Dear Ofwat,

Thank you for inviting our contributions of models for input to the PR24 modelling consultation. We enclose the attached set of documents in accordance with your email of 15 November.

Anglian Water's submission consists of:

Part 1: Separate Word documents for Water, Water Recycling and Bioresources setting out for all models

- Econometric model formulae
- Description of the dependent variables
- Description of the explanatory variables (including BON codes where available)
- Brief comment on the models
- The template data from the Part 2 Excel workbook
- The efficiency scores distribution from the Part 2 Excel workbook

These documents are called Part 1 Water, Part 1 Water Recycling and Part 1 Bioresources

Part 2: Excel workbook ANH 2023 cost modelling submission part 2 setting out for all models

- The template data set out in Ofwat's guidance document for this submission
- The efficiency scores distribution

Part 3: Excel workbooks setting out the calculations behind the efficiency scores reported in Part 2

- Water efficiency calculation
- Water Recycling efficiency calculation
- Bioresources efficiency calculation

Part 4: Excel workbooks setting out the data sets used to develop the models

- Water STATA dataset
- Water Recycling STATA dataset. This dataset was also used for the Bioresources model development

Part 5: STATA do files to create the models for

- Water
- Water Recycling
- Bioresources

We are also submitting the findings of work undertaken by Frontier Economics for Anglian Water on modelling Network Reinforcement growth. We say more about this work later in this letter.

We are submitting 13 models, as follows:

- Six water models – one in Water Resources Plus, three in Treated Water Distribution and two in Wholesale Water. Our focus in water modelling has been to incorporate new average pumping head data into models in place of the pumping station variable and to test alternative treatment complexity variables.
- Four wastewater models –two in Wastewater Network Plus and two in Wholesale Wastewater. Our aim in wastewater modelling has been to fill the gaps in the PR19

wastewater modelling suite. Our focus has been to test alternative WRC size variables and additional ‘tight consent’ variables. On the latter point we have found ‘Percentage load with BOD<10mg/l’ to perform consistently well but have not found a successful phosphorus consent variable. We think this is because the financial impact of operating WRCs to tight P consents is not yet sufficiently represented in the data for the modelled period. We expect to incur significant additional expenditure during AMP8 as a consequence of the P removal schemes we are implementing in the current period and will reflect on how these may be best reflected in the cost assessment process.

- Three Bioresources models. Our focus here has been to test alternatives to the small WRCs driver and to include a variable which captures differences between companies in their sludge treatment strategies.

We are not submitting any residential retail models.

We commissioned Frontier Economics to explore models of off-site growth costs. Our expectation was that the richer dataset which the industry has compiled in the last year would yield greater success than has been achieved in previous attempts. Regrettably, Frontier has not been able to develop growth models that meet the criteria for acceptable models. We are therefore not submitting any growth models for input to the consultation. We have, however, attached a summary of Frontier Economics’ work so their learning can be shared and their findings compared with any similar work conducted by others.

We have reflected on why it is proving difficult to produce acceptable growth models. Given the difficulty of back-casting, it is possible that companies have struggled to provide the data – going back to 2011/12 – to the necessary quality standards. Another potential explanation is that we need different data in the dataset. At the Cost Assessment Working Group in October 2021 we proposed a set of data that could usefully be gathered to explain differences in companies’ growth expenditure. We replicated this list in our response to the ‘Assessing base costs’ consultation in February 2022. Many of these data were not included in the subsequent growth and developer service data requests. It is too late to gather these data for PR24 but suggest that our data proposals be re-considered in preparation for PR29.

Due to time pressure, we have not completed the sensitivity analysis for Water and Water Recycling. Consequently, the relevant rows in the Part 1 Water and Part 1 Water Recycling documents are blank. We hope to have this completed shortly and will re-submit those documents at the earliest opportunity.

We look forward now to the modelling consultation. We would be happy to resume discussions about growth modelling or, indeed, any other aspect of our submission or cost modelling more generally.

Yours sincerely,

Richard Goodwin

Anglian Water Submission of econometric models for consultation: Water

12 January 2023

This document forms Part 1 - Water of Anglian Water's Base cost model consultation submission. The tabular data and the efficiency tables set out in Ofwat's template document is copied from the Water tab in the Excel workbook that makes up Part 2 of this submission into sections 5 and 6

Six Water models are presented.

One Water Resource Plus model, ANH_WRP1

Three Treated Water Distribution models, ANH_TWD1, ANH_TWD2 and ANH_TWD3

Two total Wholesale Water models, ANH_WW1 and ANH_WW2

1. Econometric model formulae for Water models

ANH_WRP1: 0.449lnSurfacewater + 0.153lnGroundwater + 0.266ln(DIxAPH_$_{WRP}$) - 2.091

ANH_TWD1: 1.077lnlengthofmain + 0.129lnAPH_$_{TWD}$ - 3.262lnWAD_LAD + 0.249lnWAD_LAD2 + 3.856

ANH_TWD2: 1.068lnDI + 0.176lnAPH_$_{TWD}$ - 2.104lnWAD_LAD + 0.143lnWAD_LAD2 + 4.390

ANH_TWD3: 0.922lnlengthofmain + 0.374lnboosterperlength + 0.151ln(DIxAPH_$_{TWD}$) – 2.698lnWAD_LAD + 0.212lnWAD_LAD2 + 3.709

ANH_WW1: 0.773lnlengthofmain + 0.294ln(DIxAPH_$_{Total}$) + 0.275lnWAC – 2.359lnWAD_LAD + 0.176lnWAD_LAD2 + 1.457

ANH_WW2: 0.292lnSurfacewater + 0.129lnGroundwater – 1.314lnWAD_LAD + 0.092lnWAD_LAD2 + 0.550ln(DIxAPH_$_{Total}$) + 0.991

2. Description of the Water dependent variables

ANH_WRP1: lnrealbotex wrp. This is as set out in Ofwat's PR24 water STATA files issued in October & November 2022

ANH_TWD1, ANH_TWD2, ANH_TWD3: lnrealbotexplustwd. This is as set out in Ofwat's PR24 water STATA files issued in October & November 2022

ANH_WW1, ANH_WW2: lnrealbotexplusww. This is as set out in Ofwat's PR24 water STATA files issued in October & November 2022

3. Description of the Water explanatory variables (including BON codes where available)

Independent variable	Description	BON code where available
lnDIxAPH_WRP	Distribution Input x APH for Water Resources Plus (sum of APH for Water Resources, Raw Water Distribution & Treatment)	ln(BN1000_CA22_A x (BN4861 + BN4862 + BN10902))
lnSurfacewater	Volume of surface water put into DI	CPMW0098 + CPMW0104 + CPMW0110 + CPMW0116 + CPMW0165 + CPMW0166 + CPMW0167
lnGroundwater	Volume of ground water put into DI	CPMW0027 + CPMW0033 + CPMW0039 + CPMW0045 + CPMW0185 + CPMW0197 + CPMW0198
lnWAC	Defined as per PR19 models	
lnWAD_LAD	Ofwat developed measure of density	ln(BN4002)
lnWAD_LAD2	Ofwat developed measure of density	(lnBN4002)^2
Lnlengthsofmain	Defined as per PR19 models	
Lnboosterperlength	Defined as per PR19 models	
lnAPH_TWD	APH for Treated Water Distribution	BN4870
lnDI	Distribution Input	BN1000_CA22_A
lnDIxAPH_TWD	Distribution Input x APH for Treated Water Distribution	ln(BN1000_CA22_A x BN4870)
lnDIxAPH_Total	Distribution Input x total APH	ln(BN1000_CA22_A x (BN4861 + BN4862 + BN10902 + BN4870))

4. Brief comment on the Water models

Criteria	ANH_WRP1	ANH_TWD1	ANH_TWD2	ANH_TWD3	ANH_WW1	ANH_WW2
Data used are good quality	Yes. All data used are taken from the assured PR24 data set					
Consistent with engineering, operational and economic rationale	Yes, ground water needs less treatment than surface water	Yes. TWD1 is a variant on the PR19 TWD model, with APH replacing Pumping stations/Length as the variable capturing topography	Yes. TWD2 is a variant on the PR19 TWD model, with APH replacing Pumping stations/Length as the variable capturing topography and DI replacing mains length as the scale variable	Yes. TWD3 is a variant on the PR19 TWD model, with APH in addition to Pumping stations/Length as the variable capturing topography	Yes. WW1 builds on TWD1, with WAC to capture treatment complexity in WRP	Yes. WW2 builds on WRP1. The disaggregation of volume into surface and ground water captures aspects of treatment complexity, so WAC is not significant and thus is dropped
Sensibly simple and transparent	Yes. 3 cost drivers using existing data set	4 cost drivers (2 of which are density measures) using existing data set	4 cost drivers (2 of which are density measures) using existing data set	4 cost drivers (2 of which are density measures) using existing data set	5 cost drivers (2 of which are density measures) using existing data set	5 cost drivers (2 of which are density measures) using existing data set
Focus on exogenous cost drivers	Yes. Variables used are exogenous					
Robust econometric cost models	Yes					
Set a stretching but achievable cost efficiency challenge	Yes. Range of TWD & Wholesale efficiencies is credible. The WRP model's range is wide.					
A coherent cost assessment approach that drives the right incentives	Yes					

5. Water template table

Model name	ANH_WRP1	ANH_TWD1	ANH_TWD2	ANH_TWD3	ANH_WW1	ANH_WW2
Dependent variables	lnrealbotex wrp	lnrealbotexplustwd	lnrealbotexplustwd	lnrealbotexplustwd	lnrealbotexplusww	lnrealbotexplusww
lnDIxAPH_WRP	0.2660315 (0.135)					
lnSurfacewater	0.44909*** (0.000)					0.2923582*** (0.000)
lnGroundwater	0.1534437** (0.013)					0.1291295** (0.017)
lnWAC					0.274656* (0.082)	
lnWAD_LAD		-3.262378*** (0.000)	-2.104108*** (0.000)	-2.697596*** (0.000)	-2.35899*** (0.000)	-1.313568*** (0.000)
lnWAD_LAD2		0.2489827*** (0.000)	0.143104*** (0.000)	0.2122983*** (0.000)	0.176278*** (0.000)	0.0918762*** (0.000)
Lnlengthsofmain		1.076603*** (0.000)		0.9222628*** (0.000)	0.773136*** (0.000)	
lnboosterperlength				0.3742224*** (0.003)		
lnAPH_TWD		0.129487* (0.095)	0.1758858** (0.019)			
lnDI			1.068333*** (0.000)			
lnDIxAPH_TWD				0.1510218** (0.026)		
lnDIxAPH_Total					0.294141*** (0.001)	0.5503744*** (0.000)
Constant	-2.090581* (0.069)	3.855575** (0.019)	4.389946** (0.020)	3.709329** (0.012)	1.456943 (0.157)	0.9905495 (0.476)
Estimation method (OLS or RE)	RE	RE	RE	RE	RE	RE

N (sample size)	187	187	187	187	187	187
Model robustness tests						
R^2 adjusted	0.87	0.957	0.963	0.963	0.971	0.946
RESET test	0.768	0.351	0.105	0.21	0.588	0.742
VIF (max)	4.937	203.349	196.151	217.492	207.52	217.547
Pooling / Chow test	0.057	0.912	0.002	0.823	0.166	0.042
Normality of model residuals	0.999	0.94	0.531	0.925	0.715	1
Heteroskedasticity of model residuals	0.002	0.442	0.002	0.883	0.004	0.002
Test of pooled OLS versus Random Effects (LM test)	0	0	0	0	0	0
Efficiency score distribution min	1.8654	1.3699	1.4326	1.3341	1.5334	1.3321
Efficiency score distribution max	0.3633	0.7552	0.8125	0.7791	0.8140	0.8256
Efficiency score range	150%	61%	62%	56%	72%	51%
Sensitivity of est. coefficients to removal of most & least efficient company						
Sensitivity of est. coefficients to removal of first & last year of the sample						

6. Water efficiency scores distribution

	Triangulated with existing models				Stand alone		
	Water Resource Plus	TWD	Wholesale		Water Resource Plus	TWD	Wholesale
ANH	0.7883	1.2755	1.0331		0.8373	1.2452	0.9583
HDD	1.0027	1.0547	1.0275		0.9760	1.0927	1.0481
NES	1.0948	1.0293	1.0726		1.1442	1.0221	1.1366
NWT	1.2617	0.9067	1.1009		1.4601	0.9122	1.2293
SRN	1.9533	1.0516	1.3418		1.8654	1.0864	1.3994
SVE	1.0569	1.0250	0.9957		1.0181	1.0292	0.9637
SWB	1.1152	0.6399	0.9323		1.0439	0.7571	0.8746
TMS	1.0727	1.1131	1.0720		1.1167	1.0651	1.0306
WSH	1.1740	1.2280	1.1772		1.3112	1.2117	1.2258
WSX	1.3531	0.9264	1.1623		1.7617	0.9807	1.1990
YKY	1.0445	1.2397	1.1120		1.0774	1.2186	1.1787
AFW	0.7988	1.1799	0.9439		0.7496	1.1435	0.9589
BRL	1.0261	1.4266	1.1263		0.8391	1.3824	1.1028
PRT	0.7094	0.8799	0.8665		0.7279	0.8920	0.9880
SES	1.6441	0.9568	1.2495		1.5226	1.0285	1.1285
SEW	1.0777	1.1718	1.0845		1.3543	1.1241	1.1066
SSC	0.4521	1.0537	0.7741		0.3633	1.1039	0.6925

Anglian Water Submission of econometric models for consultation: Water Recycling

12 January 2023

This document forms Part 1 - Water Recycling of Anglian Water's Base cost model consultation submission. The tabular data and the efficiency tables set out in Ofwat's template document is copied from the Water tab in the Excel workbook that makes up Part 2 of this submission into sections 5 and 6

Four Water Recycling models are presented.

Two Water Recycling Network Plus models, ANH_WWWNP1 and ANH_WWWNP2

Two Water Recycling Wholesale (that is, Network Plus and Bioresources together) models, ANH_WWW1 and ANH_WWW2

1. Econometric model formulae for Water Recycling models

ANH_WWWNP1: 0.300lnloadover125k + 0.183lnloadunder125k + 0.423lnpumpingcapperlength + 0.005pctnh3below3mg + 0.007pctBODbelow10mg - 0.664

ANH_WWWNP2: 0.225lnindigenousvolume + 0.228lnindigenousvolume +0.371lnpumpingcapperlength + 0.005pctnh3below3mg + 0.019pctBODbelow10mg - 0.651

ANH_WWW1: 0.228lnvolume + 0.212lntrade_effluent + 0.547lnpumpingcapperlength + 0.006pctnh3below3mg + 0.016pctBODbelow10mg – 0.934lnWAD_LAD + 0.060lnWAD_LAD2 + 3.705

ANH_WWW2: 0.266lnloadover125k + 0.278lnloadunder125k + 0.305lnpumpingcapperlength + 0.005pctnh3below3mg + 0.008pctBODbelow10mg - 1.138

2. Description of the Water Recycling dependent variables

ANH_WWWNP1, ANH_WWWNP2	lnrealbotexplusnpww This is as set out in Ofwat's PR24 water STATA files issued in October & November 2022
ANH_WWW1, ANH_WWW2:	lnrealbotexpluswww This is as set out in Ofwat's PR24 water STATA files issued in October & November 2022

3. Description of the Water Recycling explanatory variables (including BON codes where available)

Independent variable	Description	BON code where available
lnpumpingcapperlength	Defined as per PR19 models	
pctnh3below3mg	Defined as per PR19 models	
pctBODbelow10mg	Tight (below 10mg) BOD consent. Analogous to the tight ammonia consent variable. This is expressed in the same way as Ofwat's pct suffixed variables, as a figure from 0 – 100 representing the percentage	((STWDB121_21 + STWDB122_21)/STWD128) x100
lnWAD_LAD	Ofwat developed measure of density	ln(BN4008)
lnWAD_LAD sq	Ofwat developed measure of density	(lnBN4008)^2
lnloadover125k	Load treated at Water Recycling Centres handling over 125,000 p.e.	Variables were developed based on analysis of large works data submitted in APRs and in PR14 and PR19 data submissions. The additional variables were given the codes WRCB7, WRCB8, WRCB9, WRCB10 in Anglian Water 2023 cost modelling submission part 4 Water Recycling STATA dataset, columns ZH – ZK respectively. WRCB7 covers 125-250k p.e works.; WRCB8 covers 250-500k p.e. works; WRCB9 covers 500k – 1m p.e. works; WRCB10 covers works > 1m p.e.
lnloadunder125k	Load treated at Water Recycling Centres handling under 125,000 p.e. The break point of 125k was chosen pragmatically to allow for South West Water's largest WRC being below 250k p.e	
Lnvolume	Volume treated at Water Recycling Centres from sewers	ln(CPMS2015)
lntrade_effluent	Volume of trade effluent treated	ln(CPMS2012)
Lnindigenousvolume	Volume treated at sites co-located with sludge treatment centres	ln(CPMS2015 x MP05615)
lnnonindigenousvolume	Volume not treated at sites co-located with sludge treatment centres (and consequently transported to a sludge treatment centre)	ln(CPMS2015 x (1 - MP05615))

4. **Brief comment on the Water Recycling models**

Criteria	ANH_WWWNP1	ANH_WWWNP2	ANH_WWW1	ANH_WWW2
Data used are good quality	Yes. All data used are taken from the assured PR24 data set with the exception of: i) load>125k and load<125k. These variables were derived using the large works data submitted in APRs and in PR14 & PR19 data submissions; & ii) Updating UU's indigenous share data with corrected data			
Consistent with engineering, operational and economic rationale	Yes. Splitting load by size bands (above and below 125k) captures both density and treatment types as both factors are fundamentally driven by demographics	Yes. Splitting volume by whether sludge is treated at co-located sites captures as this factor is fundamentally driven by demographics. Compare to WWW1	WWW1 is a variant on NP2 but with total volume. In this case density is significant as a separate pair of variables	Yes. Splitting load by size bands (above and below 125k) captures both density and treatment types as both factors are fundamentally driven by demographics
Sensibly simple and transparent	Yes: 5 exogenous drivers using existing data set, augmented with assured large works data	Yes: 5 exogenous drivers using existing data set	Yes: 7 exogenous drivers using existing data set, 2 of which are density drivers	Yes: 5 exogenous drivers using existing data set, augmented with assured large works data
Focus on exogenous cost drivers	Yes variables used are exogenous			
Robust econometric cost models	Yes			
Set a stretching but achievable cost efficiency challenge	Yes. Efficiency score ranges are credible			
A coherent cost assessment approach that drives the right incentives	Yes			

5. Water Recycling Template table

Model name	ANH_WWWNP1	ANH_WWWNP2	ANH_WWW1	ANH_WWW2
Dependent variables	lnrealbotexplusnpww	Lnrealbotexplusnpww	Lnrealbotexplus www	Lnrealbotexplus www
Lnpumpingcapperlength	0.4230736*** (0.000)	0.371149*** (0.000)	0.5472604*** (0.000)	0.3046795*** (0.000)
pctnh3below3mg	0.0052551*** (0.000)	0.0054838*** (0.000)	0.0060024*** (0.000)	0.0049684*** (0.000)
pctBODbelow10mg	0.0073813*** (0.004)	0.0184713*** (0.000)	0.0162029*** (0.000)	0.0080261** (0.020)
lnWAD_LAD			-0.9339482* (0.098)	
lnWAD_LAD sq			0.0598094 (0.133)	
lnloadover125k	0.3003*** (0.000)			0.2660674*** (0.000)
lnloadunder125k	0.1831171** (0.036)			0.2779953*** (0.009)
Lnvolume			0.2282193*** (0.003)	
lntrade_effluent			0.212318*** (0.000)	
Lnindigenousvolume		0.2246538*** (0.002)		
Lnnonindigenousvolume		0.228041*** (0.000)		
Constant	-0.6641599 (0.514)	-0.6509867 (0.413)	3.704755 (0.108)	-1.138079 (0.352)
Estimation method (OLS or RE)	RE	RE	RE	RE
N (sample size)	110	110	110	110
Model robustness tests				
R2 adjusted	0.934	0.935	0.962	0.948
RESET test	0.609	0.162	0.099	0.868
VIF (max)	6.311	7.81	838.211	6.311
Pooling / Chow test	0.264	0.045	0.61	0.26
Normality of model residuals	0.998	0.817	0.884	0.987
Heteroskedasticity of model residuals	0.582	0.355	0.082	0.26
Test of pooled OLS versus Random Effects (LM test)	0	0.017	0.4	0
Efficiency score distribution min	1.09120	1.13004	1.10404	1.12533
Efficiency score distribution max	0.88412	0.86054	0.89948	0.90520
Efficiency score range	21%	27%	20%	22%
Sensitivity of estimated coefficients to removal of most and least efficient company				
Sensitivity of estimated coefficients to removal of first and last year of the sample				

6. Water Recycling efficiency scores distribution

	Network + Triangulated	Network + models	Wholesale models
ANH	1.0250	1.1050	1.0710
NES	0.9513	0.9043	0.8783
NWT	1.0877	1.0318	0.9704
SRN	1.1359	1.0403	1.0361
SVH	0.9732	0.9817	1.0031
SWB	0.9767	0.9614	0.9988
TMS	0.9384	0.9884	0.9994
WSH	1.0423	1.0211	1.0602
WSX	0.9238	0.9786	1.0252
YKY	1.0697	1.0358	1.0683

Anglian Water Submission of econometric models for consultation: Water Recycling

12 January 2023

This document forms Part 1 - Bioresources of Anglian Water's Base cost model consultation submission. The tabular data and the efficiency tables set out in Ofwat's template document is copied from the Water tab in the Excel workbook that makes up Part 2 of this submission into sections 5 and 6

Three Bioresources models are presented. These are named ANH_Bio1, ANH_Bio2 and ANH_Bio3.

1. Econometric model formulae for Bioresources models

ANH_Bio1: 0.180lnNonindigenous_sludge – 0.363lnIndigenoussludge + 0.077pctbands13 – 1.636

ANH_Bio2: 0.160lnNonindigenous_sludge – 0.104lnIndigenoussludge + 0.187lnstwperpro + 0.550

ANH_Bio3: 0.197lnNonindigenous_sludge – 0.197lnIndigenoussludge – 0.007pctADAAD – 0.152

2. Description of the Bioresources dependent variable

Lnrealbotexbr This is as set out in Ofwat's PR24 water STATA files issued in October & November 2022. It is the log of Bioresources botex unit cost, using sludge treated as the normalising factor.

3. Description of the Bioresources explanatory variables (including BON codes where available)

Independent variable	Description	BON code where available
pctbands13	Defined as per PR19 models	
Lnswtwperpro	Defined as per PR19 models	
lnIndigenous_sludge	Sludge treated at co-located sites	ln(MP05611 x MP05615)
lnNonindigenous_sludge	Sludge non treated at co-located sites	ln(MP05611 x (1 - MP05615))
pct_ADAAD	Percent of sludge treated by conventional & advanced anaerobic digestion. This is expressed in the same way as Ofwat's pct suffixed variables, as a figure from 0 – 100 representing the percentage	(BN5613INC +BN5614INC) x 100

4. Brief comment on the Bioresources models

Criteria	ANH_Bio1	ANH_Bio2	ANH_Bio3
Data used are good quality	Yes. All data used are taken from the assured PR24 data set		
Consistent with engineering, operational and economic rationale	Yes		
Sensibly simple and transparent	``Yes: 3 exogenous drivers using existing data set		
Focus on exogenous cost drivers	Yes. Indigenous share is determined by WRC size and by the minimum economic size of AAD plants. WRC size is determined by demographics. Both demographics and the economic parameters of AAD are outside the control of management		
Robust econometric cost models	Moving from total cost to unit cost for Bioresources sends the Sludge variable insignificant in the Ofwat PR19 models. What this says is that the unit cost of sludge is not driven by the volume of sludge treated per se, it is driven by how		

	and where (at what scale of plant) it is treated. Bio3 demonstrates that splitting sludges into indigenous and non-indigenous volumes captures the demographic and economy of scale factors neatly. Bio1 and Bio2 are variants of Ofwat's original PR19 Bioresources models but with sludge split also into indigenous and non-indigenous volumes. While the coefficients are not significant in Bio1 and Bio2, they have the correct signs and look sensible in scale. UC models display poorer R2 than total cost models.
Set a stretching but achievable cost efficiency challenge	All three models have sensible looking efficiency ranges and show credible looking UQ challenges
A coherent cost assessment approach that drives the right incentives	Yes

5. **Bioresources Template table**

Model name	ANH_Bio1	ANH_Bio2	ANH_Bio3
Dependent variables	lnrealbotexbr	lnrealbotexbr	lnrealbotexbr
pctbands13	0.0765969*** (0.003)		
Lnswtwperpro		0.1872608 (0.255)	
lnIndigenous_sludge	-0.0363419 (0.676)	-0.1041564* (0.346)	-0.1969785*** (0.000)
lnNonindigenous_sludge	0.179608 (0.161)	0.1603053 (0.227)	0.1973151** (0.050)
pct_ADAAD			-0.0071601*** (0.001)
Constant	-1.636062** (0.020)	0.549779 (0.623)	-0.1519966 (0.634)
Estimation method (OLS or RE)	RE	RE	RE
N (sample size)	110	110	110
Model robustness tests			
R2 adjusted	0.261	0.107	0.229
RESET test	0.311	0	0.501
VIF (max)	2.61	3.401	1.388
Pooling / Chow test	0.991	0.999	0.983
Normality of model residuals	0.155	0.006	0.058
Heteroskedasticity of model residuals	0.129	0.461	0.261
Test of pooled OLS versus Random Effects (LM test)	0.01	0.002	0
Efficiency score distribution min	1.53348	1.43268	1.55660
Efficiency score distribution max	0.70022	0.59547	0.66583
Efficiency score range	83%	84%	89%
Sensitivity of estimated coefficients to removal of most and least efficient co	Good	Good	Good
Sensitivity of estimated coefficients to removal of first and last year of the sample	Good	Good	Good

6. Bioresources efficiency scores distribution

	Bioresources based on UC models
ANH	1.0234
NES	0.6578
NWT	0.7144
SRN	0.9798
SVH	1.0110
SWB	1.0344
TMS	1.2888
WSH	1.4086
WSX	1.0278
YKY	1.5056