South Staffordshire Water

PCC Modelling Review

09/08/2024

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Summary

Summary of our assessment

There are many areas of the approach that could be challenged (at least **20 areas**), with the primary area being that the model is predicated only PCC and not all essential demand and regional components being considered (this potentially exhibits a lack of understanding of the complexities of supply/demand modelling).

- There are also a number potential challenges that could be made to the econometric approach taken, namely the limited source data (incomplete data from just eight of the companies) and reliance on national scale modelling (not sufficiently taking into account regional factors). The detailed mechanics of the modelling are not fully explained (if not a 'black box' it is certainly a 'very grey box') and the statistics reveal uncertainty in the correlation of certain variables.
- In addition, the assessment is partly based on assessing the impacts of metering programmes and water efficiency visits, which in our opinion overstates the potential impacts of these interventions and in part uses tenuous qualitative assessments.
- The concept of 'miss attributable to COVID' is potentially flawed based on the lack of granular data resolution used in these models. It also seems to disadvantage companies in close proximity to large conurbations, in particular SST and those companies in the orbit of London.

Overview of potential challenges with the current model (Part 1)

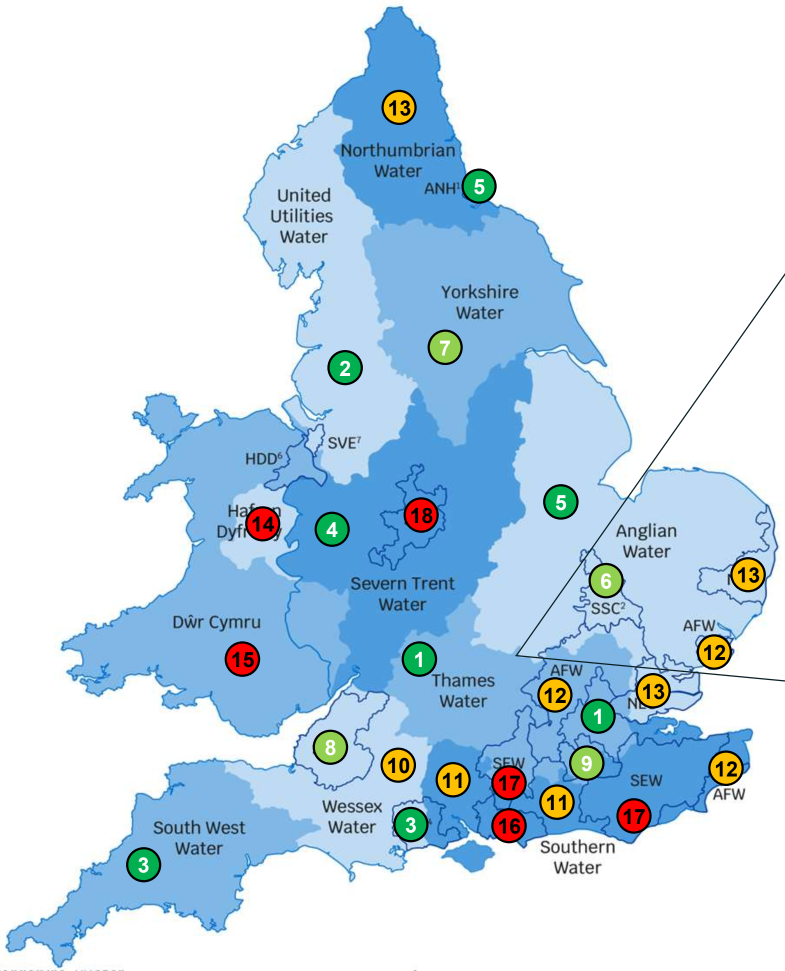
1. Fundamentally the model only uses PCC and not all other demand components.
2. The overall averaging is impacted by SWB which is a significant negative and skews some of the key statistics (although is removed in the final assessment).
3. Three-year averaging is referenced in the analysis and should not be used at all as it is not relevant to assessing the impact of COVID-19 (only annual average is applicable).
4. Based on table 1.4 in the EE report the model ignores exogenous impacts for SST.
5. Sections 2 outlines the key effects modelled:
   - Effects upon total water consumption across England and Wales
   - Effects upon the breakdown between household and non-household consumption across England and Wales
   - Effects upon the relative demand of different water companies across England and Wales
   - **This suggests the model ignores changes in day-to-day customer behaviour ?**
6. The source demand data set out Section 2.1 indicates that incomplete monthly demand data was used from only 8 of the 18 companies. It could be argued that this represent insufficient coverage for the basis of assessing all the companies and that the data used was not sufficiently granular.
7. Water efficiency measures - the EE analysis implies this has a significant impact on PCC when in reality it is limited. EE also used a set of qualitative criteria to RAG each company which is not clearly defined.
8. EE are generally unable to quantify any components of change in demand such as sanitary and recreational drivers during the pandemic (in most cases the assessment is inconclusive – which is likely a function of not having sufficiently granular data).
9. ***'A further effect upon total water consumption arises where water-using businesses are either shut down or their output is curtailed. Because our focus in this report is on PCC we do not explore this effect further'*** – this is an example of some of the flaws in the modelling and failure to understand the impacts on the overall water balance.
10. '***The literature also suggests that this hybrid working model is expected to stay in the picture for the near future. It is worth noting that there is a lack of data for the United Kingdom, with most insights coming from the United States***' **–** some of these assumptions have been used in the modelling and are potentially inappropriate to use for the UK.
11. Assumptions for OPN, Schools etc are only viewed at a national and not a regional level – example of highly generalised assumptions used in the modelling. Overall, there is limited modelling or analysis undertaken to understand regional impacts.
12. Additionally, the analysis does not breakdown to WRZ level for companies with disparate geographies, which is probably the most salient example of the lack of 'regionalisation in the model.

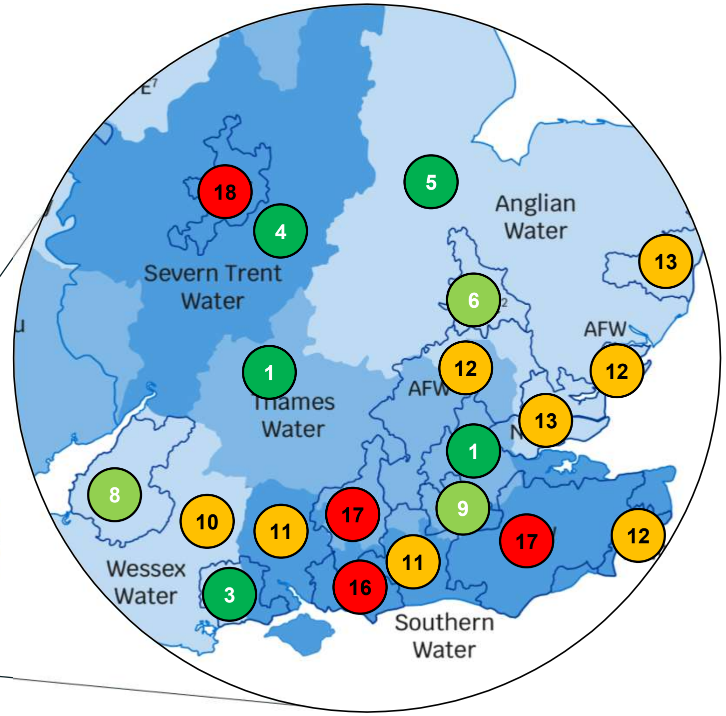
Overview of potential challenges with the current model (Part 2)

13. Home working assumptions are based on proportioning the % of home workers in a region to the water companies' area, this potentially presents a significant assumption with scope for error. Indeed, the report further states, ‘to convert this into an estimate of time spent at home, we assume that the homeworkers in the ONS data spend 80 per cent of their working time at home’, there is no basis given for this assumption and could underestimate home working during the 2020-2024 period.
14. The Artesia comparisons and validations made in the EE report seem superfluous as the Artesia report only deals with the first two years of the AMP period.
15. A number of the liner regression model outputs shown in the EE report appendix seem to show r2 values indicating week to moderate correlations between parameters at best. However, the report states that all coefficients are statistically significant with no further commentary to support this assertion.
16. The metering penetration coefficient implies the impact of installing a smart meter is around 29 litres per day, per meter. This is in line with other estimates of the impact of metering penetration, such as from Thames Water’s Green Recovery smart meter installation programme (33 l/meter/day) and forecasts provided by companies for the Accelerator Scheme June 2023 decision (Average of 21 l/meter/day).
17. The report also highlights an assumption of an average household size of 2.4 residents. ‘The per meter impact is calculated as follows: taking the region-varying PECC model, the metering coefficient of -7.5 implies a metering impact of 8.4 per cent (7.5 / 89.1, the constant). An 8.4 per cent reduction applied to average PCC for 2017-2022 is a reduction of 12.1 l/p/d. Multiplying by 2.4 (to get from per person to per meter) gives an impact of slightly over 29 litres/meter/day’ – in our assessment this too simplistic an assumption to accurately understand granular consumption behavioural changes at a regional level.
18. In the EE report, Figure 4.6 compares impacts in the COVID period to typical historical variations in PCC to get an idea of the magnitude of these shocks relative to the usual fluctuations one might expect in annual PCC. For this analysis, only 14 of the 18 water companies are included as there was not sufficient historical PCC data for the remaining 4 companies to be included. For each of the 14 companies, EE calculate a PCC trend for the period 2011-2019 and then calculate their average absolute deviation from that trend over the same period. By not including SST/CAM the EE conclusions from this analysis that: a) the overall Covid impact was far bigger than a typical PCC deviation; b) the residual Covid shock alone was bigger than a typical PCC deviation; and c) the metering impact of Covid was much smaller than a typical PCC shock,
19. It is not clear whether the historical PCC figures used are ‘convergence corrected’ and so are truly comparable prior to 2017/18.
20. The concept of ‘miss attributable to COVID’ is potentially flawed based on the lack of granular data resolution used in these models. It also seems to disadvantage companies in close proximity to large conurbations. For example, companies with major urban centres (UU, SVE and TMS) most of the ‘PCC overshoot is attributed to COVID. For the majority of the companies which border the ‘urban companies’ such as AFW, SEW, SRN and SSC, between ~ 40% to 60% of the ‘overshoot’ is attributed to COVID.

Map displaying % Change in PCC for Water Companies from 2017/18–2019/20 Average to 2020/21-2023/24 Average

No	Company	% Change in PCC (Pre-COVID to Post-COVID)
1	TMS	- 1.3
2	UUW	- 0.6
3	SWB	- 0.3
4	SVE	+ 0.8
5	ANH	+ 1.0
6	SSC-CAM	+ 1.4
7	YKY	+ 1.8
8	BRL	+ 2.3
9	SES	+ 2.7
10	WSX	+ 3.1
11	SRN	+ 3.1
12	AFW	+ 3.2
13	NES	+ 4.5
14	HDD	+ 5.2
15	WSH	+ 5.2
16	PRT	+ 6.7
17	SEW	+ 7.3
18	SSC-SST	+ 12.8
Average % Change		+ 3.3

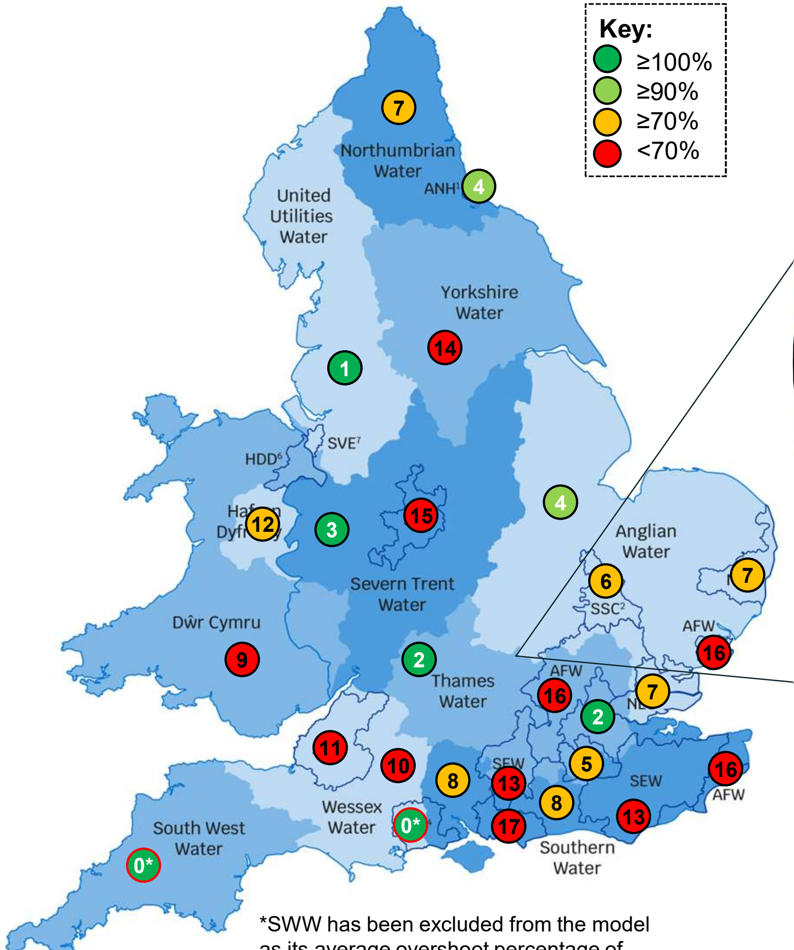


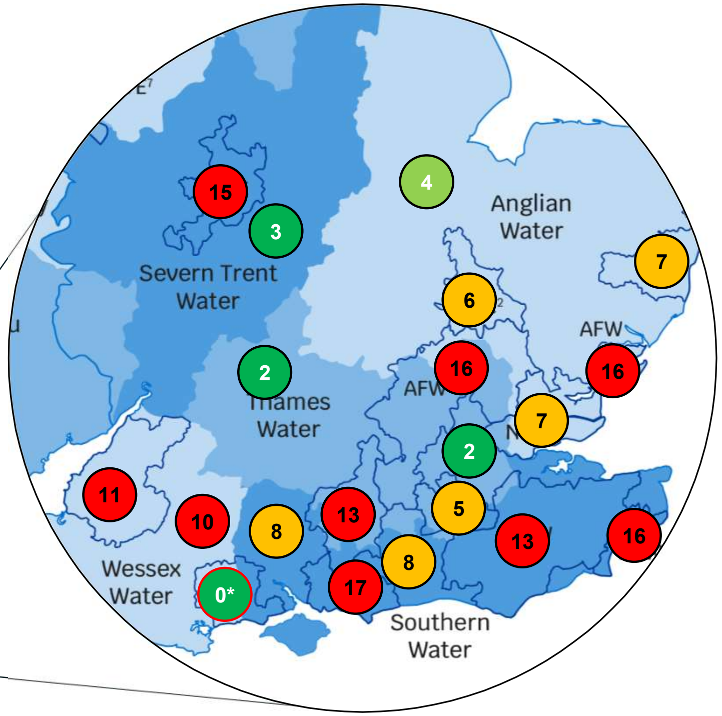


Geographical plotting reveals that the average increase in PCC is lower in areas dominated by large cities compared to the surrounding regions.

Map Displaying Average Proportion of overshoot attributable to Covid (%) in PCC for Water Companies (2020/21 – 2022/23)

No	Company	Average Proportion of overshoot attributable to Covid (%)
1	UUW	122
2	TMS	102
3	SVE	100
4	ANH	93
5	SES	77
6	SSC-CAM	73
7	NES	72
8	SRN	70
9	WSH	68
10	WSX	68
11	BRL	66
12	HDD	64
13	SEW	60
14	YKY	56
15	SSC-SST	51
16	AFW	51
17	PRT	50
Average impact		73





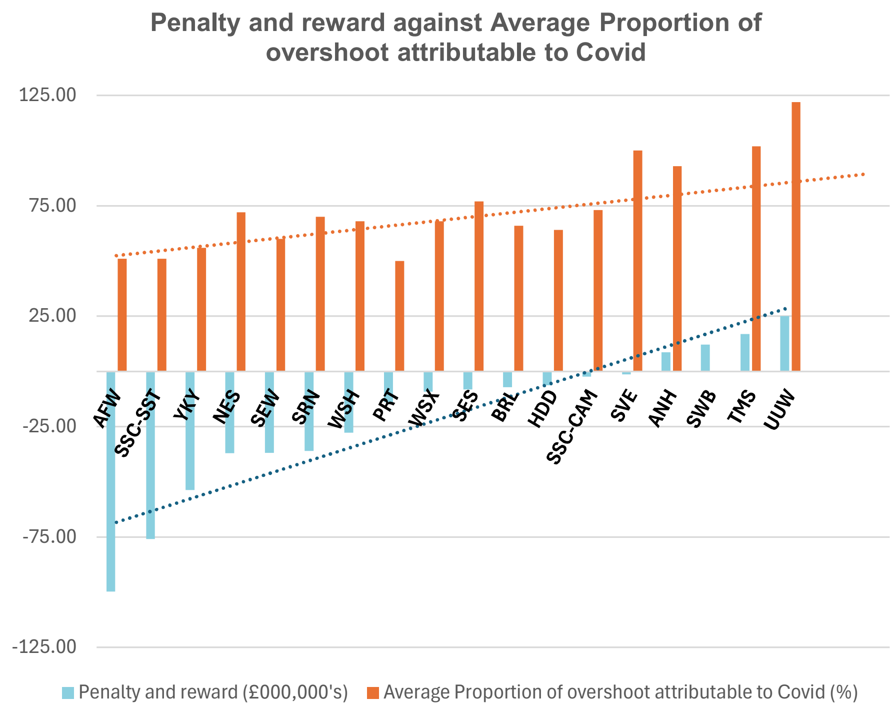
*SWW has been excluded from the model as its average overshoot percentage of 388% was classified as an outlier.

Plotting the overshoot geographically highlights two key issues, 1) % of overshoot in areas dominated by large cities is much higher than the less densely populated surrounding areas and 2) demonstrates the model does not breakdown companies by region, e.g. Thames, SRN or SVE.

Penalty and Reward Analysis by Population for Water Companies

No	Company	Penalty and reward (millions)	Total household population	Penalty and reward per head	Average Proportion of overshoot attributable to Covid (%)
1	SSC-SST	-£7.59	1,388,970	-£5.46	51
2	HDD	-£0.63	205,490	-£3.07	64
3	AFW	-£9.97	3,914,180	-£2.55	51
4	PRT	-£1.40	748,610	-£1.87	50
5	SEW	-£3.69	2,308,040	-£1.60	60
6	SRN	-£3.60	2,707,430	-£1.33	70
7	SES	-£0.81	746,760	-£1.08	77
8	YKY	-£5.37	5,347,520	-£1.00	56
9	WSH	-£2.78	3,011,300	-£0.92	68
10	NES	-£3.70	4,720,120	-£0.78	72
11	WSX	-£0.92	1,338,740	-£0.69	68
12	SSC-CAM	-£0.23	357,270	-£0.64	73
13	BRL	-£0.72	1,201,260	-£0.60	66
14	SVE	-£0.14	8,687,740	-£0.02	100
15	TMS	£1.69	10,643,000	£0.16	102
16	ANH	£0.87	4,987,460	£0.17	93
17	UUW	£2.51	7,000,000	£0.36	122
18	SWB	£1.22	2,351,680	£0.52	N/A
Average impact		-£1.959	3,215,622	-£1.13	73

*This table is ranked by Penalty and reward per head



A correlation is evident between the penalty/reward and the average proportion of overshoot attributable to COVID-19, as illustrated by the trendlines for both.

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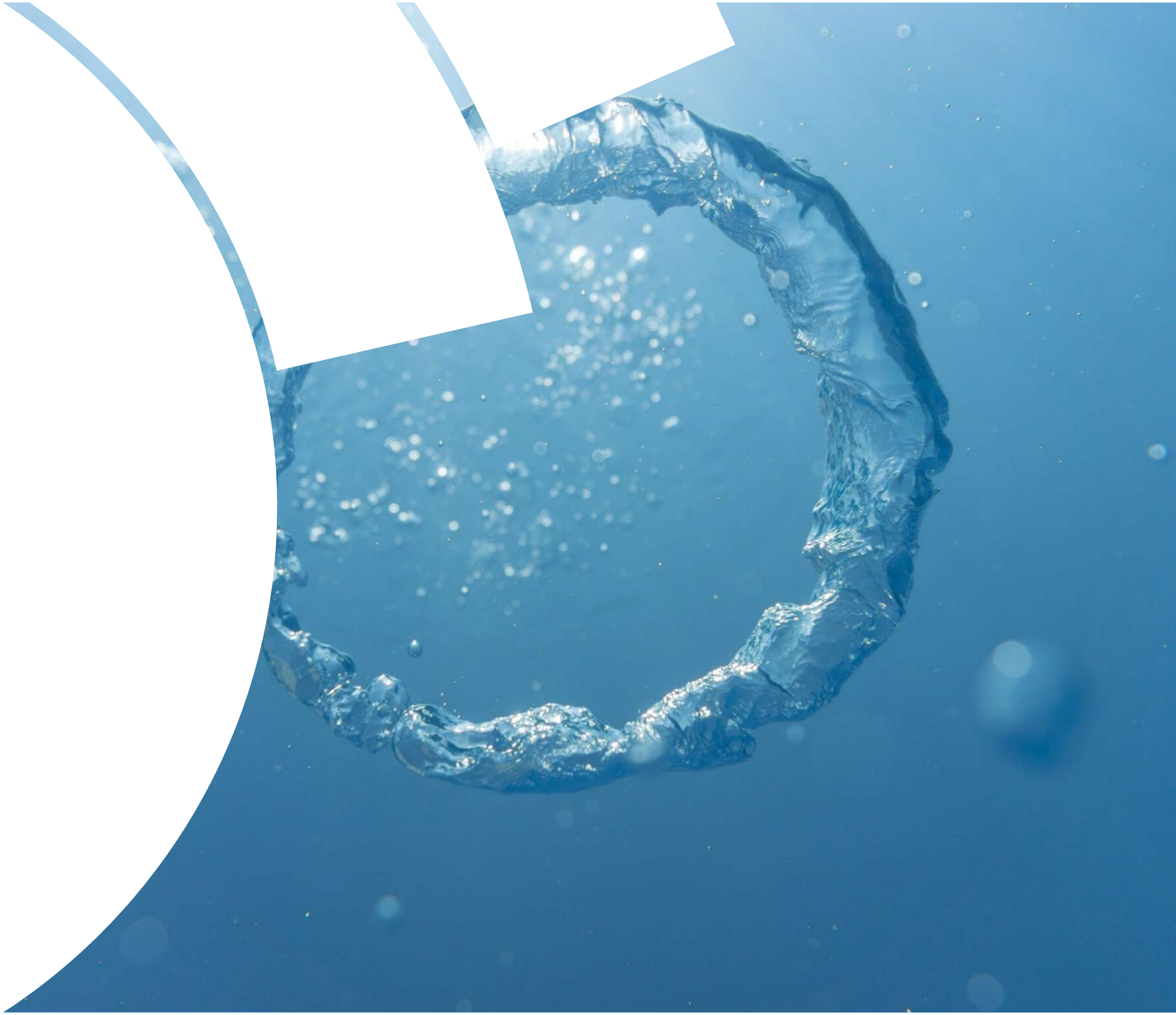
Appendix A – Mapping the EE model outputs

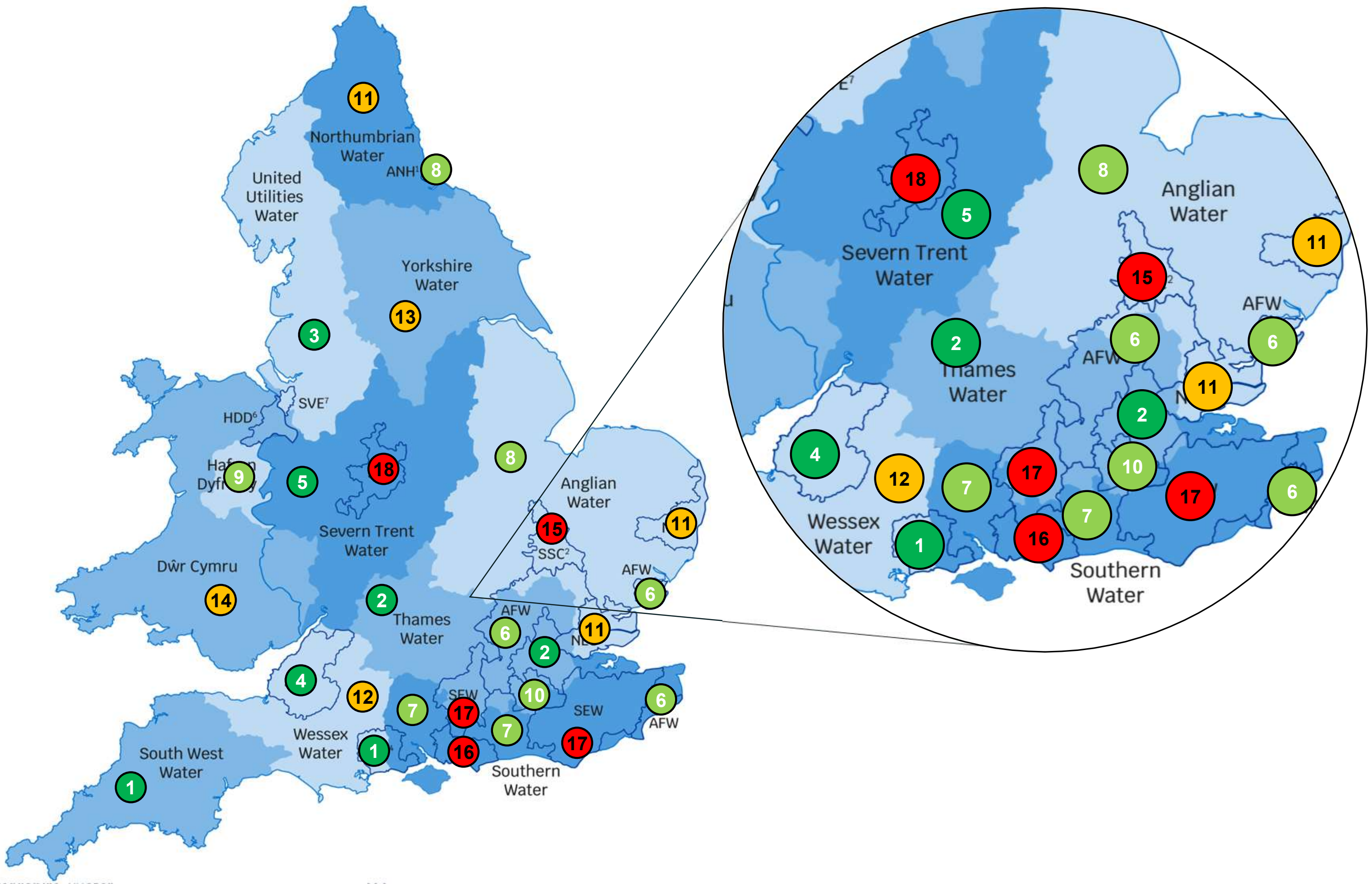


Appendix 1A

Years 2020/21

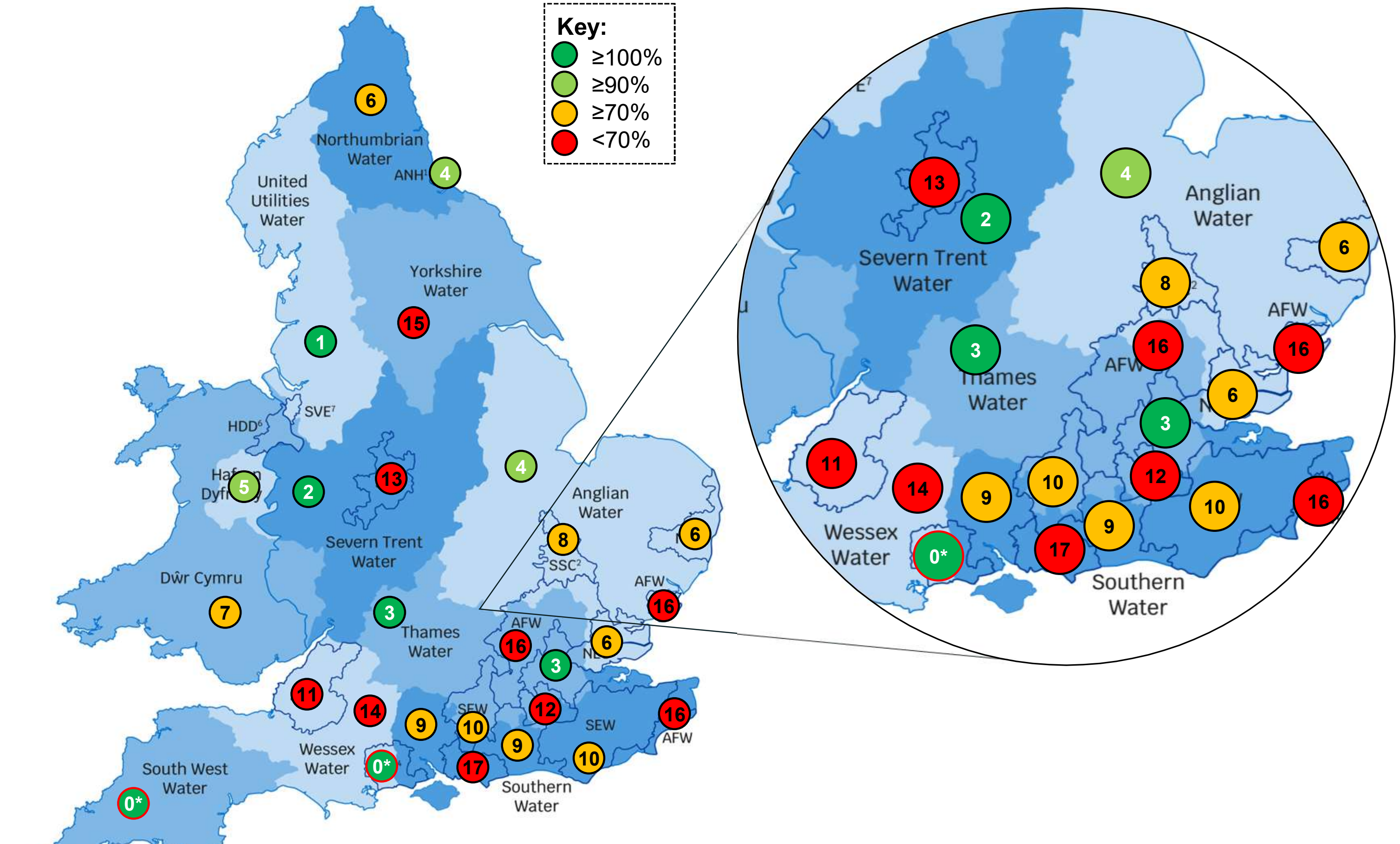
Map displaying % Change in PCC for Water Companies from 2017/18–2019/20 Average to 2020/21

No	Company	% Change in PCC (Pre-COVID to 2020/21)
1	SWB	- 5.1
2	TMS	+ 4.7
3	UUW	+ 5.0
4	BRL	+ 8.2
5	SVE	+ 8.2
6	AFW	+ 8.4
7	SRN	+ 8.7
8	ANH	+ 9.6
9	HDD	+ 9.6
10	SES	+ 9.7
11	NES	+ 10.0
12	WSX	+ 10.1
13	YKY	+ 10.1
14	WSH	+ 10.4
15	SSC-CAM	+ 11.6
16	PRT	+ 14.2
17	SEW	+ 15.2
18	SSC-SST	+ 17.4
Average % Change		+ 9.2



Map Displaying Proportion of overshoot attributable to Covid (%) in PCC for Water Companies (2020/21)

No	Company	2020/21 Proportion of overshoot attributable to Covid (%)
1	UUW	119
2	SVE	100
3	TMS	88
4	ANH	87
5	HDD	81
6	NES	79
7	WSH	77
8	SSC-CAM	75
9	SRN	74
10	SEW	72
11	BRL	69
12	SES	68
13	SSC-SST	63
14	WSX	63
15	YKY	61
16	AFW	59
17	PRT	51
Average impact		76



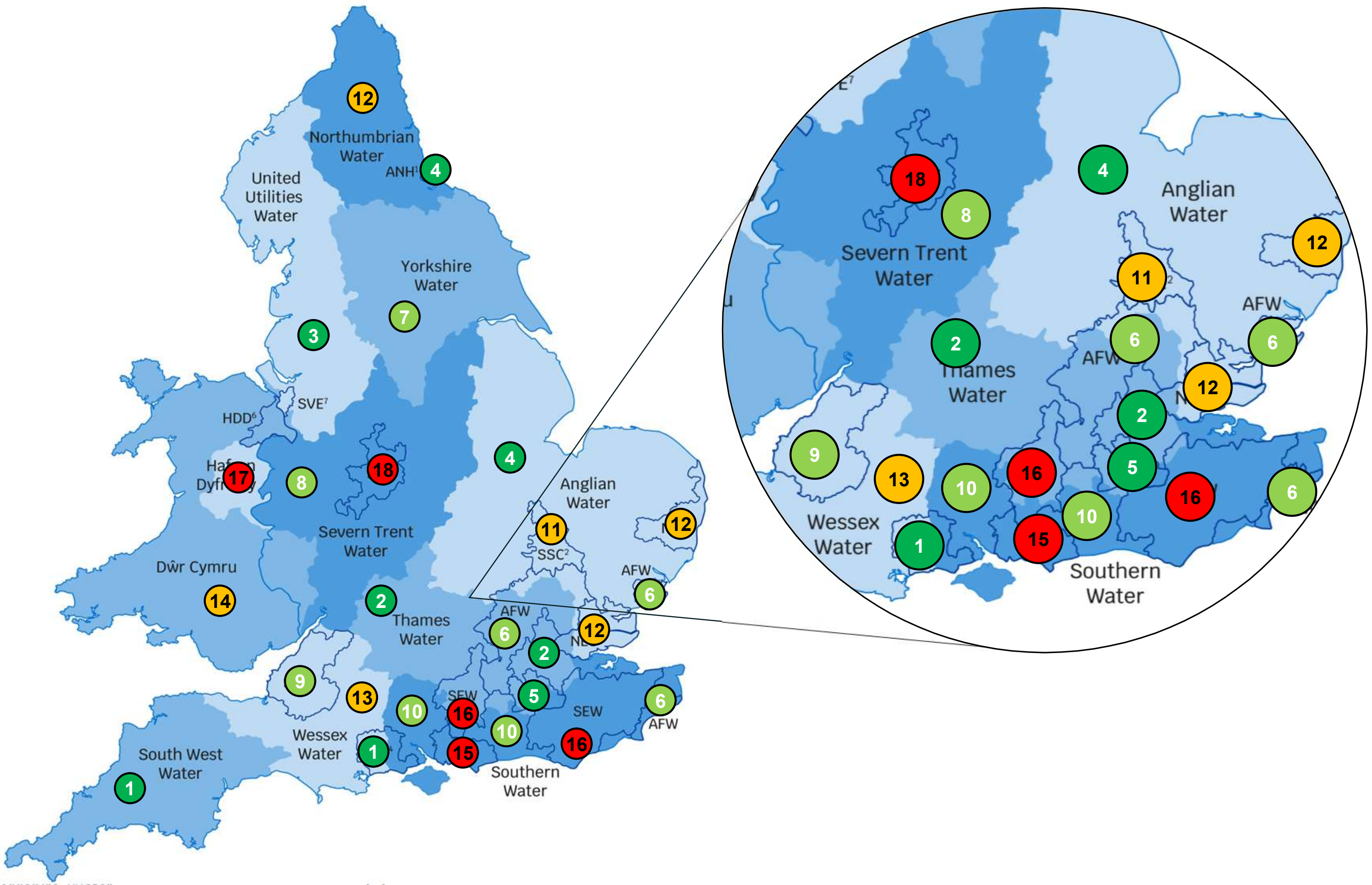
*SWW has been excluded from the model as its overshoot percentage of 639% was classified as an outlier.

Appendix 2A

Years 2021/22

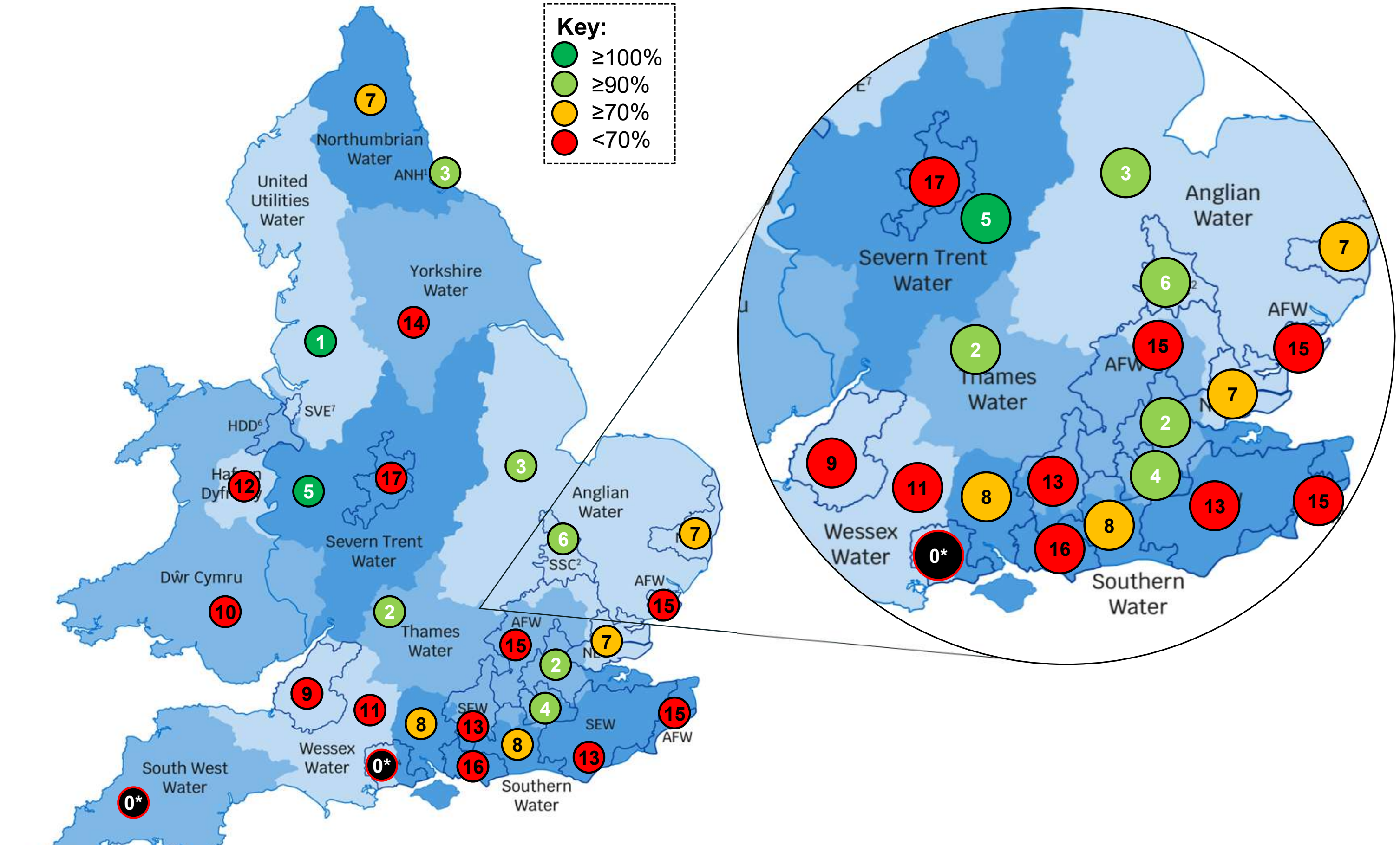
Map displaying % Change in PCC for Water Companies from 2017/18–2019/20 Average to 2021/22

No	Company	% Change in PCC (Pre-COVID to 2021/22)
1	SWB	- 1.6
2	TMS	- 0.9
3	UUW	- 0.7
4	ANH	+ 1.4
5	SES	+ 1.7
6	AFW	+ 2.5
7	YKY	+ 2.6
8	SVE	+ 3.0
9	BRL	+ 3.9
10	SRN	+ 4.5
11	SSC-CAM	+ 4.6
12	NES	+ 4.8
13	WSX	+ 5.1
14	WSH	+ 6.2
15	PRT	+ 7.3
16	SEW	+ 10.2
17	HDD	+ 11.1
18	SSC-SST	+ 15.9
Average % Change		+ 4.5



Map Displaying Proportion of overshoot attributable to Covid (%) in PCC for Water Companies (2021/22)

No	Company	2021/22 Proportion of overshoot attributable to Covid (%)
1	UUW	119
2	TMS	99
3	ANH	95
4	SES	92
5	SVE	92
6	SSC-CAM	82
7	NES	73
8	SRN	72
9	BRL	67
10	WSH	65
11	WSX	65
12	HDD	61
13	SEW	57
14	YKY	53
15	AFW	50
16	PRT	49
17	SSC-SST	49
Average impact		73



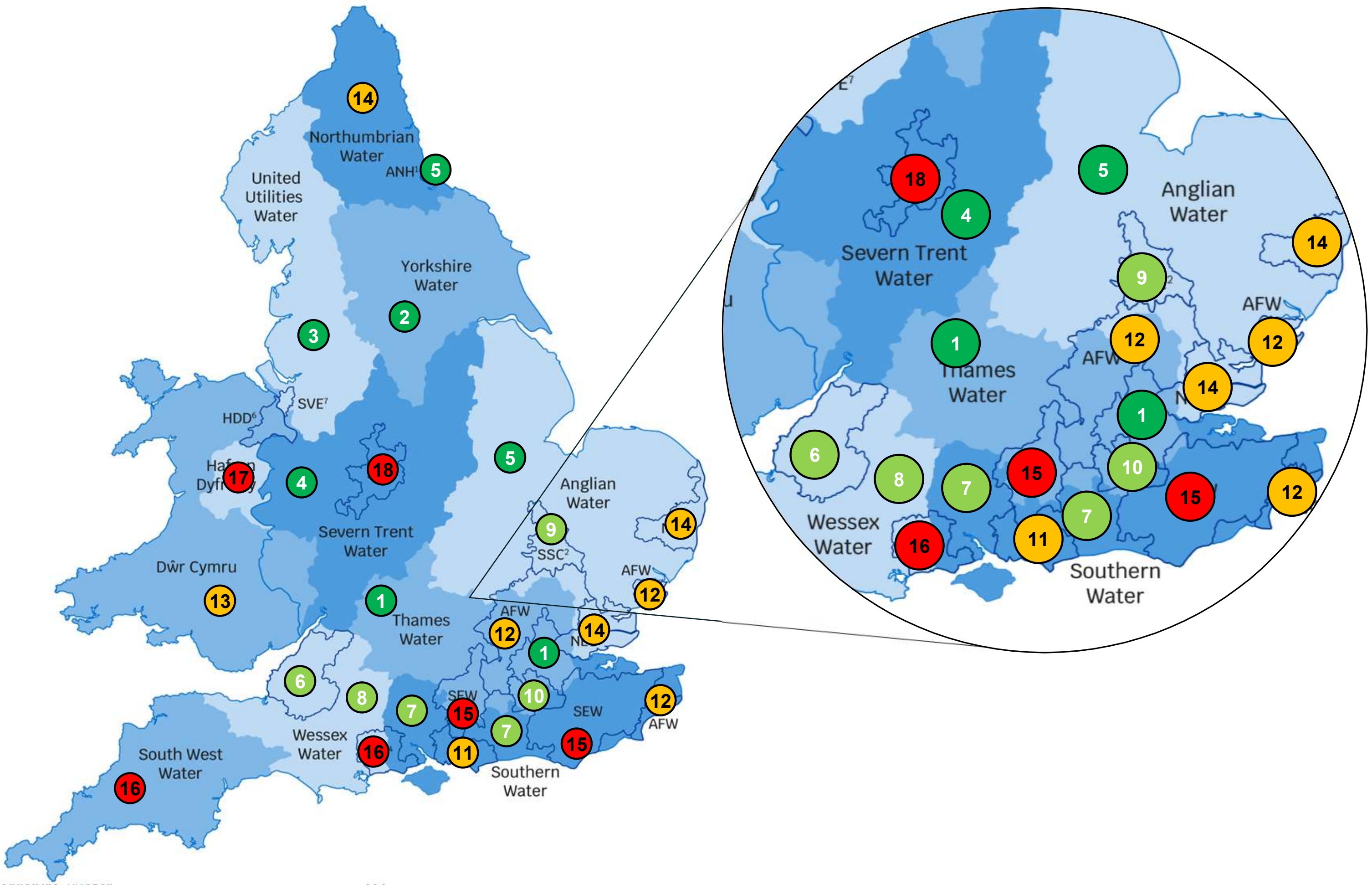
*SWW has been excluded from the model as it did not have an overshoot percentage this year.

Appendix 3A

Years 2022/23

Map displaying % Change in PCC for Water Companies from 2017/18–2019/20 Average to 2022/23

No	Company	% Change in PCC (Pre-COVID to 2022/23)
1	TMS	- 3.7
2	YKY	- 3.4
3	UUW	- 2.8
4	SVE	- 2.5
5	ANH	- 2.1
6	BRL	- 0.1
7	SRN	+ 0.4
8	WSX	+ 0.7
9	SSC-CAM	+ 0.8
10	SES	+ 1.2
11	PRT	+ 1.9
12	AFW	+ 1.9
13	WSH	+ 2.1
14	NES	+ 2.1
15	SEW	+ 4.4
16	SWB	+ 4.5
17	HDD	+ 9.1
18	SSC-SST	+ 11.2
Average % Change		+ 1.4



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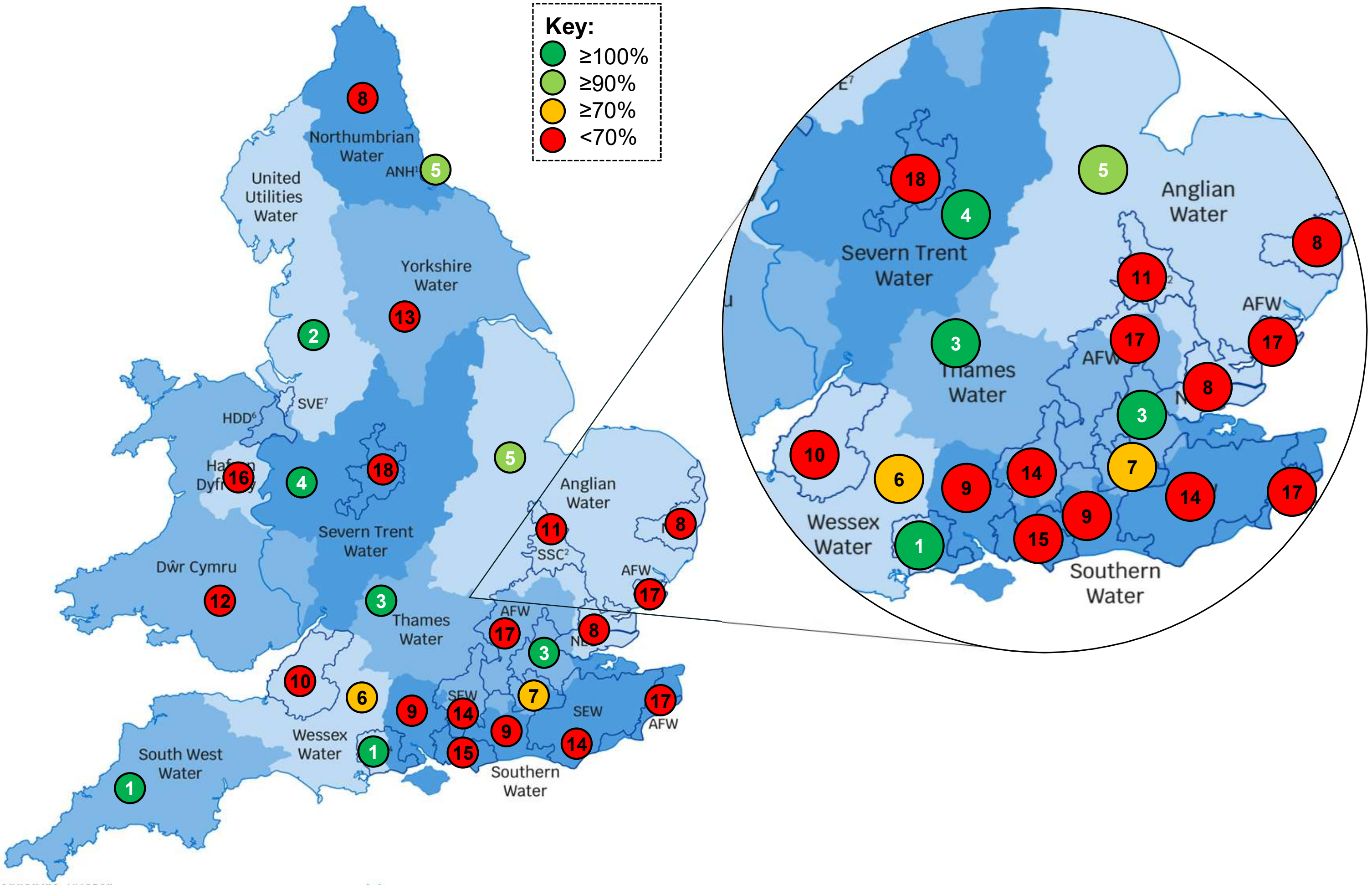
Map Displaying Proportion of overshoot attributable to Covid (%) in PCC for Water Companies (2022/23)

No	Company	2022/23 Proportion of overshoot attributable to Covid (%)
1	SWB	137
2	UUW	127
3	TMS	119
4	SVE	107
5	ANH	96
6	WSX	75
7	SES	70
8	NES	64
9	SRN	63
10	BRL	62
11	SSC-CAM	62
12	WSH	62
13	YKY	53
14	SEW	52
15	PRT	51
16	HDD	50
17	AFW	43
18	SSC-SST	41
Average impact		74



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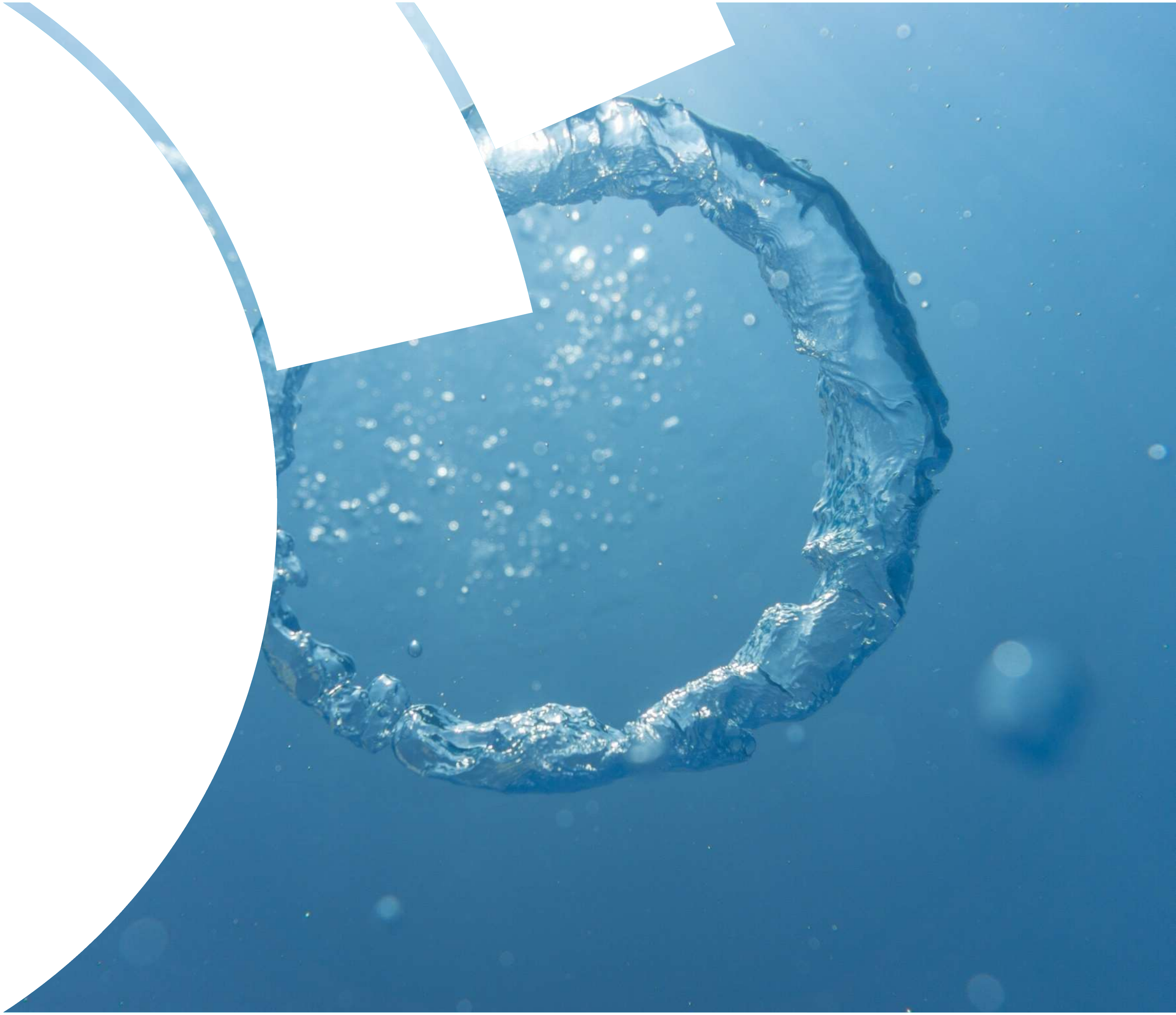
Appendix B – Overview of EE Model Outputs



Key Inputs and Outputs that were used in the European-Economics Report

Inputs	Definition	Outputs	
Temp	Temperature	Annual model 1 – Country-wide crisis – (normalised) PCC	Annual model 2 – Country-wide crisis – (normalised) PECC (“pdc”)
Wnaw	Workers Not At Work	Annual model 1 – Country-wide crisis – (normalised) PCC	
Meter_pen	Metering Penetration	Annual model 1 – Country-wide crisis – (normalised) PCC	Annual model 2 – Country-wide crisis – (normalised) PECC (“pdc”)
Pop_density	Population Density	Annual model 1 – Country-wide crisis – (normalised) PCC	Annual model 2 – Country-wide crisis – (normalised) PECC (“pdc”)
Dummy2020	Dummy Covid Variables	Annual model 1 – Country-wide crisis – (normalised) PCC	Annual model 2 – Country-wide crisis – (normalised) PECC (“pdc”)
_cons	Consumptions	Annual model 1 – Country-wide crisis – (normalised) PCC	Annual model 2 – Country-wide crisis – (normalised) PECC (“pdc”)
Wnaw_2_og	Workers Not At Work		Annual model 2 – Country-wide crisis – (normalised) PECC (“pdc”)
Death_Rate	Death Rate		Annual model 3 – Region-varying crisis – (normalised) PCC
Meteringpe~n	Metering Penetration	Monthly Model 2 – Fixed Effects using PECC (“pdc”)	Monthly Model 1 – Pooled OLS using (normalised) PECC (“pdc”)
Schools	Schools	Monthly Model 2 – Fixed Effects using PECC (“pdc”)	Monthly Model 1 – Pooled OLS using (normalised) PECC (“pdc”)

Overview of Modelling Parameters and Coefficients used in the European-Economics Report

Model Name	Model Type	R-squared
Annual model 1 – Country-wide crisis – (normalised) PCC	Linear regression	0.5066
Annual model 2 – Country-wide crisis – (normalised) PECC (“pdc”)	Linear regression	0.3794
Annual model 3 – Region-varying crisis – (normalised) PCC	Linear regression	0.5290
Annual energy – Region-varying crisis – (normalised) PECC (“pdc”)	Linear regression	0.4074
Monthly Model 1 – Pooled OLS using (normalised) PECC (“pdc”)	Linear regression	0.3209
Monthly Model 2 – Fixed Effects using PECC (“pdc”)	Fixed-effects (within) regression	within = 0.3092 between = 0.1215 overall = 0.2491

The analysis reveals that most models used in the European Economics report were linear regression models, with R-squared values ranging from 0.1215 to 0.5290. This range indicates that the models do have statistically significant correlations but only ranging from weak to moderate correlation. Consequently, these models have limited effectiveness in fully capturing the relationship between the pandemic and its effects on the industry when used in series.

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