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17th September 2022

Dear [redacted]

Creating tomorrow, together: consulting on our methodology for PR24 Bioresources Control - Appendix 4

We welcome the opportunity to comment on the draft methodology for Bioresources and the progress to date on developing the modelling approach. We set out in the attachment our responses to the specific questions raised and below I highlight three key issues:

- The impact on the development of the bioresources market of changing the regulated price will likely be small given the other barriers to the development of the market and so changes to the approach should be proportionate and as simple as possible
- The approach being developed may have adverse impacts on other policy priorities for example the achievement of Net Zero
- Changing the risk profile of bioresources needs to be reflected in the allowed return

Integrating competition in bioresources and price control

We understand that Bioresources is an area where Ofwat consider there is potential for substantial market development. However, we are less confident that all the elements for competition to develop are in place to allow substantial market development in the short-term. Whilst we can support the development of a revised approach to the bioresources price control, it should be recognised that the setting of allowed revenues or average prices is not in our view a major factor slowing the development of the bioresources market. It should therefore be developed in a way that is not overly complicated as the benefits to customers, if any, will be small.

With this in mind we continue to consider that the differences between RCV and NMEAV, as defined, will be small and therefore it would appear simpler to use RCV and RCV run-off as the measure of asset value and depreciation.

We can see that progress has been made in developing the modelling approach, although it is clear that further work needs to be undertaken and in particular in respect of Option 3. We are

very happy to work with you through the cost assessment working group in developing robust models.

Consistency with wider policy agenda

In *'PR24 and beyond – creating tomorrow together', Ofwat set out a policy intent on Net Zero - "On net zero, for PR24 we expect companies' plans to make substantial progress towards national government net zero targets"… and.. "We want companies to go further than this and propose specific net zero enhancement investments".*

Bioresources provides a great opportunity for companies to invest to achieve net zero. However, the incentives to invest in areas that do not contribute towards increased sludge volumes are significantly reduced in the proposed new approach. In addition, while a facility for additional allowances for quality enhancements is proposed, there is limited certainty over returns on long-term investment that will discourage investments of this type. Consideration should be given to whether the limited benefits from the proposed changes outweigh the adverse impacts on the wider policy objectives, for example, achieving net zero.

A fair return is essential for the development of the market

Economic regulation is fundamentally about the allocation of risk and setting an associated return which fairly compensates investors for bearing such risk. The proposed changes to the Bioresources price control are clearly increasing risk in this area. This, in itself, is not an issue providing it is compensated through an increase in the allowed return. Without that increase there is a real risk that investment will be considered too risky.

We are very happy to discuss any of these issues with you further.

Yours sincerely

Head of regulatory & market economics

Q2.1: Do you have any comments on this section

We agree with the need for improved cost consistency and support Ofwat's proposals in this area.

We also agree, to some extent, with Ofwat's proposition that water companies knew that renewables funding support schemes had a finite life (Section 2.4.3), but we draw different conclusions.

Firstly, changes to the support schemes results in changes to the efficient costs of operating the business and should be reflected in cost assessment. To the extent that historical costs are no longer a reliable indicator of future costs, there should be modelling adjustments given the way that Ofwat assess efficiency and set allowances. In a competitive market, changes in such costs would be reflected in changes in prices.

Secondly, during the life of an energy asset its value will likely change with changes in incentive schemes making it both in and out of the money relative to the market. Large scale investment in a particular renewable technology, for example, will inevitably have an impact on the level of incentives on offer from the appropriate regulatory authority. However, this simply means that the level of risk for bioresources investments is different from other price-controlled activities. This increased risk should be reflected in the cost of capital for bioresources.

We note that provisions of the Green Gas Support Scheme (GGSS) require investment in new and not existing equipment. This is problematic as the defining boundary between existing and new equipment is critical in obtaining the funding. Furthermore, we cannot assume high energy prices will last once gas resourcing moves from Russia to LNG over the period of the control. It is a plausible scenario that there will be over investment in gas assets that could even lead to negative prices as were experienced during the global pandemic. Again, this is a distinct risk that will influence the markets investability and should be reflected in the cost of capital.

Q2.2: Do you have any further comments on our approach to a separate efficiency assessment, in particular the options we consider in section 2.4.2?

We consider that a separate efficiency challenge is appropriate providing that the cost allocations are robust and consistent. We are not sure that we are in a position, as yet, to conclude that allocations are robust and consistent. For example, the standard liquor cost methodology still could be interpreted differently depending which assets are included in the treatment. At some sites the liquor may go to the head of works so costs might include Primary Sedimentation Tanks (PSTs), Activated Sludge Plants (ASPs), etc whereas at other sites liquor may just be fed into the ASP.

Question 3.1: Do you have any comments on this section?

We welcome the identification of the risks associated with the development of the bioresource market as being all regulatory in origin (3.3.2 p24). This is not trivial in its impact on the development of the market is profound and clearly by the evidence presented in Ofwat's own narrative set to be reviewed around 2025 and other regulatory barriers set to end in 2030. This could potentially dampen any investment until the uncertainty is reduced after 2030.

Ofwat state *"in addition, we propose not to apply business rates cost sharing for bioresources in PR24."* If this is the case, we argue that the allocation of risk to companies is increasing (as PR19 benefited from 75% sharing with customers) and this should be reflected in the Bioresources allowed rate of return.

The control is based on competition as an efficiency driver, so there is more risk involved for new assets than there has been previously. If the assumptions behind the deployment of a particular technology do not take into consideration of site-specific issues, then a good investment may not look that efficient compared to others. This process may also have the unintended consequence of firms choosing the same technologies as they are unlikely to be penalised on efficiency grounds. This will of course have an impact on manufactures of bioresource equipment.

Question 3.2: Do you have any further comments on the draft methodology proposals which we propose to retain from our December document and our reasons for doing so?

We have no additional comments to those made in our previous consultation response.

Question 3.3: Do you have any suggestions on how our approach to PR24 quality enhancements could be implemented in a way that achieves our objectives whilst addressing the concerns raised by stakeholders?

Quality enhancement cases are by their very nature unique and specific to the context of investor. However, the central problem likely to be encountered in the move towards a market-based price control relates to incentives to invest

In *"Creating tomorrow, together: consulting on our methodology for PR24",* Ofwat state on p.77 that *"On net zero, for PR24 we expect companies' plans to make substantial progress towards national government net zero targets"*… and *"We want companies to go further than this and propose specific net zero enhancement investments."*

Bioresources is a key business area where companies can and should invest to contribute towards the achievement of net zero. It would therefore be helpful if Ofwat could clarify whether or not enhancement expenditure in Bioresources to contribute towards the achievement of net zero would qualify as quality enhancements.

However, even if such investments are included as quality enhancements, the proposed approach will not provide sufficient incentive to invest as there is no certainty of return on the investment beyond the first AMP period and no compensation for this additional risk through the cost of capital. The vague suggestion of using cost adjustment claims (to which Ofwat apply a very high threshold and evidential hurdle) in future AMPs, will provide companies with no comfort. Without more certainty on future returns the proposed approach is likely to hinder the policy objective of achieving net zero. One way that certainty could be provided would be to create a "quality enhancements RCV", that has the same protection as pre 2020 RCV and where the return and depreciation of the RCV are added to the allowed average revenue developed from the cost assessment process.

Question 3.4: Do you agree with, or have any comments on, the degree of regulatory protection we propose for pre-2020 RCV? Do you agree with our proposal to implement option 1 to achieve this?

We accept that Ofwat wish to make a distinction between pre and post 2020 RCV. However, as set out in response to Q3.3, it may be more appropriate for some post 2020 investment, relating to quality enhancement, to have the same protections as pre-2020 RCV. We have no additional comments on Option 1 from those we made in response to the previous consultation.

It is important that both pre-2020 RCV and subsequent investments are recorded as stated RCV and published annually as such.

Question 3.5: Do you agree with, or have any comments on, our updated proposals for modelling financing costs in our benchmarking models?

We understand and agree with the proposal to use a forward-looking cost of capital. However, a forward-looking cost of capital needs to take into account the forward risks. The changes in approach are clearly increasing Bioresources risks and this should be reflected in the forward-looking cost of capital.

Question 3.6: Do you agree with, or have any comments on, our proposals in relation to managing volume risk? Do you agree with our preferred option, that is, option 2?

Key to managing volume risk is the degree to which volumes are "forecastable." We support the need for incentives but note that if the volumes are relatively stable, then even small differences in actual and forecast volumes become commercially material. This supports the use of dead bands. Any forecasting penalty should be proportionate.

Question 3.7: Do you agree with, or have any comments on, our proposals to make a separate adjustment for tax?

No comments.

Question 3.8: Do you agree with, or have any comments on, our proposal to continue to refer to the post-2020 asset base as RCV?

We consider that it is very important that the post-2020 continues to be referred to as RCV. It would be even better and avoid confusion if the asset base was defined in largely the same way as the current RCV even if it has a lower level of protection.

Question 3.9: Do you have any comments on our option assessment in the annex?

We consider that some further points should be taken into consideration in the option assessment matrix

1. Our ability to meet net zero by investment in bioresources is not hampered by the price control
2. Ofwat should not treat implementation costs as trivial and management time should be reflected
3. We do not know if there has been an underestimation of issues associated with corporate recharge/ shared assets
4. The impact of the assessment of baseline/ data that is not yet mature on the treatment of risk

QS.1: Do you have any comments on the type of data used for the example model results? Whist recognising the proposed refinements to establishing standardised depreciation in annex 6, do you have further comments on whether RCV and RCV run-off would provide an acceptable and/or more appropriate input to our econometric cost benchmarking models over the 2020 to 2025 period?

We consider that using RCV ad RCV run-off would be preferable and reduce complexity without any material adverse impact on the development of the bioresources market. At the very least RCV and RCV run-off should be tested through the econometric modelling.

QS.2: Do you have any comments on the econometric models and results? How could our models be improved? For example, should we consider alternative specifications or cost drivers?

Overall, we believe that more work is required to evaluate the options and obtain a higher level of confidence in the econometric models. In particular, the Option 3 models need further development. We will describe the current models presented in the supplementary document for Bioresources by the three different options proposed, so the comments to each of them are easily tracked. The aim is to provide some information or views to be considered in the modelling improvement process.

Option 1

Table 1, replicates the econometric outputs presented for Option 1 using the Bioresources PR19 econometric models only. The first two columns are the PR19 models using the sample period 2011-12 to 2020-21) without any adjustment, whereas the last two (BR1_O1, and BR2_O2) are the same specification with the back-casting data adjustment in the dependent cost variable. We have added for each model the standard diagnostics used by Ofwat (see table below RESET_P_value and R2_Overall) and also some other indicative tests and information about the models that could be useful to understand performances across different model specifications[1].

Table 1

Static Panel-Data Models: Bioresources Econometric Models (Sample: 2011-12 to 2020-21)

	BR1_PR19 b/se	BR2_PR19 b/se	BR1_O1 b/se	BR2_O1 b/se
Ln(Sludge)	1.392***	1.407***	1.242***	1.271***
	(0.214)	(0.327)	(0.091)	(0.233)
Ln(WDensity)	-0.372**		-0.218**	
	(0.155)		(0.102)	
Prp_Load_Bands1_3	0.071**		0.073***	
	(0.031)		(0.015)	
Ln(SWT_per_prpty)		0.520**		0.429**
		(0.261)		(0.189)
constant	-0.469	1.310*	-0.685	1.393*
	(0.901)	(0.711)	(0.649)	(0.720)
R2_Overall	0.770	0.732	0.854	0.823
Wald_Chi2	173.494	98.438	246.671	66.107
RESET_P_value	0.67	0.26	0.44	0.18
BPagan_Test_P_value	0.00	0.00	0.02	0.00
Serial_Corr_P_Value	0.10	0.12	0.02	0.03
StdDev_Ind_Effect	0.18	0.23	0.11	0.17
StdDev_Idiosy_error	0.30	0.30	0.21	0.21
Corr_comp_error	0.26	0.37	0.22	0.38
N_Sample_Size	10.00	10.00	10.00	10.00
T_Sample_Size	10.00	10.00	10.00	10.00
Observations	100.00	100.00	100.00	100.00

Source: Economic Regulation, Thames Water.
* p<0.10, ** p<0.05, *** p<0.01

These totex models at the levels[2] suggest an improvement on the R^2 when adding the allocation or back-casting historical adjustments. Regarding the catch-up efficiency challenge calculation,

[1] We provide in these tables some extra information about the models such as the Breauch-Pagan Test (POLS v RE; BPagan_Test_P_value), a serial correlation p-value (Ho: no serial correlation of the idiosyncratic error term e; Serial_Corr_P_Value) and the Standard Deviation of the Individual or unobserved heterogeneity effect (u) (StdDev_Ind_Effect) and similarly for the idiosyncratic term (StdDev_Idiosy_error). Lastly, we also report the interclass correlation of the composite error term (v=u+e) for different periods of time (Corr_comp_error). This is a useful indicator as it tell us the relative importance of the unobserved heterogeneity effect (u) in each model.

[2] i.e without averaging or normalisation to unit costs.

we think that Wastewater Treatment and Bioresources Sludge Treatment production processes are highly inter-connected, and its efficiency production process should be assessed as a joint process. Any attempt to disentangle it into a set of two bioresources models only is challenging. Within Bioresources, Sludge Treatment has the higher proportion of costs among all Bioresources activities (transport and disposal), so establishing a separate efficiency challenge is tricky. However, it seems that the back-casting adjustment (e.g., sludge liquor, energy generation, and overheads) is helping to mitigate this effect by the increase in the R^2 which might be an indication of a better allocation of costs. However, the R^2 should not be the only diagnostic that is used to determine this improvement in the models and therefore in the catch-up efficiency scores. Consideration should also be given to the overlapping costs between Wastewater and Sludge treatment. Potentially further costs adjustments may need to be considered in the process to get a more independent bioresources efficiency challenge. Overall, Option 1, and its estimated coefficients are sensible and within the expected signs and magnitudes. These results are more in line to the PR19 econometric assessment of costs, so the cost drivers are expected to fit to the models that were proposed to determine AMP8 cost allowances.

The cost drivers used so far and the results (e.g., magnitude and sign of coefficients) might not reflect the new definitions of the new dependent variables in the same direction the more we change the definition on the dependent variable we are trying to model, in particular Option 3, where a new type of costs are brought in the definition (e.g., financing costs). This could imply that cost drivers related to financing costs should be included in the model, otherwise this could bring endogeneity issues affecting the performance of the models, or in other words, the models will not perform as expected.

The introduction of the back-casting adjustments does not represent a major challenge to the PR19 models and cost drivers, on the contrary this allocation adjustment seems to provide a more accurate cost allocation (e.g., higher R^2 with respect to the PR19 models). This is reflected on the 84% of the variation of bioresources totex that can be explained when the allocation costs adjustment is included versus the 75% without the back-casting adjustment.

Option 2

Table 2 shows the models presented in Option 2 in the supplementary bioresources document, which define the dependent variable as the sum of base, all enhancement costs[3] and the back-casting adjustment. Table 2 illustrates the unit price (UP; BR1_O2 and BR2_O2) and the level cost econometric models (BR1_O2_L and BR2_O2_L). In the UP, model BR2_O2, the cost driver sludge is not statistically significant and SWT per property shows a low level of significance, making this model not very attractive to assess robustly these costs.

[3] Excluding enhancement quality.

Table 2

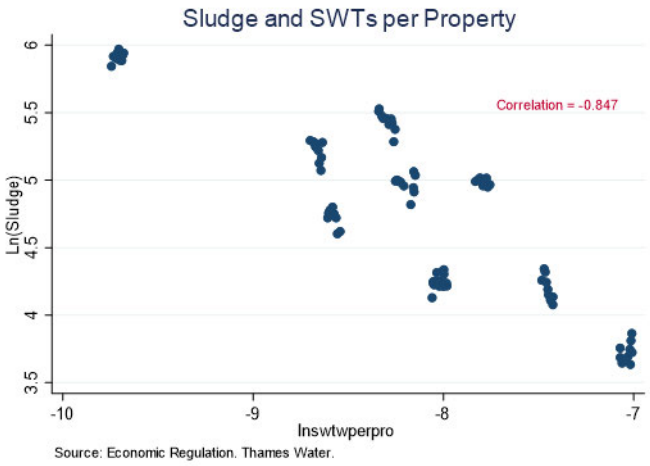
Option 2: Static Panel-Data Models(Unit Price and Level): Bioresources Econometric Models (Sample: 2011-12 to 2020-21)

	BR1_O2 b/se	BR2_O2 b/se	BR1_O2_L b/se	BR2_O2_L b/se
Ln(Sludge)	0.332**	0.335	1.332***	1.335***
	(0.136)	(0.276)	(0.136)	(0.276)
Ln(WDensity)	-0.227**		-0.227**	
	(0.107)		(0.107)	
Prp_Load_Bands1_3	0.070***		0.070***	
	(0.019)		(0.019)	
Ln(SWT_per_prpty)		0.405*		0.405*
		(0.213)		(0.213)
constant	-0.958	0.978	-0.958	0.978
	(0.749)	(0.774)	(0.749)	(0.774)
R2_Overall	0.292	0.140	0.845	0.811
Wald_Chi2	39.265	5.040	124.631	56.739
RESET_P_value	0.44	0.44	0.07	0.10
BPagan_Test_P_value	0.01	0.00	0.01	0.00
Serial_Corr_P_Value	0.01	0.01	0.01	0.01
StdDev_Ind_Effect	0.14	0.20	0.14	0.20
StdDev_Idiosy_error	0.23	0.24	0.23	0.24
Corr_comp_error	0.26	0.40	0.26	0.40
N_Sample_Size	10.00	10.00	10.00	10.00
T_Sample_Size	10.00	10.00	10.00	10.00
Observations	100.00	100.00	100.00	100.00

Source: Economic Regulation, Thames Water.
* p<0.10, ** p<0.05, *** p<0.01

As mentioned in the supplementary paper for bioresources, we also noticed that there is a high correlation between *Sludge Produced and Sewage Treatment Works per property* as depicted in Figure 1 below (these two drivers are the only cost drivers in model BR2_O2). The negative correlation of -0.847 between these two drivers suggest that companies with the higher level of sludge tend to have fewer STWs per property. In other words, companies with large SWTs tend to exploit economies of scale. This STWs per property could be read as a measure of Sewage Treatment Works Density. In a model with *population density* and *STWs per property* these two drivers might be capturing similar effects. For example, it could be expected that the more population density a company face, the fewer STWs per property are needed in order to exploit economies of density.

Figure 1



With these levels of high correlation among regressors it is worth remembering the impact on the econometric models that these correlations could have on: *i)* coefficients with possible the "wrong" sign or implausible magnitudes or *ii)* coefficients might have high standard errors and low significance levels in addition to a high R^2, or *iii)* small changes in the data could produce wide

swings in the estimations[4]. We think that it is important to keep this in mind when looking at the models presented so far in the supplementary paper.

Turning now into an isolated relationship with the dependent variable, it is hard to see a significant correlation with Average Cost/Unit Price/£ per Sludge and the Total Sludge Produced as suggested in Figure 2. The within variation of sludge produced for each company is relatively low across time, with only marginal changes, whereas the between and within variation of companies' unit price is high.

Figure 2

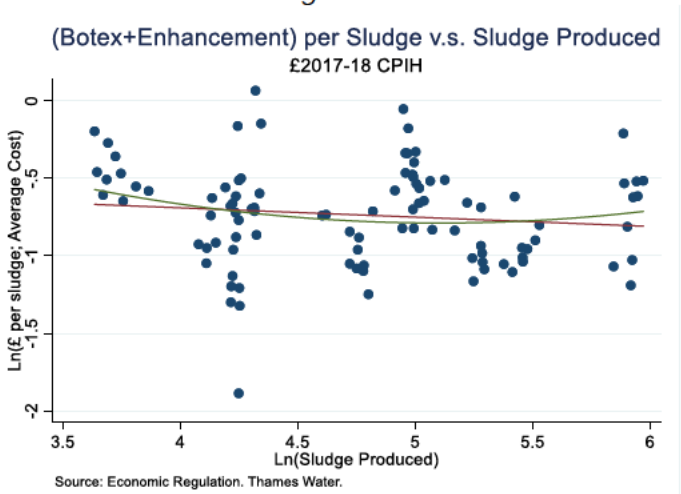
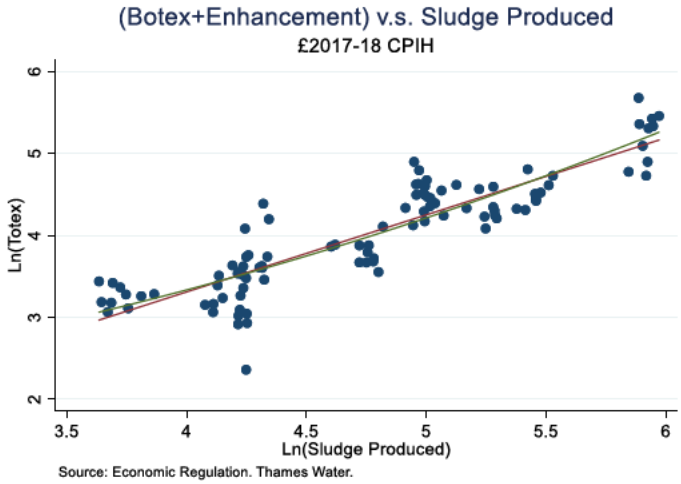


Figure 2 does not suggest a strong relationship, making this driver potentially less relevant or problematic when estimating the UP models in a more extended version of the model, or that it might require a non-linear relationship which might bring other issues (e.g., degrees of freedom). The chart also suggests some potential significant outliers in the sample. Moreover, the estimated line of best fit for the average cost, plotted against volume of sludge produced, suggests a plain or flat-line, indicating that regardless of the volume treated through a range of technological processes, the average price seems to be broadly the same across the industry.
A different perspective is found when the depicted relationship is at the levels as Figure 3 illustrates. This relationship is reflected in models BR1_O2_L and BR2_O2_L in Table 2. Figure 3 suggests the level model approach of cost versus sludge produced should not be ruled out.

Figure 3

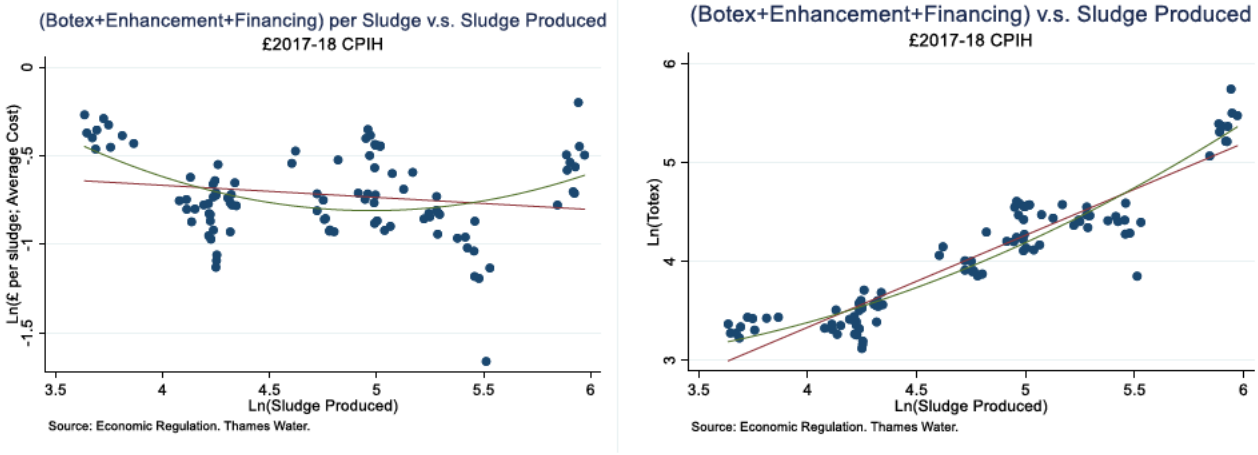


[4] See Econometric Analysis, Greene (2008), p. 59.

Option 3

The last option presented in the paper, extends the previous definition of the dependent variable used in Option 2 to include financing costs. Figure 4 depicts the relationship with the UP and Level model options. The UP version could suggest a potential non-linear relationship with sludge produced when compared to the one presented in Figure 2. Using the levels seems to be similar to Figure 3.

Figure 4



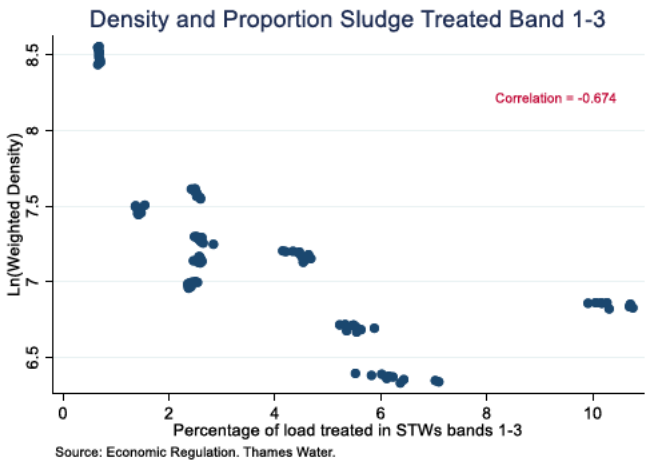
Moreover, we have also noted a high degree of correlation among the drivers used in the econometric models presented for Option 3, Table A5.2, as it is suggested in the correlation matrix below:

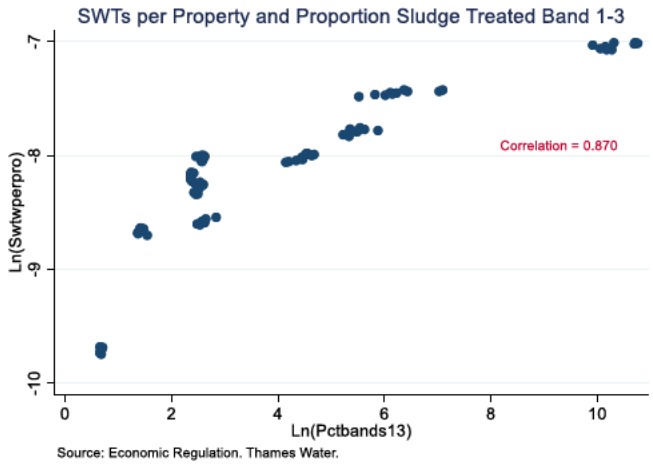
Table 3

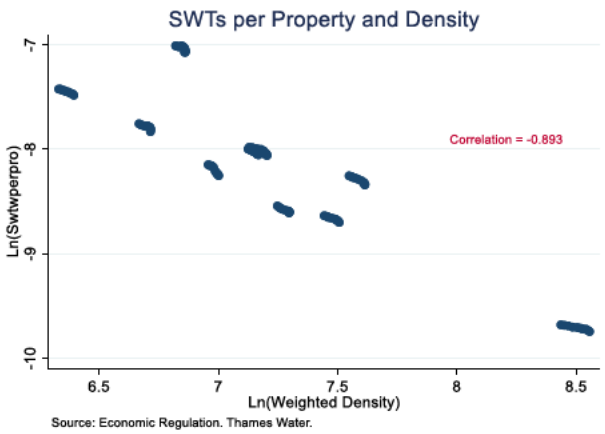
	lnslud~d	lnwede~r	lnswtw~o	pctba~13
lnsludgeprod	1.0000			
lnwedensit~r	0.7420	1.0000		
lnswtwperpro	-0.8473	-0.8939	1.0000	
pctbands13	-0.7713	-0.6747	0.8701	1.0000

These correlations need to be considered carefully, to avoid the potential issues we highlighted previously when dealing with high levels of correlation among regressors, and in particular, when the sample size (N=companies) is quite small. Figure 5 illustrates these correlations for some of the cost drivers of the bioresources models. The illustrations show low levels of within variation for companies, something that could restrict the leverage in the estimation procedures. Sometimes it could look like a sample of 10 observations in some cases.

Figure 5







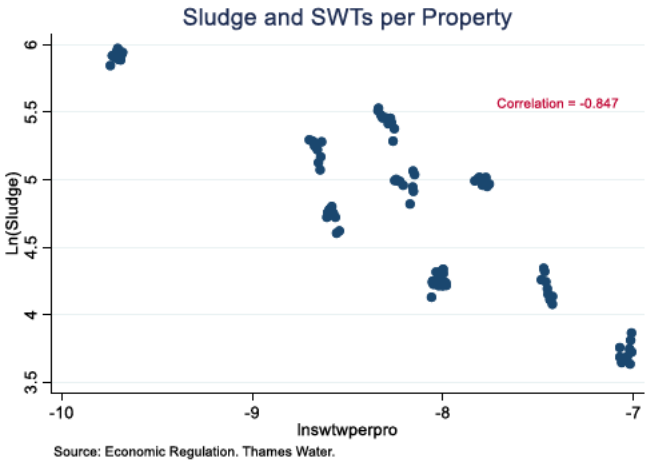


Table 4 shows the econometric models presented for Option 3 in the supplementary paper. Columns BR_UP1_O3 and BR_L1_O3 in Table 4 are the models presented in the paper in Table A5.2 using a sample of 50 observations, whereas the other two columns in Table 4 are the same models but with a sample of 100 observations. Similar issues are presented in these models in the expected sign of some cost drivers and the level of significance. In addition, there is a potential miscalculation in the RESET test.

Table 4

Option 3: Static Panel-Data Models(Unit Price and Level):(Samples: Obs = 50 and Obs = 100)

	BR_UP1_O3 b/se	BR_UP2_O3 b/se	BR_L1_O3 b/se	BR_L2_O3 b/se
Ln(Sludge)	-0.032	-0.115	0.968***	0.885***
	(0.146)	(0.195)	(0.146)	(0.195)
Ln(WDensity)	-0.373*	-0.180	-0.373*	-0.180
	(0.199)	(0.249)	(0.199)	(0.249)
Prp_Load_Bands1_3	0.140***	0.073*	0.140***	0.073*
	(0.031)	(0.041)	(0.031)	(0.041)
Ln(SWT_per_prpty)	-0.655**	-0.371	-0.655**	-0.371
	(0.274)	(0.309)	(0.274)	(0.309)
constant	-3.818***	-2.196**	-3.818***	-2.196**
	(0.829)	(1.109)	(0.829)	(1.109)
R2_Overall	0.636	0.380	0.939	0.917
Wald_Chi2	40.498	5.844	322.027	81.520
RESET_P_value	0.041	0.000	0.002	0.001
BPagan_Test_P_value	0.006	0.000	0.006	0.000
Serial_Corr_P_Value	0.465	0.465	0.465	0.465
StdDev_Ind_Effect	0.126	0.139	0.126	0.139
StdDev_Idiosy_error	0.110	0.118	0.110	0.118
Corr_comp_error	0.569	0.579	0.569	0.579
N_Sample_Size	10.000	10.000	10.000	10.000
T_Sample_Size	5.000	10.000	5.000	10.000
Observations	50.000	100.000	50.000	100.000

Source: Economic Regulation, Thames Water. Note: UP=Unit Price Model, L =Level Model.
* p<0.10, ** p<0.05, *** p<0.01

We noticed for models in Option 3 in Table A5.2 that the RESET p-values presented (0.133 and 0.699) are not the same as the ones we calculated and present in Table 4 using Ofwat's Stata code (0.041 and 0.000). This could suggest that the models are still mis-specified. To corroborate this, we make use of the Stata research community command "**resetxt**" that implements the RESET test for panel data models.

Table 5

```
==========================================================================
* GLS Random-Effects Panel Data Regression
==========================================================================
  lnrealbotexbrdfc19 = lnsludgeprod + lnwedensitywastewater + pctbands13 + lnswtwperpro
--------------------------------------------------------------------------
 Sample Size        =          50   |   Cross Sections Number   =          10
 Wald Test          =     12.6402   |   P-Value > Chi2(4)       =      0.0132
 F-Test             =      3.1600   |   P-Value > F(4 , 36)     =      0.0252
 R2  (R-Squared)    =      0.6216   |   Raw Moments R2          =      0.9623
 R2a (Adjusted R2)  =      0.4849   |   Raw Moments R2 Adj      =      0.9487
 Root MSE (Sigma)   =      0.1858   |   Log Likelihood Function =     21.4241
--------------------------------------------------------------------------
- R2h= 0.0646   R2h Adj=-0.2731  F-Test =    0.78 P-Value > F(4 , 36)  0.5472
- R2v= 0.5517   R2v Adj= 0.3898  F-Test =   13.85 P-Value > F(4 , 36)  0.0000
```

lnrealbotexbrdfc19	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnsludgeprod	-.0323424	.1408495	-0.23	0.820	-.3179983	.2533135
lnwedensitywastewater	-.3730315	.2289185	-1.63	0.112	-.8372996	.0912367
pctbands13	.139995	.043713	3.20	0.003	.051341	.228649
lnswtwperpro	-.6547171	.2954795	-2.22	0.033	-1.253977	-.0554568
_cons	-3.817782	1.370405	-2.79	0.008	-6.597092	-1.038473

```
==========================================================================
*** REgression Specification Error Tests (RESET) - Model= (xtre)
==========================================================================
 Ho: Model is Specified  -  Ha: Model is Misspecified
--------------------------------------------------------------------------
* Ramsey Specification ResetF Test
- Ramsey RESETF1 Test: Y= X Yh2         =  16.783  P-Value > F(1,  19) 0.0006
- Ramsey RESETF2 Test: Y= X Yh2 Yh3     =  12.780  P-Value > F(2,  18) 0.0004
- Ramsey RESETF3 Test: Y= X Yh2 Yh3 Yh4 =   9.008  P-Value > F(3,  17) 0.0009
--------------------------------------------------------------------------
* DeBenedictis-Giles Specification ResetL Test
- Debenedictis-Giles ResetL1 Test       =   0.539  P-Value > F(2, 18)  0.5924
- Debenedictis-Giles ResetL2 Test       =   1.791  P-Value > F(4, 16)  0.1800
- Debenedictis-Giles ResetL3 Test       =   1.505  P-Value > F(6, 14)  0.2471
--------------------------------------------------------------------------
* DeBenedictis-Giles Specification ResetS Test
- Debenedictis-Giles ResetS1 Test       =   1.448  P-Value > F(2, 18)  0.2611
- Debenedictis-Giles ResetS2 Test       =   2.026  P-Value > F(4, 16)  0.1390
- Debenedictis-Giles ResetS3 Test       =   1.408  P-Value > F(6, 14)  0.2789
--------------------------------------------------------------------------
- White Functional Form Test: E2= X X2  =  11.957  P-Value > Chi2(1)   0.0025
--------------------------------------------------------------------------
```

The results of this command are illustrated in Table 5 and they also suggest that the models are not well specified when using the *Ramsey Specification Reset test*. We welcome clarification on

how the current p-values presented in Table A5.2 for Option 3 of the supplementary document are obtained.

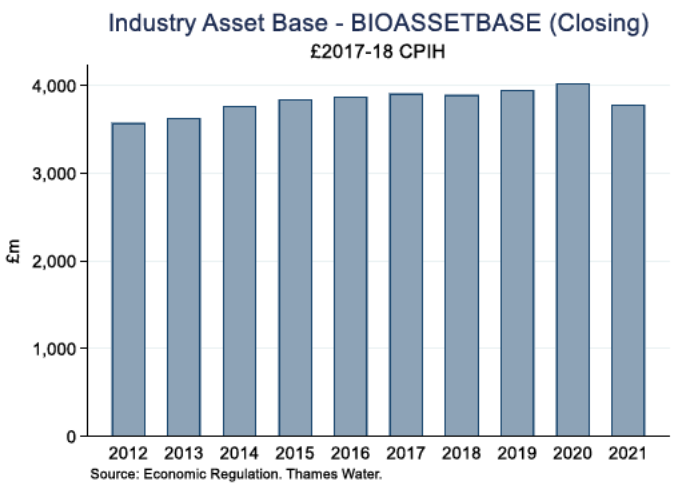
The document also publishes another set of models for Option 3 in Table A5.3 where the cost drivers used in Option 1 and 2 are assessed under the dependent variable definition of Option 3 with a sample of 100 observations. The results are not as expected, which does not provide enough confidence in these models so far. We replicate these models in Table 6. Moreover, we have extended the analysis and noticed that this is also the case when only 50 observations are used. In this way, the argument of using a sample from 2017 onwards (or 50 observations) does not provide robustness when the model is simplified with few cost drivers and smaller sample, so the data quality argument seems to be inconsistent or not robust enough as argued in the models for Option 3 presented in Table A5.2. This suggest that the results obtained in Table A5.2 of the supplementary document are not quite there for a unit price efficient calculation at this stage. We believe that there is more work to do for the models in Option 3, and that the inclusion of other drivers could help to mitigate these issues. We also believe that none of the models presented for Option 3, passed the RESET test. How they are calculated should therefore be clarified.

In theory, we understand that Option 3 assumes that companies are in equilibrium with respect to the stock of capital (e.g., asset base; MEAV) or that capital stock and other inputs of production are adjusted instantaneously to achieve a minimum cost[5]. In practical terms, this suggest that the price of capital should be included as a cost driver in the model, but due to the potential management control this has been excluded[6]. As proposed in one of the models for Option 3, if we reduce the sample from 2017 onwards, this new sample could be interpreted as a short sample, where capital stock (asset base) is more likely to be a quasi-fixed input in the sense that its modification in the short-run (e.g., a small sample period) is not feasible or is prohibitively costly (see Figure 6). If this is the case, this could be inconsistent with the definition of the dependent variable (e.g., total cost) in Option 3, hence we believe that a longer panel (10 years) is more in line with the definition of a total costs function estimation. Moreover, it could also be argued that some infrastructure projects in bioresources are built to meet different aims in the long-run (10-20 years), hence it could be assumed that companies, although they are currently investing, are not in the long-run equilibrium with respect to capital, and more when the time period covered by the panel is short (e.g., 50 observations or 5 years).

[5] Wastewater companies are price takers on inputs markets (e.g., labour, capital, energy, materials, chemicals, etc.) and its output is exogenously determined. This seems sensible as the industry is heavily regulated and companies are small players in inputs markets. Companies are also required to satisfy market demand at prices set by the regulator.

[6] We should consider the inclusion of cost drivers related to financing cost, otherwise we could face endogeneity issues such as omitted variable bias. Can a cost driver under the category of endogenous in the long-term be considered in the model? As proposed in the Draft Methodology?

Figure 6



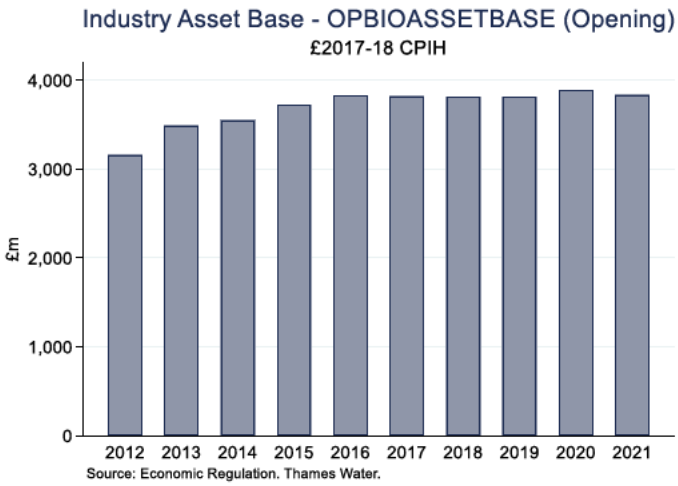


Table 6

Option 3: Static Panel-Data Models(Unit Price and Level):(Samples: Obs = 50 and Obs = 100)

	BR_UP1_O3 b/se	BR_UP2_O3 b/se	BR_L1_O3 b/se	BR_L2_O3 b/se
Ln(Sludge)	-0.159	-0.039	-0.232	-0.145
	(0.257)	(0.235)	(0.279)	(0.257)
Ln(SWT_per_prpty)	-0.005		-0.024	
	(0.208)		(0.207)	
Ln(WDensity)		0.041		0.032
		(0.139)		(0.148)
Prp_Load_Bands1_3		0.042		0.017
		(0.040)		(0.035)
constant	-0.049	-1.043	0.185	-0.326
	(0.983)	(1.365)	(0.999)	(1.243)
R2_Overall	0.062	0.280	0.032	0.092
Wald_Chi2	1.155	11.207	1.504	2.981
RESET_P_value	0.001	0.426	0.006	0.034
BPagan_Test_P_value	0.000	0.000	0.000	0.000
Serial_Corr_P_Value	0.495	0.496	0.495	0.496
StdDev_Ind_Effect	0.260	0.210	0.234	0.187
StdDev_Idiosy_error	0.116	0.109	0.122	0.119
Corr_comp_error	0.835	0.788	0.786	0.713
N_Sample_Size	10.000	10.000	10.000	10.000
T_Sample_Size	5.000	5.000	10.000	10.000
Observations	50.000	50.000	100.000	100.000

Source: Economic Regulation, Thames Water. Note: UP=Unit Price Model, L =Level Model.
* p<0.10, ** p<0.05, *** p<0.01

Conclusion

- The high degree of correlation needs to be treated carefully in the specification of the econometric model to avoid empirical issues such as swapping in the expected signs of some regressors.
- In general, we consider that other cost drivers and specifications should be explored, although given the small sample and degrees of freedom restriction, this seems challenging. Perhaps, this might require creating a set of models to mitigate the effect of relying on few models.
- A driver related to financing cost could be beneficial and should be considered. We understand the bias under management control of some potential drivers, but some driver reflecting the cost of capital is required. This driver could be in line with the Draft Methodology concept of long-term endogeneity. For example, a Capital Cost Index (CCI)[7], Construction Price Index (COPI) or equity beta. We believe that the latter is not under management control because it reflects volatility of the market, which are not in control of companies.

[7] Similarly, as the regional wage approach.

- A model that relies on a longer time panel dimension (T=10 years or more) is consistent with the total cost modelling approach, whereas reducing the sample (T=50 years) will go against this principle of Option 3.
- Overall, we believe that there is more work to do to obtain robust econometric models for Option 3.
- A CAWG to share thoughts, ideas and questions could be useful in the modelling process for Bioresources.

QS.3: Do you agree with, or have comments on, the proposed, updated approach to calculating asset values and CCA depreciation as set out in annex 6? In particular, do you:

- Agree with, or have any comments on, our proposed approach to calculating GMEAV and the alternative approach considered?

The development of the new approach to the Bioresources price control appears to be built on the premise that the Bioresources pricing is a major factor slowing the development of the market, whereas there are far bigger issues affecting the development of the market. We therefore have concerns that the process that is being developed is overly complicated for the limited benefits that are likely to accrue to customers.

GMEAV has a proper definition it seems inappropriate to devise a separate definition which is a simplified and will likely depart from true GMEAV over time. For example, it is not clear that CPIH is an appropriate proxy for the inflation of bioresource assets. In our view simply retaining RCV as the asset value would be simpler and would not materially change the charges to customers.

- Agree with, or have any comments on, our proposed approach ('gradual unwinding') and alternative approach to estimate changes in the value of the NPV adjustment?

As set out above the approach appears overly complicated for little, if any, benefit.

- Agree with, or have any comments on, our proposed approach ('bottom-up method) to recording CCA depreciation?

As set out above the approach appears overly complicated for little, if any, benefit.

- Agree with, or have any comments on, our proposed approach to the rules on asset life assumptions?

In a competitive market the value of extending the life of an asset is set against the cost of its replacement (hence the existence of MEAV). It might be economic to run the asset hard or conservatively depending on demand characteristics. Hence it is natural that the asset life will change over time.

Ofwat seem to assume on page 45, that asset life would always be extended but technological innovation in markets can also cut short the assumed asset life of the plant. The consultation itself has evidenced changes in subsidies that could have a substantial impact on the operation of certain assets such as CHP. Asset life should be seen in the context of the supply and demand conditions of a functioning market.

- Have any comments on the options to generate backcasting estimates of asset values and depreciation?"

Back-casting seems sensible methodology for testing but may have some issues:

- Investments were made with particular historical assumptions and economic conditions (low inflation, low interest rates, competing investment opportunities)
- Any fit between the model and what will happen will be linked to the policy choices used in collecting the data (hence the options available on pages 46 to 48)
- It relies on assumptions about the accuracy of historical data or the accounting policies at the time