Line 13: Total measure of intersiting 'work' done by tanker (by volume transported)

From 23/24 the projections are taken from the BMA tactical (60 week) model.

Line 1.16: Total measure of 'work' done in sludge disposal operations by truck

From 23/24 the projections are taken from the BMA tactical (60 week) model to derive the tonnages that require disposal. We have taken this projection and applied an average distance to transport sludge from the STC to farmland or alternative disposal point. The average distance is based calculated from an actual baseline position as reported in our previous APR. Some treated sludge is transported to intermediate storage prior to onward movement to farmer customers, we have assumed the average distance of 12km is maintained throughout the period. However due to the tightening of restrictions on land application through the interpretation of Farming Rules for Water and the introduction of the agreed twenty measures we have used specialist consultants (Grieve Strategic) to model the impact and advise on the average distance to land.

We report a significant impact in 23/24 with the average distance to land forecast to increase from 17km to 33.1km. This a direct result of the implementation of the twenty measures. We anticipate some other smaller changes through some anticipated adjustments to the measures over future years with the distance increasing to an average of 40km in 27/28 after which we assume this distance remains stable for the remainder of the AMP assuming no further amendments to guidance or regulation within AMP that would have a further adverse impact on available agricultural land outlets.

Line 1.18: Total measure of 'work' done by tanker in sludge disposal operations(by volume transported)

No sludge is disposed by tanker.

Line 19: Chemical P sludge as percentage of sludge produced at STWs

The increase over time is mainly due to the overall increased population at the larger works removing P chemically. We have not included sludge arising from phosphorus (P) removal at Whitlingham (Norwich) as this site is a Biological Nutrient Removal (BNR) plant removing P biologically and we do not use chemicals there. Similarly, we do not include iron salt dosing at Clacton which is for enhanced settlement. Future forecasts over AMP8 allow for increases in chemical P removal as a result of the WINEP programme.

BIO2 Bioresources operating expenditure analysis

The forecasted base operating expenditure has been assessed using our planned outturn for 2024/25 based on our latest Board approved forecast. Enhancement costs are aligned to CWW1 therefore the totals excluding third party expenditure is consistent. Please refer to the Enhancement strategy - Carbon neutral document in Annex ANH28 for details of the schemes included.

There have been no changes in the reporting methods or assumptions across the period, changes seen are as a result of fluctuations in the total cost.

The formula in line BIO2.20 contains a double count of the total in BIO2.18. Following Ofwat's guidance we have populated the data table and have not corrected the error in the calculation.

BIO3a Bioresources energy analysis

BIO3a.1 - Energy Consumption - Bioresources

Currently, all energy generated by bioresources is from biomethane, which is:

a Converted into electricity and heat in combined heat and power (CHP) engines, or
b Converted into heat in boilers, or
c Converted into heat via waste gas burner (Flared).

Within the business plan for Anglian Water there are plans to add new energy generation assets, in the form of heat pumps which convert electricity into heat,or via heat recovery from wasted sources, such as final effluent.

As we transition from CHP to Biomethane to grid injection we will evaluate and consider the use of heat pump technology to use recovered heat from our digestion processes and other available sources such as our WRC final effluent. We will use the recovered heat in the initial advanced anaerobic process steps typically heating the sludge from ambient to approx. 40 degrees Celsius. This will then minimise the volume of upgraded biomethane that will be used for process heating and therefore maximising the carbon benefits of injecting the upgraded biomethane into the grid.

For electricity we have recorded the MWh of electricity generated by each CHP which is measured by an output meter.

For heat a mass balance calculation is undertaken which provides a net estimated heat input from CHP exhaust heat into low temperature hot water circuits to supply equipment such as heat exchangers with heat for transferring to sludge in pasteurisation loops and sludge heating. In addition to this, estimated biogas in MWh used in boilers is calculated and included.

To calculate the MWh value of the biogas flared we have used Biogas flowmeter recordings to measure volume (m3) and then multiplied by 6.7KWh / 1000 to convert into heat energy through the waste gas burner. This flare data again was previously captured in the Biomethane column rather than the Heat column.

Note the measurement of biogas through flow meters is difficult due to biogas properties (variance in methane and gas moisture content) causing inaccuracies in flowmeters and therefore subject to error.

To calculate the required electrical energy required to meet the heat demand of the process, the following assumption has been made; electrical input 1MWh = 3MWh heat output as per industry standard heat pump specifications.

References used for Biogas energy calculations

Biogas | Anaerobic Digestion (biogas-info.co.uk)

https://www.valorgas.soton.ac.uk/Pub_docs/JyU%20SS%202011/CB%204.pdf

i-FH Heat Pump - Heat Pump Hire (icscoolenergy.com)

C55 Alignment - Financial and Non-Financial Reporting

For the purpose of aligning all the financial and non-financial datasets within PR24 submission, the data calculations for BIO3a have been adjusted to match the financial data. The following implications have been applied;

- New STC will no longer be available for the whole of year 4, adjustment on figures to compensate for OPEX starting in P12 of year 4 (28-29).
- Cotton Valley, Great Billing and Whitlingham Gas-to-Grid (G2G) funding begins from P7 in 26-27. CHP outputs have been shown as half-year with P7-12 calculated as biomethane exports. This has adjusted the heat requirements at these sites with the change to G2G and loss of CHP exhaust heat in the process.
- There are no changes made to Cambridge with the new site expected to start from the beginning of year 4 (28-29).

tDS Profile

To forecast the energy demands and outputs, the first input is the AMP 8 sludge profile forecast. This is provided by Bioresources Portfolio Lead and take into consideration ONS statistics on growth forecasts and the AMP 8 WINEP P programme. The output is a tDS profile which is used to estimate total sludge dry solids.

The tDS production profile is split across our network of Sludge Treatment Centres (STC's). This split is done proportional to operational capacity at each site. There has been an adjustment on year 5 of AMP 7 to allow for downtime at Whitlingham whilst the digester and CAMBI upgrade schemes are being made with site to be offline for an estimated 8-10 weeks.

The objective of the tDS profiling is to ensure 100% treatment capacity to treat all sludge whilst ensuring utilisation for each site aims to be between 80-90% capacity to allow for planned maintenance, breakdowns and network issues. By year 5 of the current AMP period, Anglian Water sludge treatment capacity shall exceed 90% utilisation which is beyond reasonable expectation of plant performance, downtime and adequate maintenance.

To meet the forecasted additional treatment capacity required, over the course of AMP 8 there are a few capital upgrades to increasing treatment capacity. The first arrives in year 1 of AMP 8 with the new digester scheme at Whitlingham and sludge treatment process upgrades to deliver an additional 6,100tDS of treatment capacity. By year 4 of AMP 8 (28-29), the Cambridge relocation project should be complete which will encompass a new site build that adds 4,000tDS treatment capacity to the Anglian Water network. This is complimented with the expected addition of a new STC/expansion of existing site to deliver 23,000tDS treatment capacity. This will aim to reduce our asset utilisation to ca. 80-83% to allow more maintenance to be undertaken and provide treatment capacity to meet the ONS forecasts for population growth.

MWh Output - CHP

Similarly, to tDS forecasts by site, MWh output is mapped against the tDS for each site. The engine output is calculated from the amount of sludge treated MWh per tDS. Each site has a specific conversion rate dependent on the sludge characteristics in the catchment and process type. This produces a gross CHP/G2G output which is then multiplied by 97.5% to remove an estimated average 2.5% engine electrical parasitic input.

For CHP outputs, a final sense check is the utilisation of CHP capacity which is shown as % in rows 38-45.

MWh Output - G2G

As part of the business plan, Cotton Valley, Great Billing and Whitlingham will be converting from CHP to G2G outputs in year 3 of AMP 8 (27-28). This will be closely followed by Cambridge in year 4 (28-29) and the introduction of new STC capacity which will also be producing biomethane exports. This requires a different calculation for estimating outputs. Total tDS throughputs of the relevant sites is multiplied by calculated biogas production m3 per tDS treated. This provides an estimated total biogas production volume in cubic metres.

At present these sites rely on CHP exhaust heat to provide heat input to the process. On the switch to G2G, these sites will require a different heat source and, in these cases, biogas to boilers will be utilised to match the heat demand where possible. The biogas will be supplied to the boilers ahead of biomethane exports and therefore reductions on the calculated biogas production range from 20% to 28% subject to the sludge treatment process.

Once the biogas to boiler allowance has been made, each cubic meter of biogas is assumed to have 6.7KWh of energy, this is then divided by 1,000 to convert to MWh outputs. Finally, a 90% process efficiency factor is applied as per industry standard uptime and reliability.

Flared Biogas

For biogas unutilised, a review of previous years biogas to waste gas burner has been conducted. To do this, estimated biogas production in years 20-21, 21-22, 22-23 by site was calculated using assumed volume of biogas by sludge treatment type and divided by the volume of biogas flared. This data was retrieved from the previous year's APR submissions. At some of the site's, flared biogas was excessive due to operational issues on sites preventing the use of CHP generation - these years were deemed excessive, were removed as anomalies to avoid distorting the forecast.

An average was then taken of the three years data, where it exists, to provide a percentage of estimated biogas production sent to waste gas burner. To map this into the forecasts, this average percentage has been used on the assumed biogas production to provide biogas flared in m3. To convert into MWh, the volume in cubic meters flared has been multiplied by 6.7KWh and divided by 1,000. Further to this, one of the sites does not have a biogas flowmeter on the waste gas burner, therefore an assumption has been made that 2% of biogas is sent to the waste gas burner. This is low as the site has CHP and biogas boilers like the sites with lower volumes of flared biogas.

There are also some reductions assumed in the calculations due to capital upgrades and G2G commencing on sites. For Whitlingham, it has been assumed a 40% reduction in biogas to flaring once the biogas to boilers scheme is delivered as this will allow unused gas to be utilised in the boilers before using waste gas burner as last resort. Similarly, at the sites which will convert to G2G in AMP 8 - Cotton Valley, Cambridge, Great Billing and Whitlingham further reductions have been assumed. It has been assumed G2G will allow us to further reduce each individual site usage of the waste gas burner by an estimated 50% and would result in these sites wasting 3% of estimated biogas production.

Energy Bought In

To forecast the volume of third-party sourced heat energy required by bioresources, the last 3 years KWh of energy purchased by each site has been converted to MWh and divided by the actual tDS throughput of each site. The same data as reported in the previous year's APR submissions. This provides a heat efficiency factor from the 3 years' worth of data by site. The heat efficiency factor is then multiplied by total tDS profile by site for each year to calculate an estimated MWh of energy required to be purchased from third party sources for heating.

Where sites have capital upgrades planned for biogas to boiler schemes or conversion to G2G, the estimated biogas to boilers (MWh) has been removed from the heat energy demand estimate. For Cambridge, a new generator is being commissioned which would not have heat outputs. To compensate for this, on the heat balance tabs for Cambridge have an additional calculation which has been done to calculate the losses for the lack of heat output based upon total tDS targets and assumed heat inputs that would have been available from the previous lead CHP.

Heat

For calculating heat generated in bioresources, a heat mass balance calculation for each sludge treatment centre has been complete. This assumes that CHPs are operating at 90% efficiency and 20% loss of heat energy through heat transfer losses through non-contact heating deficiencies such as fouling, scale and material losses. The calculation is based on the maximum available heat from the CHP capacity which is matched to actual CHP output and divided by the tDS throughputs. This provides a MWh per tDS and then multiplied by total tDS to provide a calculated total of heat generated by individual site.

In this heat column, the MWh of heat generated in bioresources through steam and hot water boilers whereby biogas has been used as the fuel has also been added. This is calculated by using the volume of cubic metres of biogas provided to the boiler via flowmeter data (where available) and assuming a 6.7KWh calorific value. An 85% efficiency has then been assumed based upon the KWh value of input to allow for boiler losses to provide an estimated MWh of heat generated through boilers.

The diagram displays the complexity of the system, with heat recovered from CHP engines through hot water and a separate exhaust gas stream. This is typical of advanced anaerobic digestion which uses steam injection for the pasteurisation process step and has a much greater level of system complexity compared with traditional systems where heat is all recovered into simple hot water circuits. The CHP engines are the prime user of biogas as fuel and the engines typically modulate in a range of 50-100% of the rated capacity. For example, depending on the rate of gas production from the digestion process a 1.2MWe engine would automatically modulate its output between 0.6 - 1.2MWe to balance output versus biogas production. Heat is produced proportionate to engine output as either hot water or exhaust gases. This heat is available for process heating but is only used where there is a heat demand from the advanced anaerobic digestion process. If heat produced is more than the heat demand, then exhaust gases bypass the boiler and/or hot water is diverted to fan radiators to dump heat to protect the CHP engines.

As a result, a spot sample of exhaust gas flow and temperature as an input into the composite steam boiler would not be representative of the heat generated, it would only be relevant for that moment in time. By measuring CHP electrical output, fossil fuel input to boilers and understanding the heat demand from the process we believe it is much more accurate to calculate heat produced and heat used in bioresources than taking monthly spot samples.

In year 4 of AMP 8 (28-29) the business plan includes the introduction of heat pump technology on the sludge treatment centres. To include this as part of our PR24 submission, an industry average for heat pump efficiency assumes 1 MWh electrical input for 3MWh of heat outputs. To calculate the heat energy required from heat pump sources for the relevant sites, the total balance of net heat required from the heat mass balance calculations has been used. From this number, the estimated biogas to boilers MWh has been removed. A further assumption has been made of 80% efficiency with heat pump efficiencies and reductions due to low temperature outputs and a 20% allowance for heat transfer losses in pipework and surface contact areas.

Heat (£)

In the value heat (£) columns, we have reported the value of energy bought from grid or third party which is used in bioresources price control for heat generation. This value is derived from the actual costs per KWh unit in 22-23. For each year 23-24 to 29-30, the average cost of MWh purchased during 22-23 has been used. This is achieved by adding together the cost of natural gas and gas oil supplied to site, divided by calculated MWh of gas oil at 10.6KWh per litre and natural gas (x1.02264 x 39.2 / 3.6) based upon volume usage data for 22-23.

This produces a MWh cost of £96.33 which is weighted on site actuals for 22-23 and therefore would assume prices remain like 22-23 and the usage split of gas oil and natural gas remains the same. Any changes to split of usage or fuel supply would impact the cost shown in the data tables. This £96.33 is then multiplied by the estimated MWh of bought in energy required as calculated previously in the data tables. Finally, to place a value on the heat energy self-generated within bioresources and used in bioresources control, the £96.33/MWh value is used to multiply MWh value of biogas to boilers MWh and CHP heat input MWh to produce estimated value.

Biomethane (£)

To producing a value for the estimated G2G outputs, the value per MWh of biomethane output has been used from the business case submitted by Bioresources Portfolio Lead. This assumes each MWh of biomethane exported has a value of £31.70 per MWh or 92.9p per therm. This value is then multiplied by the estimated MWh output for G2G.

Energy Lines 3a.1 - 3a.22

This table captures energy consumption and associated costs and benefits, including:-

- energy generated by the activities of the bioresources price control, split by
- Energy used in the bioresources price control
- Energy used by wastewater network plus
- Energy exported to the grid or third party
- Energy that is unused
- Energy bought from the grid or third party and used in bioresources control
- Total energy consumption, including from on-site fuels used for heat and transport.

Lines 1 to 11 are replicated in the shadow reporting lines 12 to 22 for 2022/23 to 2024/25. Thereafter, lines 12 to 22 become the main reporting lines, the reporting being based upon the guidance for the allocation of revenues /costs associated with energy generation in the bioresources control, as set out in RAG 2.

The data covers the years 2022/23 to 2029/30. The structure of the information replicates that used in the 2022/23 Annual Performance Report (APR). This commentary does not seek to replicate the APR commentary, more to explain any material differences, changes to assumptions and outline methodology.

All 2022/23 information has been replicated from the APR for that year. For the following years, the following represents the outline methodology:-

For 2023/24

- we have populated our APR template with the budgeted consumption and costs for that year. The exception to this is where we have adjusted the forecasts of energy generation and fuel (heat) usage to match the latest forecasts from the Bioresources Team, and also adjusted for the impact upon grid energy;
- energy consumption from transport is assumed not to have changed from 2022/23;
- Additional consumption as a result of new capital schemes (Revenue Impact of Capital Schemes, or RICS) being delivered in the year has been added.

For 2024/25 to 2029/30

We have assumed that the consumption forecast will follow on from that for 2023/24, adjusted for:-

- Change in the forecast of the population served, pro-rata to energy consumption;
- RICS for schemes forecast for delivery from 2024/25 to 2029/30. Concerning the RICS for power that is no longer generated by CHP when three of the sites change to injecting gas into the grid, we have taken a proportion (36%) of the RICS equal to that consumed in the Bioresources function. The remainder is used in wastewater network plus.
- Changes in the generation of electricity and heat in the bioresources price control and the impact upon grid energy requirements.

Regarding costs:

- We have used actual average unit costs for 2022/23, average budget unit prices for 2023/24 and a forecast of unit costs for 2024/25 through to 2029/30. Here we have combined a forecast of non-wholesale costs received from energy consultants Cornwall Insight with wholesale electricity price quotes received from January to April 2023;
- In line with our Net Zero strategy, alternative renewable energy options will be considered including generation from solar on-site. We have assumed the average market rate available in 2023;
- For exported electricity we have used the actual average unit price achieved for 2022/23 and the contracted average unit price for 2023/24 and 2024/25. For 2025/26 to 2029/30, we have used the average market price of wholesale electricity on 13/06/2023;
- Transport and Fuel costs are assumed to be the same across the 8 years in real terms;
- Costs have been re-baselined to 2022/23 using Anglian Water's forecast of CPIH.

The total energy consumption for 2022/23 shown in line 1 was 218,921 MWh. This is made up of 136,465 MWh, which is all of the energy consumed by bioresources, including grid electricity, self-generated electricity, fuel and transport, and 82,456 MWh of heat generated from biomethane and used in the boilers. It includes gas, fuel and transport and an allocation of consumption from administrative buildings and head office function; it is, therefore, not the total of lines Bio3a.2 and Bio3a.6.

The total is forecast to change in the following manner during AMP7:-

Table 1 Forecasted changes to energy consumption

Data Table and Line	Units	Line description	2022/23	2023/24	2024/25
BIO3a.1	**MWh**	**Energy consumption - bioresources**	**218,921**	**228,798**	**232,163**
	MWh	Of which - electricity, fuel and transport	136,465	138,430	139,006
	MWh	Of which - heat generated	82,456	90,368	93,157
BIO3a.7	**£m**	**Energy consumption - bioresources**	**25.777**	**35.554**	**34.990**
	£m	Of which - electricity, fuel and transport	17.834	26.824	26.017
	£m	Of which - heat generated	7.943	8.730	8.973

The main changes to note are that the heat generated by bioresources activities is forecast to grow by 7,912 MWh or 9.6 per cent between 2022/23 and 2023/24 and a further 2,789 MWh or 3.1 per cent between 2023/24 and 2024/25. This growth is reflected in the forecast increase in the tonnage of sludge dry solids to be processed over the same period. There is also forecast to be a modest growth in the total consumption of electricity, fuel and transport over the same period; 1,965 MWh or 1.4 per cent between 2022/23 and 2023/24 and a further 576 MWh or 0.4 per cent between 2023/24 and 2024/25. The latter reflects a reduction in the volume of electricity generated and an increase from RICS and a forecast population increase.

The total cost reported for 2022/23 was £25.777 million, which includes costs for electricity, gas, fuel and transport, including an allocation of costs from the administrative buildings and head office function, and an assessment of the cost of the heating the boilers with biomethane. While the increase in the cost of heat generated from biomethane in the table above reflects the increased heat consumption, the increase in the cost of electricity, fuel and transport reflects the recent sharp increases in the price of electricity. This cost is forecast to increase by £8.990 million or 50.4 per cent from 2022/23 to 2023/24, but reduce slightly by £0.807 million or 3.0 per cent from 2023/24 to 2024/25.

Table 2 Forecasted changes to cost and MWh

Data Table and Line	Units	Line description	2022/23	2023/24	2024/25
BIO3a.2	MWh	Energy generated by and used in bioresources control	29,373	32,676	32,187
BIO3a.3	MWh	Energy generated by and used in network plus control	52,331	58,215	57,344
BIO3a.4	MWh	Energy generated by bioresources control and exported to the grid or third party	32,756	31,512	31,041
BIO3a.5	MWh	Energy generated by bioresources that is unused	0	0	0
BIO3a.6	MWh	Energy bought from the grid or third party and used in bioresources control	39,611	37,316	39,339
BIO3a.8	£m	Energy generated by and used in bioresources control	3.533	8.123	7.582
BIO3a.9	£m	Energy generated by and used in network plus control	6.294	14.350	13.394
BIO3a.10	£m	Energy generated by bioresources control and exported to the grid or third party	3.910	2.662	2.570
BIO3a.11	£m	Energy bought from the grid or third party and used in bioresources control	4.744	9.144	9.138

It is forecast that there will be an increase of 7,943 MWh or 6.9 per cent in the volume of electricity generated by CHP between 2022/23 and 2023/24 as we seek to optimise some of the sites. A small reduction of 1,831 MWh or 1.5 per cent is forecast between 2023/24 and 2024/25. This impacts lines Bio3a.2 to 6 as we expect an overall increase in the electricity generated by bioresources and both used by the bioresources price control and wastewater network plus over the period to 2024/25. We expect the volume of electricity exported to remain stable across the portfolio of sites. We expect the volume of electricity bought from the grid or third parties to decrease from 2022/22 to 2023/24 by 2,295 MWh or 5.8 per cent, replaced by increased CHP generation, but then to increase from 2023/24 to 2024/25 by 2,023 MWh or 5.4 per cent with the effect of increased population and RICS.

We do not expect there to be any unused electricity across the period.

The increase in the costs of the electricity consumed between 2022/23 and 2023/24 is mainly influenced by the increased costs of electricity as already explained above, as is the decrease from 2023/24 to 2024/25. The costs for the electricity consumed were calculated using the average unit cost for half-hourly metered electricity for 2022/23 of £120.27/MWh, the forecast budgeted unit cost of £246.50/MWh in 2023/24 and our forecast of £233.57/MWh for 2024/25. In line with the Ofwat guidance, it is assumed that CHP generated electricity which was used on site has the same unit cost as imported grid electricity.

For sales of exported electricity, the sum for 2022/23 is that received from the export supplier of £3.910 million. Despite the stable exported electricity volumes, the sum received is expected to decrease to £2.662million in 2023/24 and £2.570 million in 2024/25. This is because the price we have contracted for the period April 2023 to March 2025 will fall to £89/MWh in nominal terms (in real terms this is £84/MWh in 2023/24 and £83/MWh in 2024/25) from £119/MWh in 2022/23. This reflects wholesale electricity market conditions when the prices were fixed.

During AMP8, we are forecasting the following total cost and consumption of energy:-

Table 3 AMP8 energy cost and consumption forecast.

Data Table and Line	Units	Line description	2025/26	2026/27	2027/28	2028/29	2029/30
BIO3a.1	**MWh**	**Energy consumption - bioresources**	**236,344**	**245,697**	**249,216**	**248,079**	**261,546**
	MWh	Of which - electricity, fuel and transport	141,485	145,363	146,509	143,702	149,276
	MWh	Of which - heat generated	94,859	100,334	102,707	104,377	112,270
BIO3a.7	**£m**	**Energy consumption - bioresources**	**33.172**	**33.192**	**32.370**	**31.916**	**33.748**
	£m	Of which - electricity, fuel and transport	24.035	23.528	22.477	21.862	22.934
	£m	Of which - heat generated	9.137	9.664	9.893	10.054	10.814

The main change to note is that consumption of energy is forecast to grow to 261,456 MWh, an increase of 29,393 MWh or 12.7 per cent between 2024/25 and 2029/30. While electricity, fuel and transport is forecast to increase by 10,270 or 7.4 percent, the heat generated by bioresources activities is forecast to grow by 19,113 MWh or 20.5 per cent over the same period. This growth is reflected in the forecast increase in the tonnage of sludge dry solids to be processed over the same period, but also the growing use of biogas to heat processes, replacing use of purchased fuels such as natural gas and diesel. This is driven by the forecast change to injecting biogas into the gas grid at some sites during 2026/27, rather than mainly using that gas to drive CHP engines.

Energy Costs are forecast to remain broadly stable in real terms between 2024/25 and 2029/30, with a small decrease of £1.242 million or -3.5 per cent. Within this headline figure, the cost of heat generated is forecast to increase by £1.841 million or 20.5 per cent, in line with consumption of biogas, and the cost of electricity, fuel and transport is forecast to decrease by £3.083 million or -11.8 per cent. The latter is mainly due to the reduction in the consumption of purchased fuels to heat the bioresources processes, but it is also due to some forecast reductions in the price of grid electricity and the assumption that alternative renewable options, such as on-site solar, will be used.

Table 4 Energy cost and consumption forecast

Data Table and Line	Units	Line description	2025/26	2026/27	2027/28	2028/29	2029/30
BIO3a.2	MWh	Energy generated by and used in bioresources control	33,132	25,806	17,449	15,321	14,751
BIO3a.3	MWh	Energy generated by and used in network plus control	59,027	45,975	31,086	27,295	26,279
BIO3a.4	MWh	Energy generated by bioresources control and exported to the grid or third party	31,952	24,887	16,827	14,775	14,226
BIO3a.5	MWh	Energy generated by bioresources that is unused	0	0	0	0	0
BIO3a.6	MWh	Energy bought from the grid or third party and used in bioresources control	38,961	53,906	66,968	66,270	72,333
BIO3a.8	£m	Energy generated by and used in bioresources control	6.702	5.219	3.528	3.097	2.981
BIO3a.9	£m	Energy generated by and used in network plus control	11.840	9.222	6.235	5.475	5.271
BIO3a.10	£m	Energy generated by bioresources control and exported to the grid or third party	3.286	2.509	1.663	1.432	1.351
BIO3a.11	£m	Energy bought from the grid or third party and used in bioresources control	7.774	9.466	10.780	10.640	11.856

It is forecast that there will be a decrease of 65,316 MWh or 54.2 per cent in the volume of electricity generated by CHP between 2024/25 and 2029/30 as we forecast to change to injecting biogas into the natural gas network. This directly impacts all of the lines shown in the table above, Bio3a.2 to 11 (except Bio3a.5), as we expect to see significant reductions in the energy generated by and used in the bioresources control, the energy used in wastewater network plus control and the volume of energy exported. Conversely, we expect to see a significant increase of 32,994 MWh or 83.9 per cent in the volume of electricity bought from third parties and used in the bioresources control over this period.

Consequently, we forecast that the costs associated with the electricity generated by CHP will also fall, along with the value gained by sales of exported energy; this decreasing by £1.219 million or -47.4% to £1.351 million. Conversely, we forecast that the cost of the electricity bought from third parties and used in the bioresources control will increase by £2.718 million or 29.7 per cent to £11.856 million.

We do not expect there to be any unused electricity across the AMP8 period.

A number of assumptions have been made in calculating the water recycling energy consumption data.

- For the whole of the water recycling function, we have applied a financial split from the 2022/23 regulatory accounts between bioresources and wastewater network plus for electricity consumption. This financial split is based upon assessments of proportional use by different Ofwat business units made by operational experts.

- We have included energy from renewable sources generated and used on site, including CHP (combined heat and power), wind and solar.
- Grid electricity and fuel (oil and natural gas) used in offices has been included and split equally between water and water recycling.
- Fuel oil is not recorded on our corporate systems against Ofwat's business units and therefore the same split used for electricity has been assumed for each fuel type with the exception of gas oil and diesel delivered to water recycling sites;
- We have assumed a 35 per cent thermal efficiency for natural gas consumption in converting to energy output (boilers and CHP).
- In line with fuel reports produced from our ERP system for 2022/23, we have allocated 68 per cent of diesel deliveries to bioresources and 32 percent to wastewater network plus.
- Transport (claimed mileage and fleet fuel purchased on fuel cards) is not recorded in our corporate systems against Ofwat's business units and therefore we have split the total 50/50 between water and water recycling and then assumed that they split in the same proportions as electricity between the business units. This is with the exception of RES fleet Biosolids haulage which has been allocated entirely to bioresources.
- Sub contracted transport (bioresources and cake) has not been included, only fleet (directly operated) vehicles.
- Transport for company cars is collected as mileage. For 2022/23, we have converted mileage into kWh through using BEIS' greenhouse gas reporting condensed conversion factors for 2022, and we have assumed no change to 2023/24 and through to 2029/30.
- For electric vehicles in 2022/23, a small volume of energy was collected via fuel cards or was metered at employees' homes. For the remaining, larger volume we made the assumption that the mileage claimed relates to charging at home or on public charging points, rather than using the charging points at our offices. Many people are still working from home a lot of the time and we don't have a reliable source to tell us how many miles are being claimed from charging at Anglian Water sites. We believe this assumption to be safe and not capable of skewing the overall figures since (i) electric car consumption from claimed mileage totalled just 238,643 kWh across the whole of Anglian Water and (ii) wherever cars are charged, the driver may be charging for domestic and commuting miles (which cannot be claimed) as well as for business. While there may be an overlap with the electricity consumption data, we consider that this will be de-minimus. We are looking to improve our processes in order to better capture consumption by electric cars charged at home and AW infrastructure. For 2023/24 and through to 2029/30 we have assumed no change to this approach, however, it should be noted that whatever the blend between electric, hybrid, petrol and diesel driven vehicles, the fundamental unit of the energy consumed - the Watt - does not change. It is a measure of work done, in this case to move vehicles, people and bioresources from A to B, and the amount consumed for a given journey will be similar for differently fuelled vehicles, regardless of the fuel used.
- Electricity figures used in table Bio3a lines.2 to 6 for 2022/23 - grid import, CHP generation and export - are all metered so there is a high level of confidence in these figures.

BIO3b Bioresources income, liquors and metering analysis

Income from renewable energy subsidies Lines 3b.1 - 3b.8

This table captures the forecast income for the bioresources price control from:-

- the sale of Renewable Obligation Certificates (ROC's);
- the Renewable Heat Incentive (RHI); and
- any other Renewable Energy (RE) subsidies.

The data covers the years 2022/23 to 2029/30. The structure of the information replicates that used in the 2022/23 Annual Performance Report (APR). This commentary does not seek to replicate the APR commentary, more to explain any material differences, changes to assumptions and outline methodology.

All 2022/23 information has been replicated from the APR for that year. For the following years, we have used the latest forecasts from the Bioresources Team for CHP electricity generation and gas to grid to from 2023/24 to 2029/30 to determine the forecast income.

For the price of ROC's, we have used that obtained for 2022/23 throughout, £55.85 per ROC. Ofgem's buy-out price for the Renewables Obligation, which underpins the price of ROC's, increases with inflation each year so it is reasonable to use the 2022/23 price rather than inflate and then deflate it in line with our estimate of CPIH.

The income for the period April 2022 to March 2023 totals **£5.663 million**, all of which came from ROC's; no other income was claimed or received.

For 2023/24, we are forecasting income of **£6.219 million**, again all from ROC's, reflecting the increased forecast of CHP generation in that year.

For 2024/25, we are forecasting income of **£6.134 million**, all from ROC's, reflecting a small reduction in the forecast of CHP generation in that year, but also the expiry of ROC accreditation for one of the engines during the year.

For 2025/26, we are forecasting income of **£6.167 million**, all from ROC's, reflecting a small increase in the forecast of CHP generation in that year, but also the expiry of ROC accreditation for one of the engines during the year.

For 2026/27, we are forecasting income of **£4.936 million**, all from ROC's, reflecting a significant reduction in the forecast of CHP generation in that year as gas production at some of the sites is forecast to be diverted to gas injection to the grid part way through the year.

For 2027/28, we are forecasting income of **£3.224 million**, all from ROC's, reflecting a full year of reduction in the forecast of CHP generation as gas production at some of the sites is forecast to be diverted to gas injection to the grid.

For 2028/29, we are forecasting income of **£2.331 million**, all from ROC's, reflecting a reduction in the forecast of CHP generation in that year, but also the expiry of ROC accreditation for two of the engines part way through the year.

For 2029/30, we are forecasting income of **£2.005 million**, all from ROC's, reflecting a small reduction in the forecast of CHP generation in that year, but also the full year effect of the expiry of ROC accreditation for two of the engines during the previous year.

No income was or is forecast to be gained for RHI as we do not have any facilities at bioresources sites which are registered for RHI nor do we expect to. No other RE subsidies were or are forecast to be applied for nor obtained.

Lines Bio3b.7 and Bio3b.8 show the percentage and the relevant year's value of RE subsidies due to expire on bioresources sites in the subsequent two financial years:-

For 2022/23 the totals are 2% and £0.114 million respectively, reflecting the expiry of ROC accreditation at CHP number 1 at Cambridge Sludge Treatment Centre on 01/10/2024;

For 2023/24 the totals are forecast to be 8% and £0.505 million respectively, reflecting the expiry of ROC accreditation at CHP number 1 at Cambridge Sludge Treatment Centre on 01/10/2024 and at CHP number 1at Cotton Valley Sludge Treatment Centre on 01/07/2025;

For 2024/25 the totals are forecast to be 6% and £0.380 million respectively, reflecting the expiry of ROC accreditation at CHP number 1 at Cambridge Sludge Treatment Centre on 01/10/2024 and at CHP number 1at Cotton Valley Sludge Treatment Centre on 01/07/2025.

For 2025/26 the totals are forecast to be 1% and £0.053 million respectively, reflecting the expiry of ROC accreditation at CHP number 1 at Cotton Valley Sludge Treatment Centre on 01/07/2025.

For 2026/27 the totals are forecast to be 9% and £0.436 million respectively, reflecting the expiry of ROC accreditation at CHP numbers 1 and 2 at King's Lynn Sludge Treatment Centre on 14/08/2028.

For 2027/28 the totals are forecast to be 22% and £0.697 million respectively, reflecting the expiry of ROC accreditation at CHP numbers 1 and 2 at King's Lynn Sludge Treatment Centre on 14/08/2028.

For 2028/29 the totals are forecast to be 13% and £0.312 million respectively, reflecting the expiry of ROC accreditation at CHP numbers 1 and 2 at King's Lynn Sludge Treatment Centre on 14/08/2028.

For 2029/30 the totals are forecast to be 62% and £1.237 million respectively, reflecting the expiry of ROC accreditation at CHP number 2 at Colchester Sludge Treatment Centre, CHP numbers 1 and 2 at Basildon Sludge Treatment Centre, all on 15/03/2031, and at CHP numbers 1 and 2 at Cliff Quay Sludge Treatment Centre on 18/03/2031.

Bioresources liquors treated by network plus (shadow reported) Lines 3b.9 - 3b.11

Line 3b.9 and 3b.10

2022-23 entries were calculated as described below (excerpt from APR commentary 8C.15, 8C.16)

"Improvements to data collection and handling have been implemented in 2022/23 for these lines. Models have been made available from company subject matter experts who provide data for sample results, onsite readings and tankering/haulage volumes. These models have all been connected together to a single point, combining the relevant data and performing calculations needed to provide the data for lines 15, 16 and 17.

Significantly different volume data has been used for two sites, Ingoldmells and Pyewipe, which were both outliers in the 2021/22 data collection. Haulage/tankering records were not available for those sites in 2021/22 and flow points from ViewX (our telemetry system) were used instead. Ingoldmells has a drainage liquors flow meter and Pyewipe has two gravity belt thickener (GBT) feed flow meters. Neither of these are accredited flow meters. In 2022/23, haulage records have been used for all sites which has improved the accuracy of data for these two sites.

A further improvement in 2022/23 is the use of actual recorded percentage dry solids data rather than assumed values. This was highlighted as a proposed improvement to the process to achieve in 2022/23 as it is believed to have a material cost to the volumes."

We have taken these output numbers and used them to generate an average returns concentration per tDS processed for both Biological Oxygen Demand (BOD) and Ammonia (NH3). The forward forecast has been generated by taking the annual site production as prescribed using our BMA tactical planning (60 week) model (see commentary from BIO1 for further description of how this model operates) and multiplying this by the derived concentration.

Hitchin has been removed from the table as in December 2022 we shut down the centrifuges and started exporting thickened liquid sludge, as this is now below the 10% dry solids threshold, these costs sit outside the bioresources price control. Caister has been added, the digesters on site were decommissioned two years ago and liquid sludge has been exported from site since. A project has been initiated to dewater this sludge using the existing digested sludge dewatering plant. As no samples or flows exist for this site, the concentrations have been assumed by taking an average of the combined BOD loads from the raw cake producing sites (Caister accounts for approximately 1.2 per cent of total modelled production).

From 2025 onwards Whitlingham NH3 concentration has been adjusted to match that of Cliff Quay following the delivery of a project to refurbish and recommission the existing liquor treatment plant on site. Great Billing and Cotton Valley have liquor treatment/recovery projects planned as part of our Net Zero ambitions, the operation of these has been factored in to our projections for year 5 of the AMP.

Metering Lines 3b.12

Table BIO3b, line 12 measures the percentage of bioresources energy consumption that is metered as opposed to being estimated. The value for 2022/23 is 58%. This was determined using the following methodology:-

- For electricity, this has been assessed using the percentage of the total energy cost in the regulated accounts for those sites where the costs have been allocated based upon sub-metered data collected from meters connected to IRIS in January 2017. This is considered the most accurate of the assessment methodologies that we currently use to allocate revenues and costs for electricity. While the electricity data used in the 2022/23 allocation of costs and consumption has not been taken from those sub-meters in that period, our interpretation of the line description is that it represents the total from sites that have accurate metering.

- For gas, we have used the metered natural gas delivered to bioresources facilities. We have assumed a 35% thermal efficiency for natural gas consumption in converting to energy output (boilers and CHP).
- For diesel fuel, we have used the volumes actually delivered to our bioresources facilities. We have converted the litres delivered to an equivalent energy output using the UK Government's conversion factors.
- For diesel transport fuel, we have used the volume of diesel purchased through fuel cards for the bioresources transport vehicles. We have converted the litres consumed to an equivalent energy output using the UK Government's conversion factors.
- For heat, we have used the gas volume measured at boiler biogas flow meters. A thermal efficiency factor has been applied to convert to energy output.

For 2023/24 through to 2026/27, the level of submetering is not expected to increase significantly, although the approach will change to include the actual sub-metered data for each year. The level is forecast to grow to:

- 60% in 2023/24
- 60% in 2024/25
- 60% in 2025/26 and
- 62% in 2026/27.

From 2027/28 to 2029/30, we have forecast a significant increase, reflecting the expectation that the new treatment works at Cambridge and the forecast gas to grid installations at other sites will have the relevant metering installed. The forecasts are:-

- 79% in 2027/28
- 81% in 2028/29
- 80% in 2029/30

For available existing data, we have applied a confidence grade of A2 as the majority of raw data is based on metering and has been audited as part of the ISO-14064 certification process. For forecast data we have applied a confidence grade of C4 as this is based upon extrapolation of metered data.

BIO4 Bioresources sludge treatment and disposal data

Overview

Our strategy continues to move towards a position where we are able to treat all sludge produced through our nine advanced anaerobic digestion sites and one pasteurisation site. To allow for sufficient downtime for planned maintenance shutdowns we have amended our strategy to target a more realistic 85% uptime target compared with the 90% target we set ourselves at PR19. To achieve our long term objective this relies on additional advanced digestion capacity becoming available during the AMP8 investment period, together with our AMP7 capacity investment at our Whitlingham STC that will complete in 24/25. Additional capacity is planned at Cambridge (through the separate Cambridge WRC relocation project) and additional 23,000 tDS/year capacity for a new STC at Colchester, this investment provides for additional sludge growth and improves our operational resilience ultimately allowing us to cease liming by the end of AMP8.

22/23 data is taken from APR.

Sludge treatment process Lines 4.1 - 4.7

Line 4.1: % Sludge - untreated

No sludge will be untreated from 2023/24.

Line 4.2: % Sludge treatment process - raw sludge liming

From 28/29we do not anticipate that we will treat raw sludge by lime stabilisation. Values from 2023-28 have been taken from the BMA tactical planning model outputs. For 2024-25 only we have made a manual adjustment to account for the untreated volumes (approx 1.2TTDS) at Whitlingham STC while it is closed for 8 weeks for upgrade works.

Line 4.3: % Sludge treatment process - conventional AD

Chelmsford STC remains as our only conventional AD site. It treats indigenous sludge only and accounts for approximately 2% of sludge produced across the region.

Line 4.4: % Sludge treatment process - advanced AD

Values have been taken from the BMA model from 2023/24 onwards.

Line 4.5: % Sludge treatment process - incineration of raw sludge

No raw sludge will be incinerated

Line 4.6: % Sludge treatment process - other (specify)

We have no other methods of sludge treatment.

(Un-incinerated) sludge disposal and recycling route Lines 4.8 - 4.13

Line 4.8: % Sludge disposal route - landfill, raw

No raw sludge will be sent to landfill

Line 4.9: % Sludge disposal route - landfill, partly treated

No partly treated sludge will be sent to landfill.

Line 4.10: % Sludge disposal route - land restoration/ reclamation

A small amount of sludge will be sent to land reclamation in 2023/24. We do not anticipate that anything will be disposed of from 2024/25 onwards.

Line 4.11: % Sludge disposal route - sludge recycled to farmland

We plan that all sludge continues to be disposed to farmland. Note that historically we have occasionally, on a case by case basis, provided some digested sludge to third parties for seeding of new assets. Whilst we do not have any plans to do this in the future, we will continue to consider this service as and when the opportunity arises. We have assumed that any sludge which is treated and disposed of by third parties, will be recycled to agricultural farmland.

Line 4.12: % Sludge disposal route - other (specify)

We do not plan to dispose of sludge in any other means than those described above.

BIO5 Bioresources - additional treatment and storage data

Bioresources data Lines 5.1 - 5.10

Line 5.1 and 8

No new capacity through WINEP, new capacity is covered by line 11.

Line 5.3 and 4

No investment planned

Line 5.5 and 6

Eleven cake pads to be upgraded to covered cake stores, six to be completed in year 4 totalling 69'546m2 and a further five in year 5 with a combined area of 76'398m2

Lines 5.2, 7 and 9

We have created one investment for enhanced dewatering at three sites, Basildon (10'300TDS), Cliff Quay (14'800TDS) and Colchester (14'900TDS). While design and procurement will begin in 2026/27 we do not anticipate beneficial use of the assets until 2029/30. The capacity is stated as the STC raw capacity, digested sludge TDS will be approximately 55% of this although this may vary depending on actual performance of the digesters. The volume of sludge processed is based on the combined design maximum throughput for these three sites which assumes 7% dry solids feed in to digestion. It is not anticipated that these projects will be completed in time to have a material impact on the total volumes of cake applied to land within the AMP and is therefore not included in BIO1.16.

Line 5.10

We engaged specialist consultants Grieve Strategic to undertake a capacity assessment of land bank against a range of regulatory scenarios. The landbank availability assumptions from this modelling are detailed in this section.

Extract from Biosolids Landbank Assessment, completed by Grieve/ADAS in November 2022.

Executive Summary

1. Five different scenarios based on the PR24 WINEP drivers were developed and modelled to understand the effect of increasingly stringent environmental restrictions on Anglian Water Services (AWS) landbank. These were modelled using an updated version of the ALOWANCE GIS modelling tool with AWS's current Sludge Treatment Centre (STC) configuration. The outputs are summarised in the tables below.

2. For Scenarios 1 - 3 there is sufficient available agricultural land within at most 60 kilometres of AWS's STCs. For Scenarios 4 and 5 there is likely insufficient available agricultural land for all biosolids in Great Britain. For Scenario 4 there is an almost 5-fold increase in landbank required and for Scenario 5 there is an over 10-fold increase (based on an increase over Scenario 3).

3. The key factors which result in the increase in landbank required (between Scenario 3 and Scenarios 4 and 5) are a ban on applications in the autumn to winter cereals, increased restrictions on phosphate management and increased quantity and P content of biosolids. Restrictions on biosolids use on grassland, rules in/around sensitive sites and a decrease in farmer acceptance also have a negative effect.

4. Producing an enhanced treated biosolids at almost all the sites would significantly reduce the landbank required, leading to a reduction of almost 1 million hectares. However, the key determining factor is still the environmental restrictions and in particular if biosolids can be applied in the autumn before winter cereals. Changing the rules around phosphorus restrictions and the quantity and quality of biosolids produced also have a significant effect, but the effect is dwarfed by the impact of a possible ban on autumn applications. There are possible alternative technologies that could be useful in reducing the required landbank, however, they are not yet proven commercially (e.g. thermal processes or carbon efficient pelletisation) or have practical limitations that make their benefits questionable (e.g. pelletisation or composting).

5. The potential ban on biosolids applications in the autumn to winter cereals was and is still greatly debated. Given the significant effect this one change has on the agricultural landbank and the fact the Secretary of State for the Environment introduced Statutory Guidance on the interpretation of the Farming Rules for Water at least partly to not apply this interpretation, the possible use of this

approach in the future must be reviewed. It is essential biosolids recycling does not harm the environment, but if the interpretation is not scientifically justified, it would result in the water industry (including AWS) spending millions (or billions) to change the way they treat and recycle biosolids for no overall environmental benefit (e.g. a small reduction in nitrate leaching compared with increased ammonia emissions and risk of compaction and associated impacts) at a time when water bill payers are facing huge pressures due to the rise in the cost of living.

Forecast of landbank availability - assumptions

Scenario 1 reflects the position in 2022-23 (pre Industry 20 measures) as the Industry's 20 measures weren't implemented until July 2022 and any orders taken prior to this date for autumn 2022 application at P Index 4 were allowed to continue, on the basis that the farmer couldn't reasonably be expected to change plans at short notice (i.e. there is a lead time to obtain an alternative manure)

Scenario 3 reflects the position post July 2022**and after a full crop rotation has been completed**. Some of the restrictions associated with Scenario 3 will apply immediately on all land, such as -

- Farmer Acceptance
- Market Competition
- Nitrogen restrictions - light soils in autumn
- Grassland restrictions
- Nutrient neutrality/sensitive catchments
- Designated sites (Habitats)
- CIP impact on farmer acceptance/microplastics/PFAS

It's assumed that c.50% of the overall impact is accounted for by these factors and that c.40% impacts immediately and 10% progressively across the following 5 years.

Other restrictions will apply progressively as a full crop rotation proceeds -

- Phosphate (no applications at Index 4 and rotational applications at Index 3)

It's assumed that c.50% of the overall impact is accounted for by these factors, with c.50% impacting immediately (Index 4) and c.50% impacting progressively over the five year crop rotation (Index 3).

The overall impact on landbank availability, based on these assumptions, is as follows -

Table 5 Landbank Availability

	AMP7			AMP8				
Year	Baseline 2022-23	Year 1 - 2023-24	Year 2 - 2024-25	Year 3 - 2025-26	Year 4 - 2026-27	Year 5 - 2027-28	Year 6 - 2028-29	Year 7 - 2029-30
Landbank scenario	Scenario 1					Scenario 3		
Landbank impact	0.0%	70.0%	77.5%	85.0%	92.5%	100.0%	100.0%	100.0%
Landbank required	204200	415320	437940	460560	483180	505800	505800	505800
Max mileage (km)	24.0	47.1	49.6	52.1	54.5	57.0	57.0	57.0
Average mileage (km)	17.0	33.1	34.8	36.6	38.3	40.0	40.0	40.0
Landbank available - PR24 metric	**100%**	**49.17%**	**46.63%**	**44.34%**	**42.26%**	**40.37%**	**40.37%**	**40.37%**

Sludge management/sludge treatment/ Bioresources cost drivers Lines 5.11 - 5.15

LINE 5.11 - Additional Line 1 - Sludge Treatment Resilience

We are proposing to increase our sludge treatment capacity by 23 TTDS per annum with an additional STC at Colchester. This investment is to provide additional capacity for increased sludge production over the period (Growth & WINEP) and additional resilience capacity across our sludge treatment asset base. This line represents the resilience capacity element for the new STC with the growth element being picked up under table commentary CWW3 and BIO1 line 1.1.

The cross industry work with other WASCs in evidence gathering for the sludge WINEP drivers identified there was insufficient capacity across England and Wales to cater for forecast growth, demonstrating additional sludge treatment capacity is required and concluding use of markets with cross border trading could not meet future needs or provide the capacity resilience required. Furthermore, it demonstrated that seasonal variations in sludge production and capacity within networks to manage planned scheduled maintenance was insufficient, leading to increased risks for both bioresource operations and network plus in terms of permit and discharge compliance.

At PR19 we planned to increase our sludge treatment centre uptime from circa 80 to 90% availability before instigating the need for investment in new capacity, based on the annual average sludge production. Whilst we have improved our availability over time we have concluded it is not sustainable to operate continuously at 90% when allowing for planned maintenance activities such as tank inspections and refurbishments. This also does not allow sufficient headroom during periods of the year where sludge stocks are naturally high, as this results in a need to store raw cake and at times deploy mobile lime treatment plants to peak lop production. Peak sludge production occurs across the industry at broadly the same time of year, meaning availability for cross border trades with neighbouring WASCs is poor.

LINE 5.12 - Additional Line 2 - Industrial Emissions & Regulatory Change

This represents addition enhancement items associated with the industrial emissions directive and other regulatory change for items we consider enhancement over base expenditure. Ten of the eleven schemes identified are for the installation of required secondary containment on our ten sludge treatment centres that require Industrial Emissions Directive (IED) permits. This is a new requirement and therefore new enhancement expenditure. This is consistent with what we have reported in the IED data request issued by Ofwat on 1st August 2023. The eleventh output reported on this line represents new operating expenditure items we consider enhancement expenditure as a direct result of the IED requirements and other regulatory changes due to the interpretation of the Farming Rules for Water (FRfW). The opex items include new requirements and are not historically included with our base expenditure, additional items include; a written scheme of examination and formal inspection programme for all tanks on IED sites, frequent odour and bioaerosol surveys and regular sampling of liquors returned to the head of the host water recycling centre. These items we also identified in our response to the Ofwat IED data request. The additional opex expenditure as a result of the FRfW guidance and introduction of the agreed twenty measures include additional sampling and increases to our recycling cost in terms of reduced access to land.

LINE 5.13 - Open Cake Storage Enhancements

This represents the area in m2 of storage areas for treated cake that we propose to be enhanced with new walls, floors and enhanced drainage.

Line 5.14 - Adaptive Planning - Future Technology

This is an investment to accelerate the development of sustainable, readily deployable alternative for the current practice of biosolids cake for use as a soil conditioner in agriculture. The investment will target development of advanced thermal conversion (ATC) technologies from pilot/small plants to larger plants that are suitable for deployment at scale across the UK water industry. The work will explore not only scalability but also a better understanding of pathways of potential pollutants and emerging contaminants such as mirco-plastics, Perfluorinated Alkyl Substances (PFAS) and Perfluoroocatane Sulphate (PFOS). For example do these partition to the gas phase or solids phase into BioChar. The proposed work will also examine routes to market for the beneficial use of the products ATC process generate and work with regulators to ensure appropriate regulatory frameworks are developed and put into place. We see this investment being part of a much larger industry wide investment to accelerate these alternative technologies and this investment is consistent with the recommended next steps as an outcome of the WaterUK, CIWEM National Long Term Bioresources Strategy completed in 2023.

BIO6 Bioresources - NMEAV for capital enhancement schemes

Overview:

We would like to note that all of the AMP8 data in table BIO6 is aligned with our WINEP programme's relevant schemes currently in place (start date from 2025/26) and has been populated on the basis of:

- Ofwat's Guidance: PR24 business plan table guidance part 6; Bioresources (Aug 2023)
- Ofwat's Guidance: Bioresources control: supplementary document (Sep 2022)
- Ofwat's Responses to submitted Queries 222, 285, 473, 474, 475, 493, 494, 497

Also, we would like to note that we have used the latest inflation (CPIH) data from the Official National Statistics (ONS) with base year 2022/23 and prices from the Financial Year Average (FYA) with projected inflation data for years 2023-25 fed from the inflation data table PD1.

For years 2025-30, we have used Ofwat's long-term inflation projections that accompanied the aforementioned document of Ofwat's Guidance (Bioresources control: supplementary document (Sep 2022)).

Following Ofwat's Guidance and the nature of the bioresources' enhancement WINEP-related assets, the calculation of the respective Net Mean Asset Value (NMEAV) figures are based on the following:

i. Calculations and figures starting from 2025/26 (ie the relevant WINEP schemes' start date).
ii. Enhancement Capex figures are post-efficiency Real Price Effects (RPE) figures that are linked to the respective pre-efficiency Enhancement Capex figures from the CWW3 Data Table and converted using our internal Enhancement Capex Efficiency (RPE) Factors.
iii. Disposal adjustments are considered to be zero throughout PR24
iv. Gross Mean Asset Value (GMEAV) figures are assumed to be approximately equal to the lagged GMEAV figures plus the respective post-efficiency (RPE) Enhancement Capex figures.
v. Current Cost Accounting (CCA) Depreciation of the respective assets is assumed as straight-line from 2025/26 until 2029/30.

Sludge storage -Tanks (pre-thickening, pre-dewatering Lines 6.1-6.7 or untreated) (WINEP/NEP)

No Capex Enhancement exists for this category under the relevant WINEP schemes therefore the corresponding GMEAV and NMEAV figures are zero from 2022/23 until 2029/30.

Sludge storage - Tanks (thickened/dewatered or treated) (WINEP/NEP) Lines 6.8-6.14

No Capex Enhancement exists for this category under the relevant WINEP schemes therefore the corresponding GMEAV and NMEAV figures are zero from 2022/23 until 2029/30.

Sludge storage - Cake pads / bays (WINEP/NEP) bioresources Lines 6.15 -6.21

GMEAV and NMEAV variations for this category are dependent on the respective Enhancement Capex variations that are in place under the relevant WINEP schemes for years 2025-30.

As per Ofwat's guidance, figures referring to years 2022-25 (ie before 2025/26, the start date of the relevant WINEP Schemes) are set to zero.

CCA Depreciation figures for this category are based on the relevant asset economic life that is 25 years since this category refers to Civils-Industrial buildings under the relevant WINEP schemes for years from 2025/26 until 2029/30.

Sludge treatment - Anaerobic digestion and/or advanced anaerobic digestion (WINEP/NEP) bioresources Line 6.22-6.28

No Capex Enhancement exists for this category under the relevant WINEP schemes therefore the corresponding GMEAV and NMEAV figures are zero from 2022/23 until 2029/30.

Sludge treatment - Thickening and/or dewatering (WINEP/NEP) bioresources Lines 6.29-6.35

GMEAV and NMEAV variations for this category are dependent on the respective Enhancement Capex variations that are in place under the relevant WINEP schemes for years 2025-30.

As per Ofwat's guidance, figures referring to years 2022-25 (ie before 2025/26, the start date of the relevant WINEP Schemes) are set to zero.

CCA Depreciation figures for this category are based on the sum of CCA Depreciations for both sub-categories of dewatering assets under the relevant WINEP schemes for years from 2025/26 until 2029/30.

As per the relevant WINEP schemes for years from 2025/26 until 2029/30, 85% of the total Enhancement Capex for this category refers to M&E plant and equipment with corresponding asset economic life set at fifteen years. The remaining dewatering assets not falling into the aforementioned M&E plant and equipment sub-category and which account for 15% of the total Enhancement Capex under the relevant WINEP schemes for years from 2025/26 until 2029/30 for this category, are estimated to have twenty five years of asset economic life.

Sludge treatment - Other (WINEP/NEP) bioresources Lines 6.36-6.42

GMEAV and NMEAV variations for this category are dependent on the respective Enhancement Capex variations that are in place under the relevant WINEP schemes for years 2025-30.

As per Ofwat's guidance, figures referring to years 2022-25 (ie before 2025/26, the start date of the relevant WINEP Schemes) are set to zero.

CCA Depreciation figures for this category are based on the relevant asset economic life that is seven years since this category refers to Spreading fleet and equipment under the relevant WINEP schemes for years from 2025/26 until 2029/30.

Sludge investigations and monitoring (WINEP/NEP) bioresources Lines 6.43 -6.49

This category refers to the NEP programme that is, by definition, not relevant for English Water/Wastewater Companies. Therefore, the corresponding values of this category are set to zero from 2022/23 until 2029/30.

love every drop
anglianwater

THE QUEEN'S AWARDS FOR ENTERPRISE: SUSTAINABLE DEVELOPMENT 2020

Anglian Water Services Limited
Lancaster House
Lancaster Way
Ermine Business Park
Huntingdon
Cambridgeshire
PE29 6XU

anglianwater.co.uk