

# Measuring Water Poverty using a bills to income metric

Water UK

June 2020





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## 1. EXECUTIVE SUMMARY

The English water industry has adopted a Public Interest Commitment (PIC) to:

*“Make bills affordable as a minimum for all households with water and sewerage bills more than 5% of their disposable income by 2030 and develop a strategy to end water poverty”*

This PIC requires the development of a common metric for measuring water poverty at a national and regional aggregated level to:

- Understand current levels of water poverty in England.
- Track industry progress towards achieving the PIC.

The water poverty PIC is a key strategic and reputational driver for the industry over the next decade. It is crucial that the adopted metric, all other things being equal, will show the impact of the water industry’s interventions on reducing current levels of water poverty in England.

This project was commissioned by Water UK in light of, and to build on, the finding of the project carried out by CEPA for UKWIR<sup>2</sup> that “the most suitable metric is likely to be a percentage of disposable income metric” and the conclusion that “a ‘percentage of disposable income’ metric is taken forward for detailed design development and testing.”

This report sets out the findings from CEPA’s work for Water UK from January to March 2020. This work was an initial project with water companies and water sector stakeholders to seek to agree a high-level methodology for how a ‘bills to income’ metric would be calculated and modelled, and to define the potential scope for modelling and data requirements for possible subsequent work.

Water UK, together with a Steering Group of water companies, were involved throughout the project, with workshops held on 27<sup>th</sup> January and 16<sup>th</sup> March<sup>3</sup> to update the Steering Group on progress and to get stakeholders’ views on issues. Working papers that set out more detail on key areas of discussion were circulated to the Steering Group between these workshops.

At the first of these workshops six principles to guide the options analysis were developed with the Steering Group, and had broad support. These Principles were that the methodology and model:

- Would provide a **strategic and dynamic** picture of current and future levels of water poverty, such that the progress in reducing water poverty could be demonstrated and tracked.
- Must be **consistent** in application across companies.
- Are **transparent**, in an environment where companies need to demonstrate legitimacy and support for affordability. In practice, this is likely to mean that the methodology and resulting measure of water poverty needs to be able to be scrutinised.
- Are sufficiently **simple and flexible** to model and update in the timescales available each year that the calculations need to be performed.
- Are **sufficiently accurate** to draw appropriate conclusions of progress towards the goal of reducing water poverty.

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<sup>2</sup> UKWIR (March 2020): ‘Defining water poverty and evaluating existing information and approaches to reduce water poverty’

<sup>3</sup> The workshop on 16<sup>th</sup> March also included representatives from Ofwat and CCW, and was changed to a teleconference due to the COVID-19 pandemic

- Should be seen as “fair” within the industry and to external stakeholders, recognising that there are likely to be different perspectives on the definition of “fairness”<sup>4</sup>.

The remainder of this Executive Summary sets out the findings from this project. It considers options for how the industry could approach its water poverty measure, the definition of income used in the ‘bills to income’ metric and the arguments for and against equalising these incomes. It also briefly describes the proof of concept model that we have built and the impact that methodological choices have on the estimates of water poverty that result from this model. Finally, the summary sets out possible next steps for potential future stages of this work,

Inevitably, the Covid-19 pandemic and its consequences have had some impact on the progress that it was possible to make in the latter stages of this project. Water poverty – both the ambition for its reduction in the next decade and this project to measure it on a common basis – will need to remain under review in light of this changing and challenging operating environment.

### 1.1. APPROACH TO CALCULATING WATER POVERTY

In principle, modelling an industry wide ‘bills to income’ metric appears a relatively simple, although potentially data intensive, modelling exercise. Data of actual customer bills could be requested from companies and matched with data of the known income of the relevant households. This would be a data collection driven “bottom up” approach, that would require income data and customer bills for around 25 million households in England and Wales.

A possible alternative to this “bottom up” approach would be a methodology that takes a more aggregated modelling methodology. While the bottom-up method would be driven by intensive data collection and manipulation by the companies, a top-down approach would, in contrast, apply statistical approaches to derive a picture of overall levels of water poverty. It would have some similarities with the approach used for measuring fuel poverty, but would be based on company data of customer bills.

These two strategic options for a common industry measure of water poverty: **Bottom up** or **Top down**, are contrasted in Table 1.

Table 1: Top-down and bottom-up options

Top-down process	Bottom-up process
Derive a distribution of income for a geographic area (using public data)	Companies collect household level bill and income data (e.g. using CRAs)
Derive a distribution of bills for a geographic area (using company data)	Companies cleanse the data and match household income stats with bills
Calculate the “ratio” between the income and bills distributions taking into account bills and income “correlations”	Bills to income ratio calculated at an individual household level then aggregated to a defined geographic area

These approaches are described in greater detail in Section 2. Table 2 below compares the two options against the principles for a common water poverty methodology developed for this project.

Table 2: Comparison of strategic options

Principle	Top-down methodology	Bottom-up method
Dynamic	Easy to update as more data becomes available, though potentially	Though income data would likely be needed from CRA each time model is run (one company has suggested

<sup>4</sup> We did not apply a formal definition of fairness for this work, but considered how a measure would be perceived within the industry and by stakeholders. We note that there is a distinction between a fair measure and a fair response to addressing water poverty, and more formal approaches may be needed to ensure that responses to water poverty are fair, for example being fair in the burden carried by different generations.

		delayed due to lag until official data available		DWP P60 data might be used as an alternative)
Consistent		Subject to clear definition of billing data collected – a common statistical method is then applied		Would need to ensure consistent matching and data cleansing due to individual circumstances of each company
Sufficiently accurate		Subject to enough information on income distribution and correlations. Impact of company interventions may not be recognised without augmentation (see below)		In principle more accurate since can calculate bill/income ratios for individual households. Could be used by companies to target assistance on specific households
Transparent		Approach based on public data and spreadsheets allows each step in the process to be scrutinised		Likely to need to rely on CRA (or potentially DWP P60) data that cannot be published. Review and assurance by third parties not possible
Simple and flexible		Only source of detailed data is company records that are already held		Would likely require the full process of data cleaning and matching to be undertaken each year
Fair		No impact – fairness will be impacted by decisions on income definition, equalisation etc.		As per top-down methodology

Source: CEPA analysis

A bottom-up method would likely be costly and time burdensome. It would be a data heavy process that would typically need to be run each year. Given that both income and bills data would be for individual household the process could not be scrutinised and so would be unlikely to be perceived as ‘transparent’.

A top-down methodology would be more transparent and flexible to apply in practice by companies. Subject to sufficient information on the distribution of bills and incomes (and their correlation) within a given geographical area, it should in principle also lead to a sufficiently accurate measure of water poverty.

However, a simple top-down method, that utilises only distributions of household incomes and bills, would not capture social tariff (cross-subsidies) and other interventions well without further development. We have therefore suggested that a top-down approach would need to be augmented by bottom-up data of water companies’ interventions. This would involve the following three steps:

- Calculate water poverty levels before interventions (i.e. in the absence of any specific action by the companies).
- Use company records of interventions / social tariffs to evidence number and location of assisted households.
- Move the assisted households into different bills/income ratio location on distribution to revise water poverty levels.

This augmented top down method effectively becomes a hybrid, with statistical analysis used to calculate “macro” effects of bills to income while “micro” data on water company targeting approaches is used to model the impact that industry interventions are having on geographic levels of water poverty. This dramatically reduces the level of household level data from the bottom up approach by targeting the data collection on households where the companies have the most detailed information.

If this approach were to be fair and transparent there would need to be a common reporting mechanism for water company interventions, and this would need to be appropriately reviewed and/or audited. We have reviewed the interventions that companies currently offer and all of these should be able to be managed within this framework.

We believe that this approach has significant advantages. It:

- Allows “background” levels of water poverty to be calculated transparently using publicly available data.
- Can provide a clear demonstration of “before” and “after” impact on water poverty levels from interventions.
- Will be relatively simple to update and flexible to apply on an industry basis.
- Decisions on the selection and targeting of actual company interventions, such as whether and how to offer social tariffs and the eligibility of households for these, can be based on detailed information and/or modelling of individual household incomes and specific circumstances, as each company deems appropriate: the approach does not constrain companies’ approaches to addressing water poverty within their supply area.

## 1.2. PROOF OF CONCEPT MODEL

We have developed a “proof of concept” model to test the top-down approach and demonstrate whether the model can deliver results that look reasonable given the assumptions and data that are input.

The model was applied to billing data from four companies. For this proof of concept modelling only combined water and sewerage, standard tariff bills were examined. Both metered and unmetered bills were modelled. The results are based on Middle Super Output Area (MSOA) geographic data on incomes (sourced from the ONS<sup>5</sup>) and bills (sourced from each of the companies). The model uses a Monte Carlo simulation to match the distributions of bills and incomes within an MSOA given assumptions on the correlation between the two distributions.

Table 3 sets out the results of applying this model for a Before Housing Cost (BHC) income definition, where income is equivalised using the ONS’ equivalisation scale. A simplified adjustment has been made for Disability Living Allowance and Personal Independence Payment.

Table 3: Base case outputs from proof of concept model

Metric	Company A	Company B	Company C	Company D	Average
Average Income <sup>6</sup>	£27,000	£28,900	£27,600	£31,400	<b>£28,700</b>
Average Bill <sup>7</sup>	£450	£420	£400	£420	<b>£420</b>
Average Bill / Income	1.67%	1.45%	1.45%	1.34%	<b>1.48%</b>
Bill / Income above 3%	22.2%	16.0%	14.9%	12.7%	<b>16.4%</b>
Bill / Income above 5%	6.6%	4.7%	4.4%	3.9%	<b>4.9%</b>

Source: CEPA analysis

The modelling approach gives results that appear to make sense given the average incomes and costs of the four companies. For example, companies with higher average bills, relative to income, also have higher levels of water poverty. We have also compared our outputs, at a high-level, to estimates of water poverty previously prepared for Company D based on more detailed Lower Super Output Area (LSOA) analysis using credit reference agency (CRA) data. Our aggregate results are comparable to this previous analysis: water poverty at the 3% level is very close to that calculated by Company D, while water poverty at the 5% level is lower in our analysis.

<sup>5</sup> Office of National Statistics (ONS).

<sup>6</sup> Weighted average of billed households

<sup>7</sup> Weighted average based on data from companies, not used in water poverty modelling

As with all modelling, the quality of our output is dependent on the quality of the inputs. Two issues in the concept model are particularly important:

- Correlation between bills and income has a significant effect and more work on this would be needed to deliver reliable outputs.
- More sophisticated assumptions of the shape of the income distribution, especially at low income levels, would be helpful.

We would be able develop our analysis and assumptions further in these areas.

The modelling approach could be extended to apply to other companies or to calculate at LSOA level (albeit with MSOA income data) relatively easily. There is also scope to develop the modelling further to refine the input assumptions and take advantage of the Monte Carlo simulation that is used in more sophisticated ways; in particular to better address disability allowances and potentially social tariffs. Other sources of income data could be considered to increase the accuracy of the modelling (e.g. from CRAs, or Households Below Average Income data from the ONS), but this may involve trade-offs in terms of transparency and complexity if CRA data is utilised.

Our suggested “augmented” top-down approach would adjust these base case results for interventions. We do not currently have sufficient information on any of these interventions to incorporate them fully into our model.

However, we can illustrate how it might apply to social tariffs since we have data from the four sample companies on the number of households that are on social tariffs. We can therefore illustrate what proportion of households would be brought out of water poverty by these social tariffs by calculating the proportion of households that receive them. This is the maximum number of households that could be brought out of water poverty, at either the 3% or 5% bills to income level, by current numbers of social tariffs. We cannot judge whether these interventions would be sufficient to move households to below the 5% or 3% level with the data available.

This maximum impact on water poverty for the four companies is depicted in Table 4.

*Table 4: Illustration of current impact of social tariffs*

Metric	Company A	Company B	Company C	Company D	Average
Bill / Income above 3%	22.2%	16.0%	14.9%	12.7%	<b>16.4%</b>
Bill / Income above 5%	6.6%	4.7%	4.4%	3.9%	<b>4.9%</b>
<b>Maximum reduction in water poverty due to social tariffs</b>	<b>3.2%</b>	<b>1.3%</b>	<b>2.1%</b>	<b>2.5%</b>	<b>2.3%</b>

*Source: CEPA analysis*

### **1.3. INCOME DEFINITION**

A key aspect of a common water poverty measure is the definition of income that is used. All else being equal, an income definition that removes more household costs will result in a lower “disposable” income and a higher ratio of water bill to this income. This will result in the apparent level of water poverty being higher for a fixed definition of water poverty, for example a bill to income ratio of 5%.

In considering the question of income definition, we have focussed on four questions of what aspects of household costs to remove prior to calculating bill to income ratios:

- Whether to remove taxes from Gross Income and utilise Net Income?
- Whether to remove housing costs (BHC) or use an income definition after housing costs (AHC)?
- Whether to judge water poverty before removing childcare costs or after childcare costs?

- Whether to adjust incomes to reflect disability allowances such as Disability Living Allowance (DLA) and Personal Independence Payment (PIP)?

Both the water companies and other stakeholders agreed that **taxes should be removed and that an adjustment should be made for disability allowances**. The rationale for these adjustments were that:

- Taxes are not a discretionary spend, and so any fair assessment of “disposable” income should remove them.
- Disability allowances such as DLA and PIP are intended to offset the increased costs of households that are associated with disabilities. Any additional income is therefore offset by an additional cost and so it would be unfair to include them as additional income.

The impacts of childcare and housing costs were considered in more detail, examining references such as House of Commons briefings on poverty measures and precedents set in the water and other industries.

For housing costs, we found that, while a BHC measure acknowledges that some households may *choose* to spend more on a better quality of accommodation, an AHC measure may be more illuminating where geographical differences mean that two households could face very different costs for comparable standards of housing. In addition, all external measures of poverty that we could find, whether from the water industry or elsewhere, applied AHC measures of income. Stakeholders through the two workshops generally agreed that **AHC costs should be used** for the common measure of water poverty.

We also tested the estimated impact of moving from a BHC to AHC definition of income within our “proof of concept” model. This is depicted in Table 5.

Table 5: Impact of income definition

Metric	Company A	Company B	Company C	Company D	Average
Average Income (BHC)	£27,000	£28,900	£27,600	£31,400	<b>£28,700</b>
Bill / Income above 3% (BHC)	22.2%	16.0%	14.9%	12.7%	<b>16.4%</b>
Bill / Income above 5% (BHC)	6.6%	4.7%	4.4%	3.9%	<b>4.9%</b>
Average Income (AHC)	£24,200	£26,100	£24,800	£28,200	<b>£25,800</b>
Bill / Income above 3% (AHC)	29.4%	21.4%	20.6%	16.5%	<b>22.0%</b>
Bill / Income above 5% (AHC)	9.5%	6.6%	6.1%	5.1%	<b>6.8%</b>
<b>Increment<sup>8</sup> in Bill / Income above 3%</b>	<b>7.2%</b>	<b>5.4%</b>	<b>5.7%</b>	<b>3.8%</b>	<b>5.5%</b>
<b>Increment in Bill / Income above 5%</b>	<b>2.9%</b>	<b>1.9%</b>	<b>1.8%</b>	<b>1.2%</b>	<b>1.9%</b>

Source: CEPA analysis

The impact of applying AHC, rather than BHC, is substantial. The impact of these choices on the possible level of cross-subsidy between “standard” and “social” tariffs that may be necessary to meet the Public Interest

<sup>8</sup> So, for example, if % of customers with bill / income ratio above 3% was 15% before housing costs and the increment is 2%, the % of households with a Bill/Income ratio above 3% would be 17%.

Commitment, and whether this level of cross-subsidy is compatible with the current policy framework<sup>9</sup>, should be assessed before making a final decision.

For childcare costs, we consider that the decision on whether to reduce income to reflect these costs is linked to three points:

- **Data availability:** We do not believe that childcare costs are published by the ONS, though data is available from the Family and Childcare Trust.
- **Practicality of implementation:** Detailed analysis would likely require breakdowns of the number of children per household as a minimum and ideally the ability to link this to specific deciles.
- **Crossover with equivalisation:** Applying a deduction for childcare costs, as well as equivalisation, could result in double counting.

We believe that the latter point is particularly significant.

Stakeholders through the workshop process generally agreed that if equivalisation were applied, then income would not be adjusted for childcare costs. If incomes were not equivalised then this issue would be revisited.

## 1.4. EQUIVALISATION

Equivalisation is the process of adjusting income-based statistics to capture the impact that household size (i.e. number of individuals) and composition (e.g. number of earning individuals and children) have on the standard of living that is available for a given level of income. Effectively the income of high occupancy households is reduced<sup>10</sup> to reflect the fact that their available *resources* have to deliver increased *needs*.

In reviewing the approaches used in the water industry and elsewhere it is clear that there is not a clear-cut technically “correct” decision as to whether incomes (and / or bills) should be equivalised when measuring water poverty. Rather, it is a decision for the water industry and its stakeholders to make taking into account considerations such as the sector’s ambition for reducing water poverty over the next decade, the impacts on the accuracy of the measure of water poverty and what might be perceived as the “fairest” approach<sup>11</sup>.

The work undertaken in this project suggests that:

- There are a range of views amongst stakeholders within the industry on the appropriate basis to reach a decision and how to apply equivalisation.
- The impact on water poverty of using equivalised or non-equivalised ONS incomes data and equivalisation scale appears small. However, further analysis is needed to test the validity of this finding.
- Equivalisation has been a contentious issue in measuring poverty in other sectors – e.g. for fuel poverty – and so the water industry should be cautious in being too definitive on this issue without further consideration.
- Further analysis may be needed of what would be an appropriate equivalisation scale in a water poverty metric (if equivalisation was used), having regard to the context in which it might be applied.

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<sup>9</sup> We note that policy frameworks may well evolve over time, particularly in light of the possible impact of Covid-19 on wider poverty measures and the impact that this may have on the expectations of society of the role of both government and the water industry in addressing this

<sup>10</sup> And small households increased.

<sup>11</sup> For example, by key consumer advocacy stakeholders.

## **1.5. NEXT STEPS**

This project has set out a high-level modelling methodology that satisfies the principles that have been developed for this work. For the approach to be able to be used to assess and track progress toward the water companies' PIC we suggest the following next steps:

- Comparison of results from the proof of concept model (existing or refined) to more detailed calculations undertaken by companies.
- Estimation of the monetary “size of the water poverty gap”: how much is the minimum amount of cross subsidy likely to be required to eliminate water poverty at 3% or 5% bills to income level, and is this compatible with the current policy framework?
- Extension of approach to Water Only Companies.
- Application of alternative sources of income data, particularly at low incomes.
- Development of understanding and application of correlations between bills and incomes.
- Further testing of the impact of the decision on equivalisation and, if deemed appropriate, the appropriate equivalisation scale that should be used.

Finally, we note that this paper was developed predominantly in February and the first half of March 2020 before the impacts of Coronavirus (Covid-19) on UK households, water industry operations and the wider economy. Covid-19 is expected to have short and longer-term impacts on household incomes and circumstances, and the water industry's capacity to deliver programmes at the same time as responding to the challenges of Covid-19. While the full impact of Covid-19 is uncertain and will take some time to become clear, it is already apparent that the size of the challenge will increase.

As noted above, water poverty – both the ambition for its reduction in the next decade and this project to measure it on a common basis – will need to remain under review in light of this changing and challenging operating environment. The work described in this paper is not an analysis of the impact of Covid-19, and is not intended to limit the approaches applied by the water industry to addressing water poverty.

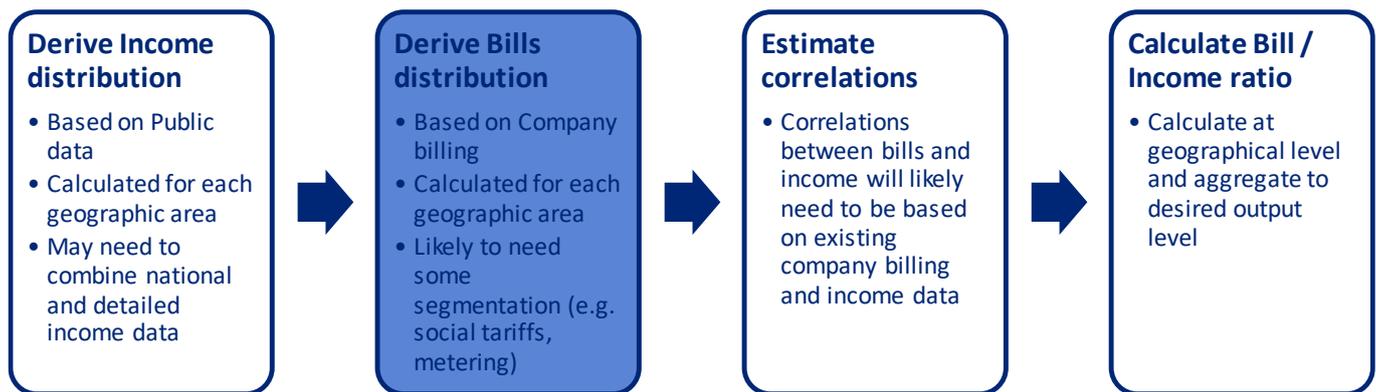
The remainder of this document describes the issues summarised above in more detail. Section 2 describes the potential approaches to calculating water poverty and section 3 sets out the approach applied in the proof of concept model. Sections 4 and 5 discuss income definitions and equivalisation, respectively, while section 6 sets out the next steps.

## 2. APPROACH TO CALCULATING WATER POVERTY

### 2.1. TOP-DOWN AND BOTTOM-UP APPROACHES

A top-down approach is based on data at Lower Super Output Area (LSOA) or Middle Super Output Area (MSOA) level. The approach that would be applied is identical for either level of aggregation, and is depicted in Figure 1. Tasks that would be undertaken primarily by CEPA are colour-coded white, while tasks that would need to be undertaken by Companies are blue.

Figure 1: Process for calculation based on LSOA or MSOA data



Source: CEPA Illustration

This approach involves:

- CEPA identifying income data from public sources based on averages and distributional data at either LSOA or MSOA level.
- Water companies providing aggregated data based on their billing systems at LSOA or MSOA level.
- CEPA calculating the distribution of bill to income ratios for each LSOA or MSOA, and calculating what proportion of households in each area had bill to income ratios in excess of 3% or 5%.
- CEPA aggregating this data to give outputs at an agreed level of detail.

The majority of the analysis would, therefore, be undertaken by CEPA, with Companies providing aggregated data based on their existing billing systems.

The calculations would output a % of people in water poverty within each LSOA or MSOA, which results in around 35,000 or 7,000 outputs for LSOA and MSOA, respectively (i.e. one for each area). This output would be based on around 10-40 data-points of income and bills data per LSOA/MSOA, depending on the level of detail of bills and income distributions, resulting in around 70k to 1.2m individual pieces of input data.

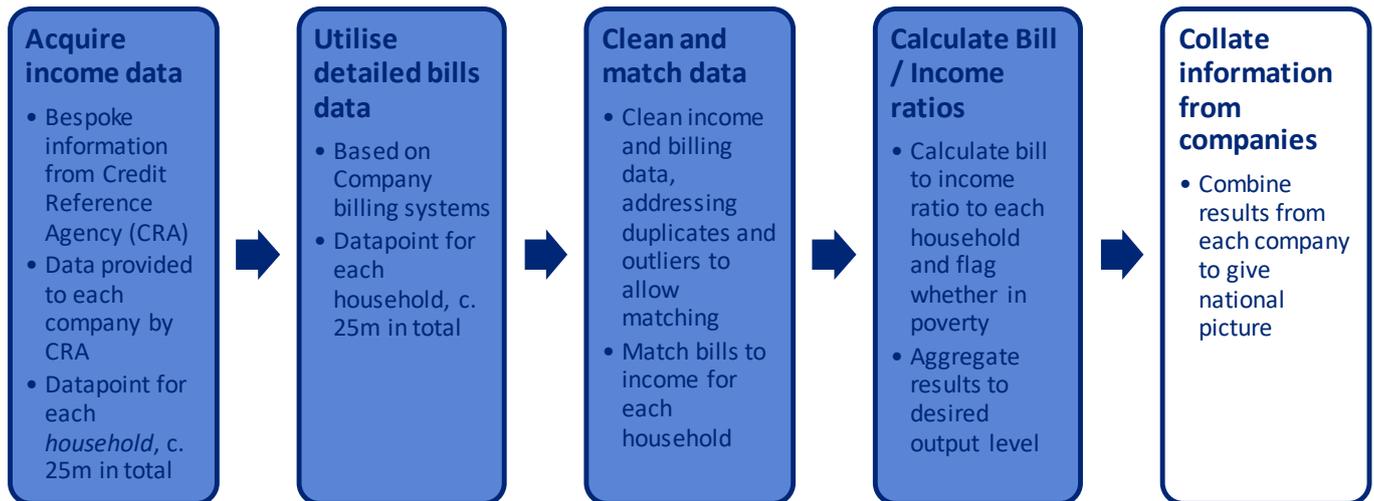
Around 35,000 lines of calculations is within the capabilities of MS Excel (albeit that 7,000 lines of calculations would be preferable) and so the above analysis could be undertaken in a single, albeit large, spreadsheet. This would allow calculations to be easily checked and assured and any errors or modifications to the approach to be addressed.

Alternatively, it would be possible for a common model to be supplied to, and billing information populated by, each company. This would potentially result in a number of smaller spreadsheets, albeit that the overlaps between companies would need to be resolved and results aggregated centrally. A centrally controlled model, with specified billing data supplied by companies, makes resolution of such boundary issues more straightforward.

In addition, because all data that is exchanged is an aggregated amount or distribution, there is no way to associate any income or bill data with specific households. Data protection rules are therefore not particularly relevant and, subject to normal confidentiality expectations, income, bill and water poverty data can be readily transmitted between parties.

The approach that would be needed if the bills to income ratio were calculated for individual households is set out in Figure 2. Again, tasks that would be undertaken primarily by CEPA are colour-coded white, while tasks that would need to be undertaken by Companies are blue.

Figure 2: Process for calculation for individual households



Source: CEPA Illustration

This approach involves:

- Water companies getting data for individual households from Credit Reference Agencies (CRAs) on a consistent basis, likely coordinated by an organisation such as Water UK. Income data would need to be transferred from CRAs directly to water companies to minimise data privacy issues.
- Water companies cleaning and matching the income data from CRAs with bills data from their own systems, calculating bills to income ratios for each household and aggregating these calculations from individual household level to, for example, LSOA, to give proportion of households in poverty by LSOA, for example.
- LSOA level data being collated, and data from each company aggregated into a single dataset.

As for the previous approach, the output from this approach would be the % of households in each LSOA or MSOA that were in water poverty according to the agreed definition. The number of outputs would therefore likely be similar to that if results were calculated at a more aggregated level.

This output would be based on round 50 million datapoints (i.e. one each for income and bill), albeit that these would be divided between a number of companies. A large company such as Thames Water would have of the order of 15-20 million datapoints to clean, match and calculate bills to income ratios. This would likely need to be undertaken via a bespoke database, either linked to company's existing billing system or held independently for audit and data privacy reasons. While the calculation of bills to income ratio is trivial, the majority of effort would likely be in cleaning and matching the data. This process would have to be well understood and coordinated to ensure that a consistent approach was employed for all companies.

Data protection and privacy issues would be substantial since income and water bills could be traced directly to individual households. Review and/or assurance of outputs would be necessary to ensure that the approaches employed by companies were consistent with agreed protocols.

Table 6, below, summarises the advantages and disadvantages against the Principles:

Table 6: Consistency of approaches with principles

Principle	LSOA or MSOA	Individual Household
Provides strategic and dynamic picture	<b>Yes</b> , easy to update as more data available, though potentially delayed due to lag until official data available	<b>Yes</b> , though income data would likely be needed from CRA each time model is run
Consistent across companies	<b>Yes</b> , subject to clear definition of billing data	<b>Maybe</b> . Difficult to ensure consistent matching and data cleaning due to likely individual circumstances of each company (e.g. multi-occupancy buildings, duplicated records)
Sufficiently accurate	<b>Yes</b> , subject to sufficient income distribution and correlations information. We anticipate, in the first instance, relying on analysis undertaken by companies on correlations.	<b>Yes</b> . In principle more accurate since can calculate bill/income ratios for individual households. Could be used by companies to target assistance on specific households
Transparent	<b>Yes</b> , approach based on public data and spreadsheets allows each step in process to be scrutinised	<b>No</b> , acquiring income data from CRA would likely be subject to publication restrictions. Review and assurance of personal data by external parties would not be possible
Sufficiently simple and flexible	<b>Yes</b> , only source of detailed data is company records that are already held.	<b>No</b> . Would likely require the full process of data cleaning and matching to be undertaken each year
Fair	No impact	No impact

Source: CEPA Analysis

In addition to the principles highlighted above, the individual household approach would require potentially substantial cost for the provision of income data for each household. At the 27th January workshop companies suggested that data from CRAs cost of the order of £1 per data point. Even assuming that this was reduced, perhaps substantially, due to the volume of information required the cost would still be millions of pounds, and potentially more than £10m. This would likely be required each time the calculation was updated.

## 2.2. AUGMENTED TOP-DOWN APPROACH

A bottom-up method would likely be costly and time burdensome. It would be a data heavy process that would typically need to be run each year. Given that both income and bills data would be for individual household the process could not be scrutinised and so would be unlikely to be perceived as 'transparent'.

However, a simple top-down method, that utilises only distributions of incomes and bills, would not capture social tariff interventions (cross-subsidies) well without further development. We have therefore suggested that a top-down approach be augmented by bottom-up data of water companies' interventions. This would involve the following three steps:

- Calculate water poverty levels before interventions (i.e. in the absence of any specific action by the companies).
- Use company records of interventions / social tariffs to evidence number and location of assisted households.

- Move the assisted households into different bills/income ratio location on distribution to revise water poverty levels.

This method effectively becomes a hybrid, with statistical analysis used to calculate “macro” effects of bills to income while “micro” data on water company targeting approaches is used to model the impact that industry interventions are having on geographic levels of water poverty. This dramatically reduces the level of household level data from the bottom up approach by targeting the data collection on households where the companies have the most detailed information.

If this approach were to be fair and transparent there would need to be a common reporting mechanism for water company interventions, and this would need to be appropriately reviewed and/or audited. We have reviewed the interventions that companies currently offer and all of these should be able to be managed within this framework.

We believe that this approach has significant advantages. It:

- Allows “background” levels of water poverty to be calculated transparently using publicly available data.
- Can provide a clear demonstration of “before” and “after” impact on water poverty levels from interventions.
- Will be relatively simple to update and flexible to apply on an industry basis.
- Decisions on the selection and targeting of actual company interventions, such as whether and how to offer social tariffs and the eligibility of households for these, can be based on detailed information and/or modelling of individual household incomes and specific circumstances, as each company deems appropriate: the approach does not constrain companies’ approaches to addressing water poverty in their supply area.

## 2.3. MSOA vs LSOA AGGREGATION

### 2.3.1. Context and issues

#### Background and Principles

There are a number of levels of geographical aggregation at which water poverty can be calculated and output. These are set out in Table 7 below.

Table 7: Aggregation Options for Income and Bills Data

Description	Number of Areas in England and Wales	Approx. Number of Households per area
Individual Households	c. 25m	1
Census Output Areas	181,408	c. 125
Lower Layer Super Output Areas (LSOAs)	34,753	c. 700
Middle Layer Super Output Areas (MSOAs)	7,201	c. 3,000
Local Authority Districts (LADs)	348	c. 66,000
Counties / Unitary Authorities / London Boroughs	82+22+33 = 137	c. 170,000

Source: CEPA analysis based on ONS and GOV.UK data

The level of geographic aggregation of income and bills data was discussed with water companies at the Water Poverty Stage 1a Workshop on 27th January 2020. Discussion focussed on making a decision between LSOA and MSOA levels of aggregation.

In principle, performing calculations at LSOA level has three advantages when compared to MSOA level:

- households will be more homogenous within the smaller area, making information about the distribution of bills and incomes within the area less important;
- it could be based on more detailed income and billing data, and so is more likely to identify “pockets” of water poverty that could be missed by more aggregated analysis; and
- it could provide data that would be sufficiently detailed to allow Companies to use the output to target interventions to address water poverty.

However, publicly available data is less readily available at LSOA level.

## Precedent

Other organisations have grappled with this compromise between data availability and geographical detail of output when undertaking analysis of poverty or deprivation.

The Department for Business, Energy & Industrial Strategy (BEIS) publishes annual statistics on the number and proportion of households that are fuel poor.<sup>12</sup> This information is designated as a National Statistic and is based on a “low Income, High Costs” definition of fuel poverty. BEIS also publishes data on the number and proportion of households that are fuel poor by local authorities, LSOAs, parliamentary constituencies, counties and regions<sup>13</sup> across England. This data is designated as Experimental Statistics.

In its publication on sub-regional fuel poverty,<sup>14</sup> BEIS stated that its 2013 review of the methodology used to produce these sub-regional estimates:

*“found that estimates of fuel poverty were robust at Local Authority level, but not robust at lower levels of geography. Estimates of fuel poverty at the sub-regional level should only be used to look at general trends and identify areas of particularly high or low fuel poverty. They should not be used to identify trends over time.*

*In particular, estimates of fuel poverty at Lower Super Output Area (LSOA) **should be treated with caution.** They should not be used to identify trends over time within an LSOA, or to compare LSOAs with similar fuel poverty levels due to **very small sample sizes and consequent instability in estimates at this level.**”*

CEPA emphasis added.

The ONS have built on this work by BEIS to estimate fuel poverty at local and small area levels.<sup>15</sup> This calculated fuel poverty levels for each Local Authority in England, together with confidence intervals to indicate the uncertainty in these outputs. This analysis aimed to be comparable to the BEIS statistics, but the addition of confidence intervals gives useful information about the uncertainty in these estimates. The confidence intervals can be large, and averaged plus or minus 2.7% at Local Authority level. Overall, 10.9% of households were assessed as being in fuel poverty, so the confidence interval at Local Authority level is around a quarter of the typical level of fuel poverty.

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<sup>12</sup> BEIS (13 June 2019), “Annual Fuel Poverty Statistics in England”, available at:[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/829006/Annual\\_Fuel\\_Poverty\\_Statistics\\_Report\\_2019\\_2017\\_data\\_.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/829006/Annual_Fuel_Poverty_Statistics_Report_2019_2017_data_.pdf).

<sup>13</sup> BEIS website, Fuel poverty sub-regional statistics. URL: <https://www.gov.uk/government/collections/fuel-poverty-sub-regional-statistics#2017-statistics> , visited on 17<sup>th</sup> February 2020.

<sup>14</sup> BEIS (13 June 2019), Sub-regional fuel poverty in England, available at:[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/808295/Fuel\\_poverty\\_sub\\_regional\\_2019\\_2017\\_data\\_.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/808295/Fuel_poverty_sub_regional_2019_2017_data_.pdf).

<sup>15</sup> ONS website, Research Outputs: Small area estimation of fuel poverty in England, 2013 to 2017, URL: <https://www.ons.gov.uk/peoplepopulationandcommunity/housing/articles/researchoutputsmallareaestimationoffuelpovertyinengland2013to2017/2019-07-08>, visited 17<sup>th</sup> February 2020.

Other companies have also undertaken analysis at a detailed level. For example, Western Power Distribution (an electricity distribution company) have developed analysis of the vulnerability of their customers by LSOA<sup>16</sup>, generating a “Priority Service Register gap index” that indicated the relative level of vulnerability of people within each LSOA. This was based on publicly available data on, for example, the age distribution of customers, the proportion of people claiming disability benefit and the proportion of low-income households. However, it is important to note that the output from this was used to improve targeting of outreach rather than aggregation of calculated outputs.

This precedent would suggest that the value of more detailed outputs or calculations is therefore primarily to identify particularly high (or low) areas of water poverty. Calculation at a detailed level is unlikely to increase the accuracy of any output that is presented or aggregated at a higher level unless the source data itself is available at this detailed level. However, we undertook a high-level review of income data and statistics at a LSOA and MSOA level – see subsection 2.3.3 below – to test this assumption further.

### 2.3.2. Practicalities

#### Data Availability - Income

Income information is available from both public and private sources. At the 27<sup>th</sup> January workshop with water companies it was agreed that as a point of principle it would be preferable to use publicly available data if at all possible, both to increase the transparency of the calculations and since private data, typically from CRA, would be costly and limit the extent to which data could be published (see discussion in Section 2.1). We have therefore examined what income data is publicly available.

The Office of National Statistics (ONS) typically publishes income statistics using either average (or mean) annual income or income distributions. Income distributions can be via deciles<sup>17</sup> or the number of observations in the sample that fall within certain pre-defined categories of income.

Under our top-down method (see Figure 1), we aim to use an income distribution to determine the water poverty metric. This income distribution would need to involve some modelling at the more detailed levels that we are considering. The modelled income distribution in each area of interest (i.e. LSOA or MSOA) would be based on public data on average incomes combined with distributional data.

There are, therefore, two aspects of income data availability that need to be considered:

- average income data; and
- income distribution data.

Official UK-wide statistics on average annual income are **available for MSOA but not for LSOA**. For example, the “Small area income estimates for middle layer super output areas” release<sup>18</sup> contains MSOA-level information on gross and net average annual income, including or excluding housing and childcare costs and accounting for household size.

Official statistics on the distribution of incomes are less readily available for “small areas”. For example, ONS data on the impact of taxes and benefits on household income<sup>19</sup> include deciles of the income distribution at a national

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<sup>16</sup> Western Power Distribution website, Social indicator mapping, URL: <https://www.westernpower.co.uk/customers-and-community/priority-services/social-indicator-mapping>, visited on 17<sup>th</sup> February 2020.

<sup>17</sup> If incomes were lined up in ascending order, the income that would be at 10%, 20% and so on in this sequence.

<sup>18</sup> ONS website, Small area income estimates for middle layer super output areas, England and Wales, URL: <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/smallareaincomeestimatesformiddlelayersuperoutputareaseotlandandwales>, visited on 30 January 2020.

<sup>19</sup> ONS website, Effect of taxes and benefits on household income, URL: <https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/incomeandwealth/datasets/theeffectoftaxesandbenefitsonhouseholdincomefinancialyearending2014>, visited 13 February 2020.

level, with some data on regional income distributions available from the Family Resources Survey data.<sup>20</sup> In addition, the ONS's households in poverty estimates<sup>21</sup> include estimates of the proportion of households in poverty before and after housing costs at MSOA level, and this therefore provides some distributional information at MSOA level.

The ONS does have some data available on income at LSOA level<sup>22</sup> that includes distributional information. Household incomes are provided by LSOA in income bands. However, the ONS does not consider its LSOA income distribution release to count as "official statistics". They explicitly state that "Research Output" on LSOA income from Pay As You Earn (PAYE) and benefits for tax year ending in 2016 are "*outputs from research into a different methodology to that currently used in the production of income statistics. **These outputs must not be interpreted as an indicator of poverty or living standards***". CEPA emphasis added.

## Data Availability - Bills

Given the involvement of the water companies in this work we do not anticipate there being material issues with undertaking analysis of bills at either LSOA or MSOA level.

## Data Manipulation

It should be possible to construct an Excel spreadsheet whether the calculations are undertaken at LSOA or MSOA level, albeit that the spreadsheet would be around five times as large if LSOA level calculations were undertaken.

The key data manipulation step will be in estimating the income distribution for either an MSOA or LSOA. Given that average income data is available at MSOA level, and that this is the most detailed level at which any official statistics on distribution are available, it should be possible to directly estimate income distributions based on the data at MSOA level, albeit that we would need to rely largely on regional or national data for distributional information.

It would be difficult to estimate either average income or the income distribution at LSOA level. An approach to estimate income distributions would either need to:

1. Assume that income at LSOA level was consistent with that at the MSOA level; or
2. Base the analysis on the experimental ONS data based on PAYE and benefits information; or
3. Identify drivers or indicators of income, for which there are data (or proxies) available official datasets, and use this to model LSOA level income distributions.

We believe that only the first of these approaches is realistic within this project. The alternatives are major tasks that would require significant analysis and testing and, given their wider applicability, they would be better undertaken by (for example) the ONS.

This first approach does not preclude calculations being undertaken at LSOA level, or output being provided at LSOA level. It would, however, limit the identification of areas of water poverty risk smaller than MSOA to the bills in those smaller areas rather than pockets of low incomes.

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<sup>20</sup> ONS provides the percentage of households that fall within specified categories of income for years up to 2017/2018 only at regional level. Source: ONS website, Family Resource Survey, URL:<https://www.gov.uk/government/collections/family-resources-survey--2>, visited on 31 January 2020.

<sup>21</sup> ONS website, Small area model-based households in poverty estimates, England and Wales: financial year ending 2014, URL:<https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/incomeandwealth/bulletins/smalleramodelbasedhouseholdsinpovertyestimatesenglandandwales/financialyearending2014>, visited 13 February 2020.

<sup>22</sup> ONS website, Research Outputs: Income from Pay As You Earn (PAYE) and benefits for tax year ending 2016, URL:<https://www.ons.gov.uk/census/censustransformationprogramme/administratedatacensusproject/administratedatacensusresearchoutputs/populationcharacteristics/researchoutputsincomefrompayasyouearnpayeandbenefitsfortaxyearending2016>, visited on 30 January 2020.

### 2.3.3. Impact – Initial analysis

The purpose of undertaking analysis and presenting results at a more detailed level is primarily to identify areas of low/high poverty at LSOA level that are not available from MSOA level calculations. We have therefore undertaken some initial analysis to get a high-level understanding of how much variation there might be *within* MSOAs.

This analysis has focussed on the variation of income within MSOAs from three sources of publicly information, all of which are available at LSOA level:

- Average income levels in London Boroughs;
- Estimated proportion of households in fuel poverty; and
- ONS research output on PAYE and benefits and income data.

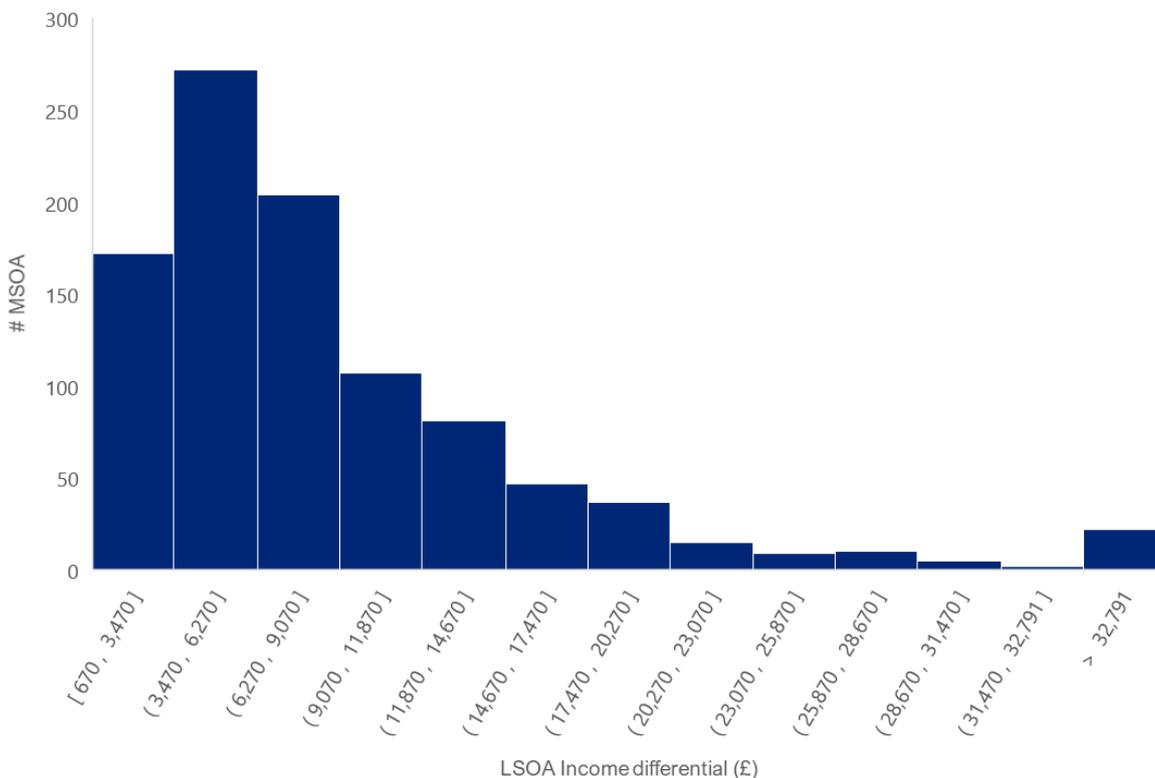
We discuss these analyses in turn below.

#### Average Income in London Boroughs

In 2015, the Greater London Authority (GLA) published gross annual household income for the 2001 to 2013 period at both MSOA and LSOA level. We used 2012/2013 data to investigate how accurately average income at MSOA level reflects the spectrum of incomes of associated LSOAs.<sup>23</sup>

To this end, we computed the maximum difference within each MSOA between average incomes of the underlying LSOAs in each London Borough.

Figure 3: Distribution of LSOA average income interval within each MSOA



Source: CEPA analysis based on Greater London Authority data

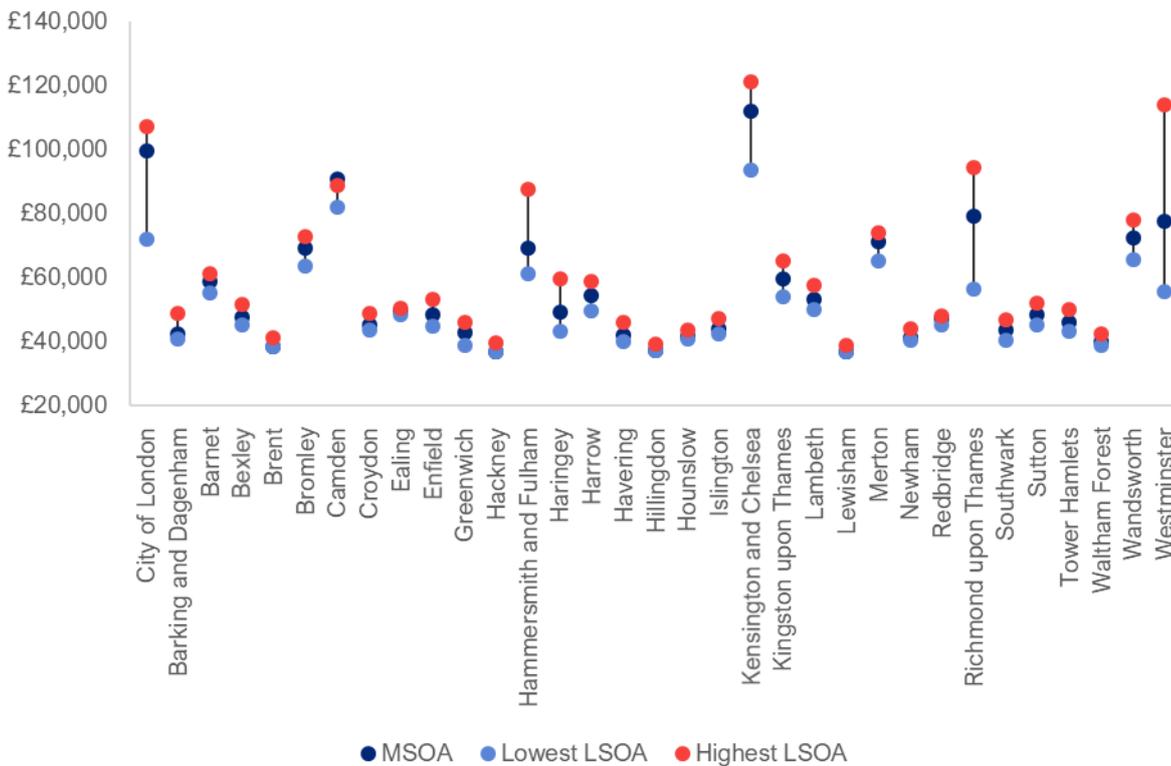
<sup>23</sup> Data.London.GOV.UK website, Household income estimates for small areas, URL:<https://data.london.gov.uk/dataset/household-income-estimates-small-areas>, visited on 17<sup>th</sup> February 2020.

As shown in Figure 3, the variation of LSOA average income levels within each MSOA is below £12,000 for the vast majority of the sample, meaning that, for example, MSOA average income of say £40,000 reflects LSOA incomes from £34,000 to £46,000 for most of the sample.

Notwithstanding that the variation of LSOA income within each MSOA in the GLA data set is mostly contained within £12,000, water poverty could be mis-estimated if areas with larger within-MSOA income variation are those with lower average income. To this end, we investigated within-MSOA income variation across the different London Boroughs. As shown in Figure 4, larger variation occurs mostly within a few “richer” Boroughs such as City of London, Westminster, Richmond and Kensington.

It is important to note that the variation observed, relative to MSOA level income in Figure 3 and 4, is based on the lowest and highest LSOA within each MSOA. This means that other LSOAs within each of the MSOAs will have less variation relative to the MSOA average income.

Figure 4: Within-MSOA average income variation in London Boroughs



Source: CEPA analysis based on Greater London Authority data

### Estimated Proportion of Households in Fuel Poverty

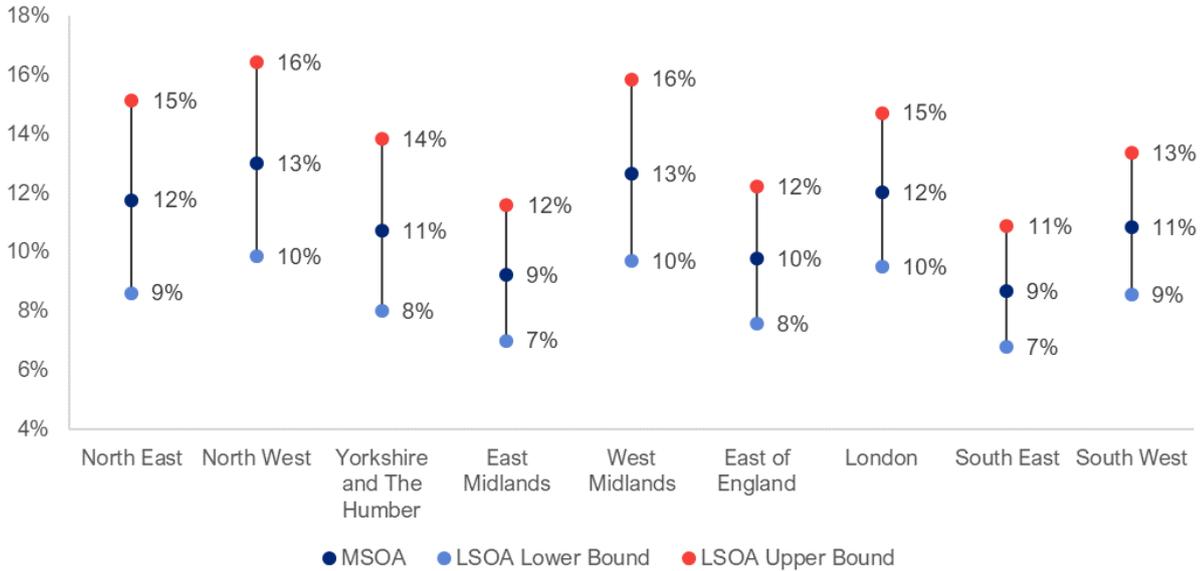
As discussed above, BEIS estimates fuel poverty relying on LSOA data on number of households and number of households in fuel poverty. We used this data to derive fuel poverty for each MSOA and to show how fuel poverty of each MSOA compares to the level of fuel poverty of underlying LSOAs. More specifically, we compared MSOA level fuel poverty with the lowest and highest values of related LSOAs to capture the maximum impact.

In Figure 5 below we report this comparison for different regions of England.<sup>24</sup> This analysis shows that fuel poverty of different LSOAs within each MSOA spans at maximum from -2% and -3% to +2% and +3% depending on the region. This means that, for example, MSOA-based fuel poverty is 9% on average in the South East, maximum fuel poverty in the underlying LSOAs is on average 11% whilst the minimum is 7%.

<sup>24</sup> BEIS fuel poverty publication does not include data on Wales.

As with the London Borough data, it is important to note that the within MSOA variation in Figure 5 is based on the lowest and highest LSOA in each MSOA. Other LSOAs will have less variation relative to the MSOA average fuel poverty calculation. We also note that fuel poverty statistics are based on inferred – i.e. estimated – bills and income, which would not be the case with an envisaged water poverty metric.

Figure 5: Within-MSOA fuel poverty variation by region (proportion of households in fuel poverty)



Source: CEPA analysis based on ONS data

## ONS Research Output on Income data

To assess the impact that MSOA and LSOA aggregation has on income data we have also compared income distributions of MSOAs with those of underlying LSOAs.

We combined ONS research output on PAYE and benefits and income data with the ONS' statistics on the number of households in each LSOA and MSOA to determine income distributions at both levels of aggregation.

Figure 6 shows the average distribution of income at MSOA level and at LSOA level using the ONS data set. This suggests the average distribution at MSOA is not substantially different from the average distribution at LSOA level, although LSOA-based distribution show more households with lower level of incomes and less with higher levels.

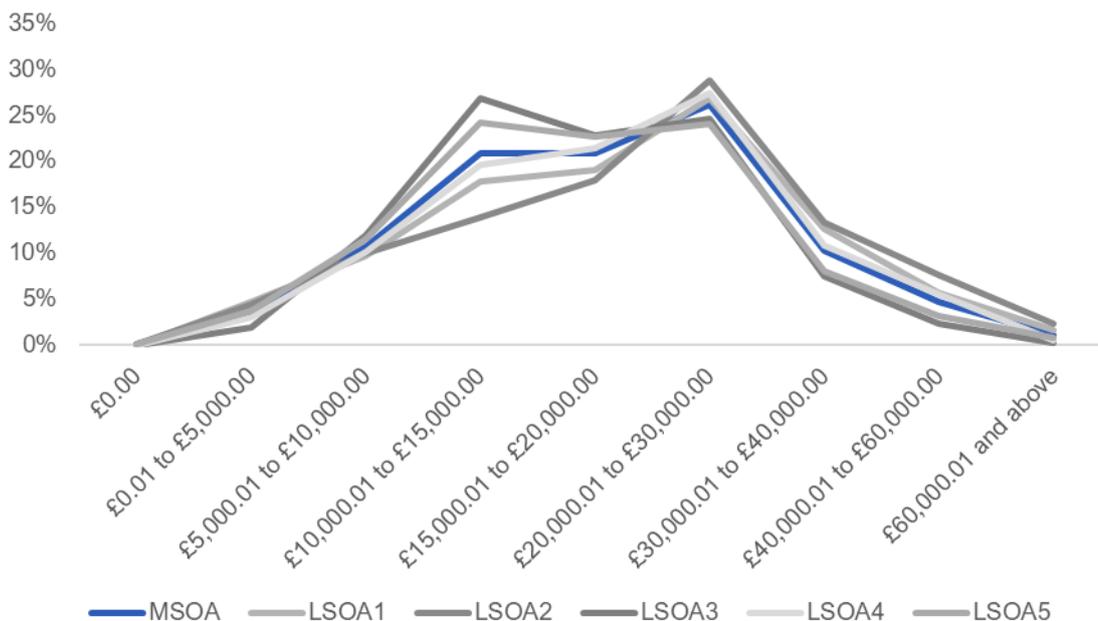
Figure 6: Average distribution of income at MSOA and LSOA level



Source: CEPA analysis based on ONS data

Despite similar average distributions, the impact of data aggregation from LSOA to MSOA level on income distribution can be very different across MSOAs and LSOAs. Whilst a full assessment for each MSOA is not possible in this report,<sup>25</sup> we show the differences in the distributional impact for Newport 020 and County Durham 001 in Figure 7 and Figure 8 below

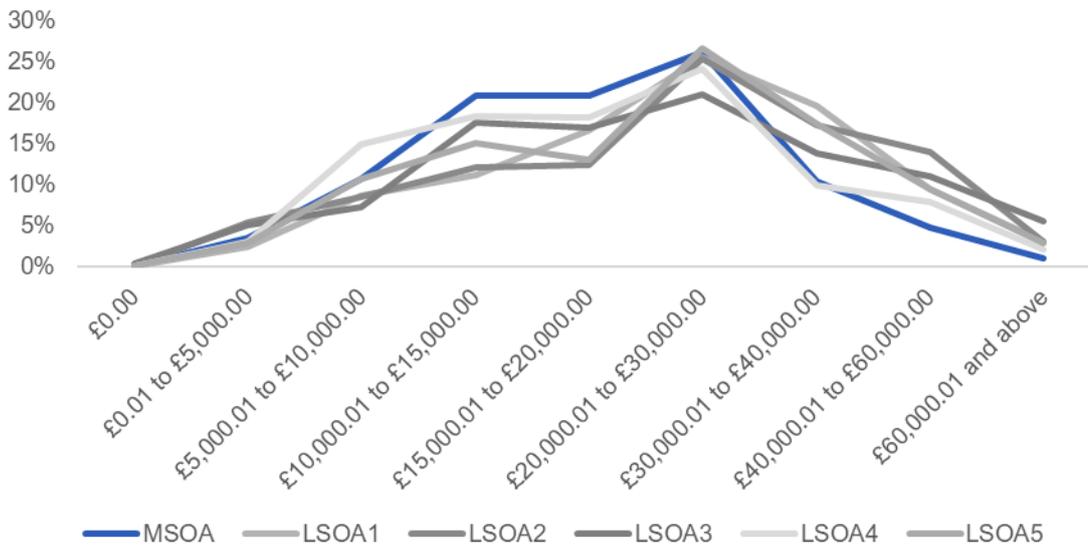
Figure 7: Income Distribution at MSOA and LSOA level for County Durham 001



Source: CEPA analysis based on ONS data

<sup>25</sup> We would need to report separately the comparison of the distributions for each of the 7201 MSOAs with those of the underlying 34753 LSOAs.

Figure 8: Income Distribution at MSOA and LSOA level for Newport 020



Source: CEPA analysis based on ONS data

### 2.3.4. Summary and implications

Table 8 below, summarises the inferences that we have drawn from our work on MSOA vs. LSOA data aggregation impacts against the Principles.

For this summary, we have provided a simple Red-Amber-Green (RAG) rating to indicate how we consider an LSOA and MSOA based methodology performs against the set of principles identified at the workshop.

Table 8: Consistency of approaches with principles

Principle	LSOA	MSOA
Provides strategic and dynamic picture	<b>Yes</b> , LSOA data could in principle be used to provide a view on water poverty at a relatively granular level of aggregation It may help to identify particularly high (or low) areas of water poverty, subject to appropriate data being available	<b>Yes</b> , MSOA data could be used to provide a view on water poverty at a regional, but still relatively granular, level of aggregation
Consistent across companies	<b>Yes</b> , subject to clear definition of billing data	<b>Yes</b> , subject to clear definition of billing data
Sufficiently accurate	<b>Yes</b> , LSOA data is in principle more granular and will capture within-MSOA variation of data However, given the scarcity of public sources and our preliminary impact analysis of income data publicly available at LSOA level, the expected accuracy gains vs. MSOA is inconclusive Given the limited LSOA income data available, we consider that a practical LSOA method would need to assume that income at an LSOA level was consistent with that an MSOA level. This would limit the identification of areas of water poverty risk smaller than MSOA to	<b>Yes</b> , although potentially less accurate for small areas within each MSOA Given the issues we identify with estimating water poverty at an LSOA level (see left), we consider that it is unlikely an MSOA level of aggregation would result in a significantly less accurate output than using an LSOA method However, this conclusion can be tested further using companies' response to the 10 <sup>th</sup> February data request

the bills in those smaller areas, rather than pockets of income

Transparent	<p><b>No</b><sup>26</sup>, there are no public data sources on average income at LSOA level, only unofficial statistics on income distributions</p> <p>Transparency would be lower under a full LSOA method due to expected reliance on either private data on income or additional modelling and assumptions</p> <p>However, if income at an LSOA level was assumed to be consistent with that at an MSOA level, the transparency of the method would be improved, as only bills data at an LSOA level would be used in the adopted methodology</p>	<p><b>Yes</b>, MSOA information on income is available in the public domain, ensuring transparency and not limiting publication</p>
Sufficiently simple and flexible	<p><b>No</b><sup>27</sup>, reliance on LSOA data on income likely to make manipulation on income definition (e.g. housing costs deduction) less simple (unless income at an LSOA level was assumed to be consistent with that at an MSOA level)</p> <p>Larger sample size reduces flexibility and efficiency of updates</p>	<p><b>Yes</b>, high availability of MSOA data on income allows to maximise ease and flexibility in definition of income manipulations (e.g. equivalisation, housing costs)</p>
Fair	No impact	No impact

Source: CEPA analysis

<sup>26</sup> If both an LSOA level bills and income data set was targeted.

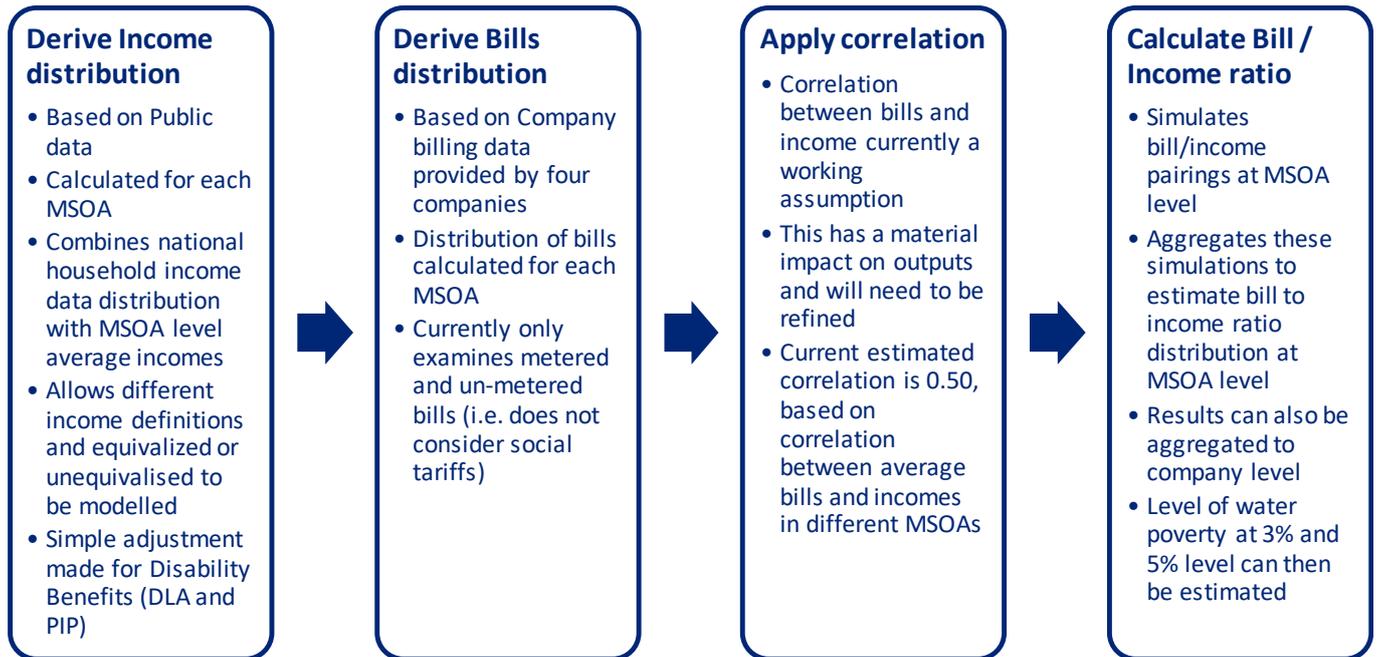
<sup>27</sup> If both an LSOA level bills and income data set was targeted.

### 3. PROOF OF CONCEPT MODEL

#### 3.1. APPROACH AND BASE CASE RESULTS

We have developed a “proof of concept” model to test the top-down approach and demonstrate whether the model can deliver results that look reasonable given the assumptions and data that are input. The approach to the modelling is set out in Figure 9.

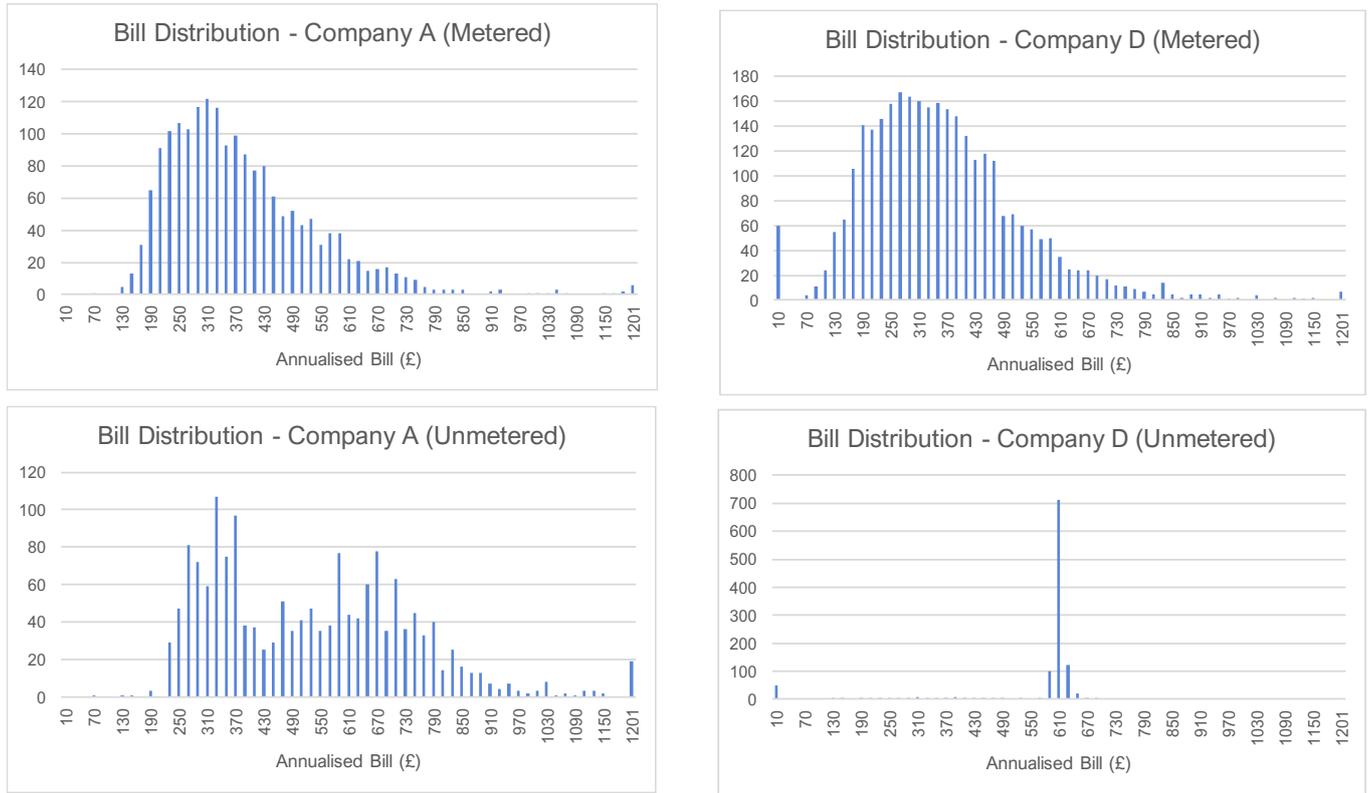
Figure 9: Proof of concept approach



Source: CEPA analysis

The model was applied to billing data from four companies. For this proof of concept modelling we analysed combined water and sewerage, standard tariff bills. Both metered and unmetered bills were modelled, but we did not undertake any analysis where companies provided only water or sewerage. Figure 10 shows some example input bill distributions from two of the companies for a single MSOA.

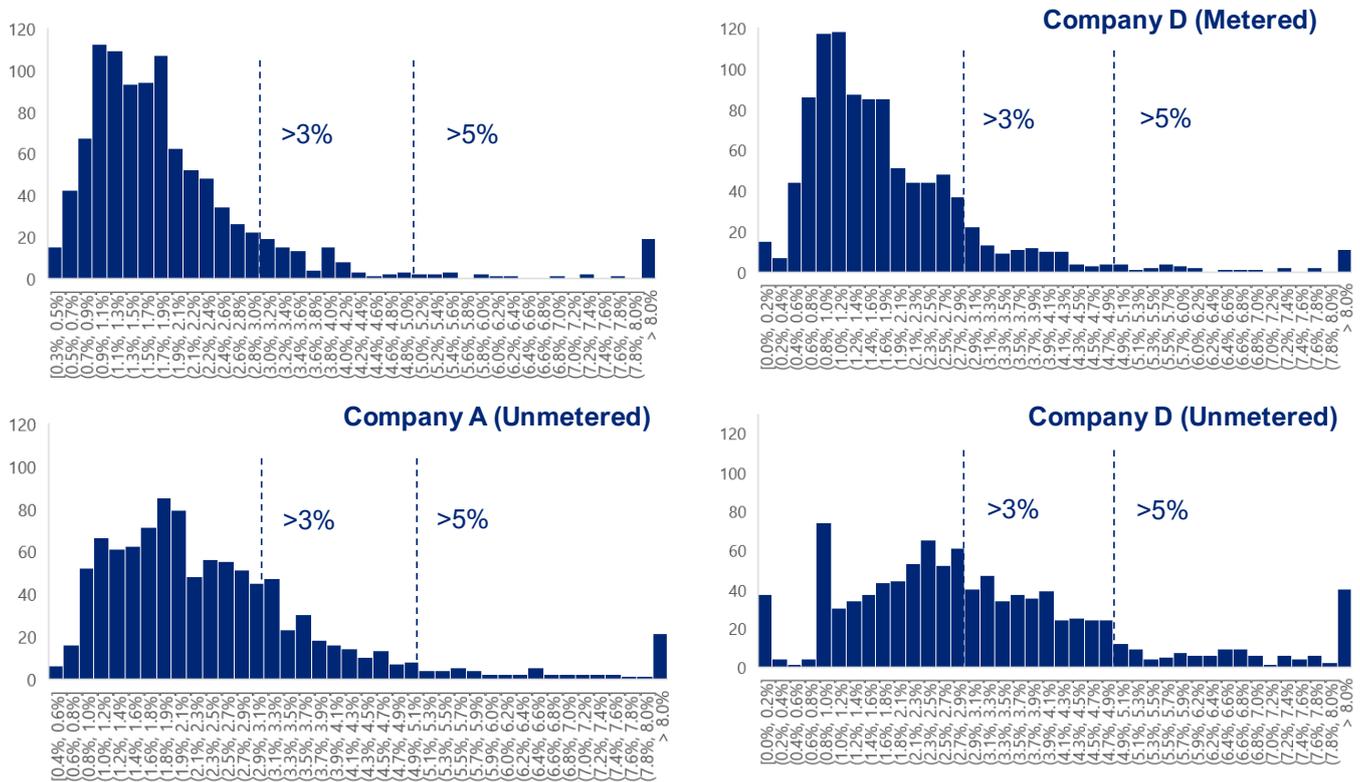
Figure 10: Example bill distributions



Source: CEPA analysis

The output distributions of the bill to income ratios for these two MSOAs are depicted in Figure 11 below.

Figure 11: Example Bill to income distributions



Source: CEPA analysis

These output distributions appear realistic, and the proportion of households that are in water poverty can be calculated by counting the proportion of households that are to the right of the “>3%” and “>5%” lines in Figure 11. The approach can therefore easily be tailored for different defined levels of water poverty.

In addition, by changing the input income distributions, for example by moving from a BHC to AHC definition, it is possible to examine the impact of changing the definitions.

Table 9 sets out the results of applying this model for a BHC income definition, where income is equivalised. A simplified adjustment has been made for Disability Living Allowance and Personal Independence Payment.

*Table 9: Base case outputs from proof of concept model*

Metric	Company A	Company B	Company C	Company D	Average
Average Income <sup>28</sup>	£27,000	£28,900	£27,600	£31,400	<b>£28,700</b>
Average Bill <sup>29</sup>	£450	£420	£400	£420	<b>£420</b>
Average Bill / Income	1.67%	1.45%	1.45%	1.34%	<b>1.48%</b>
Bill / Income above 3%	22.2%	16.0%	14.9%	12.7%	<b>16.4%</b>
Bill / Income above 5%	6.6%	4.7%	4.4%	3.9%	<b>4.9%</b>

*Source: CEPA analysis*

The modelling approach gives results that appear to make sense given the average incomes and costs of the four companies. For example, companies with higher average bills, relative to income, also have higher levels of water poverty. We have also compared our outputs, at a high-level, to estimates of water poverty previously prepared for Company D based on more detailed LSOA analysis using CRA data. Our aggregate results are comparable to this previous analysis: water poverty at the 3% level is very close to that calculated by Company D, while water poverty at the 5% level is lower in our analysis.

As with all modelling, the quality of our output is dependent on the quality of the inputs. Two issues are particularly important:

- Correlation between bills and income has a significant effect and more work on this would be needed to deliver reliable outputs.
- More sophisticated assumptions of the shape of the income distribution, especially at low income levels, would be helpful.

We would be able to develop our analysis and assumptions further in these areas.

The approach could be extended to apply to other companies or to calculate at LSOA level (albeit with MSOA income data) relatively easily. There is also scope to develop the modelling further to refine the input assumptions and take advantage of the Monte Carlo simulation that is used in more sophisticated ways; in particular to better address disability allowances and potentially social tariffs.

Other sources of income data could be considered to increase the accuracy of the modelling, but this may involve trade-offs in terms of transparency and complexity relative to use of ONS data.

<sup>28</sup> Weighted average of billed households

<sup>29</sup> Weighted average based on data from companies, not used in water poverty modelling

### 3.2. IMPACT OF INTERVENTIONS

Our suggested “augmented” top-down approach would adjust these base case results for interventions. There are a range of interventions that companies currently apply to those that are having trouble with their bills. These include:

- Installing a water meter, potentially with a lowest price guarantee
- Advice on water use and water saving
- Benefits advice to maximise household income
- Social tariffs
- Payments holidays and / or phasing of payments

In principle, all of these could result in changes to the bill to income ratio, via either reducing bills or increasing income (with the possible exception of phasing of payments). We could therefore take information from the companies to evidence these interventions and adjust the bill to income distributions. This would allow us to utilise detailed data as necessary.

We do not currently have sufficient information on any of these interventions to incorporate them fully into our model. However, we can illustrate how it might apply to social tariffs since we have data from the four sample companies on the number of households that are on social tariffs. We can therefore illustrate what proportion of households would be brought out of water poverty by these social tariffs by calculating the proportion of households that receive them. This is the maximum number of households that could be brought out of water poverty, at either the 3% or 5% bills to income level, by current numbers of social tariffs. We cannot judge whether these interventions would be sufficient to move households to below the 5% or 3% level with the data available. This maximum impact on water poverty for the four companies is depicted in Table 10.

Table 10: Potential current impact of social tariffs

Metric	Company A	Company B	Company C	Company D	Average
Bill / Income above 3%	22.2%	16.0%	14.9%	12.7%	<b>16.4%</b>
Bill / Income above 5%	6.6%	4.7%	4.4%	3.9%	<b>4.9%</b>
<b>Maximum reduction in water poverty due to social tariffs</b>	<b>3.2%</b>	<b>1.3%</b>	<b>2.1%</b>	<b>2.5%</b>	<b>2.3%</b>

Source: CEPA analysis

## 4. INCOME DEFINITION

### 4.1. BACKGROUND AND PRINCIPLES

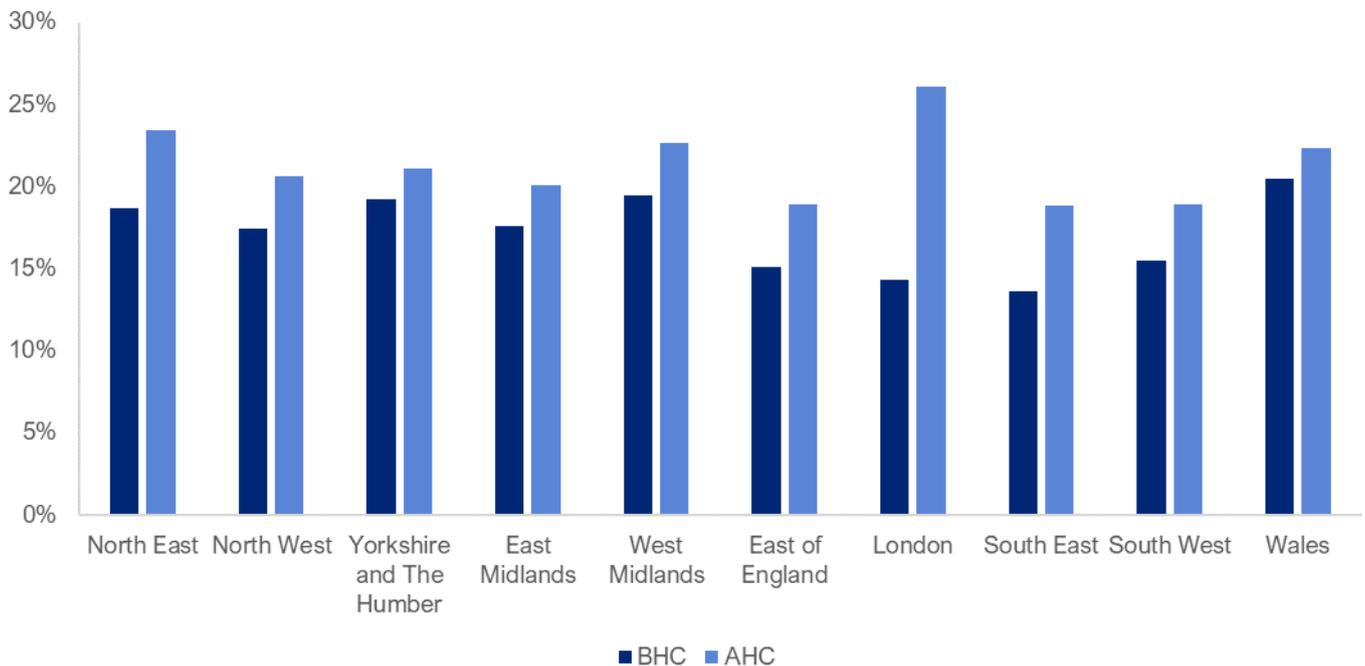
There are a number of different definitions of income that can be applied to calculate the proportion of households that have a bill to income ratio above a certain level (typically either 3% or 5%). The definition that is utilised has an impact on the calculated proportion of households whose bills exceed the chosen threshold, since incomes that have more deductions (such as housing or childcare costs) are obviously reduced.

Any such reduction in the income used for water poverty calculations has two effects when a specified bill to income ratio is used as a threshold to define water poverty:

- It increases the calculated level of water poverty; and
- It can affect the geographic distribution of water poverty if the deductions are not consistent across the country. Most obviously, we might expect housing costs to be higher in urban areas which would increase calculated water poverty in these locations relative to others.

The effect of income definition on poverty levels (i.e. percentage of households below 60% of the adopted definition of median income) can be seen in Figure 12, which shows the proportion of households in poverty in English regions and in Wales if income is defined before housing costs (BHC) or after housing costs (AHC).<sup>30</sup>

Figure 12: Households in Poverty by Region in 2013/14



Source: CEPA analysis based on ONS data

While it is important to note that Figure 12 depicts overall, rather than water, poverty it is clear that the decision to examine income BHC or AHC has a particularly large impact on London and the South East.

Some of the principles that were agreed for this water poverty project are also relevant to the decision about which income definition to apply. These relevant principles are that the measure should be:

<sup>30</sup> ONS website, Small area model-based households in poverty estimates, England and Wales: financial year ending 2014. URL: <https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/incomeandwealth/bulletins/smalleramodelbasedhouseholdsinpovertyestimatesenglandandwales/financialyearending2014>, visited on 30 January 2020.

- Sufficiently accurate to draw conclusions of progress in addressing water poverty;
- Transparent, implying that use of public data should be maximised; and
- Fair, a measure needs to be recognised as a fair measure of water poverty by internal and external stakeholders.

The first two areas are related and we have addressed them in this report by considering the availability of public data to calculate income levels and/or the ability to transparently and robustly adjust data for different definitions (see Section 4.3 below).

We have assessed fairness by considering what income definitions are used for other analogous work or that has been recommended in previous studies of water poverty. This is discussed in the subsection below where we discuss relevant precedent.

## 4.2. PRECEDENT

BEIS has worked on fuel poverty for many years and regularly releases fuel poverty statistics.<sup>31</sup> At present, fuel poverty in England is measured using the Low-Income High Costs (LIHC) indicator.

Under LIHC a household is fuel poor if:

- required fuel costs are above the median level; and
- if they incurred the required fuel cost amount, they would remain with a disposable income below the official poverty line.<sup>32</sup>

LIHC relies on an equivalised *AHC* measure of income. The income equivalisation factor is the same as that of the ONS, which is based on the approach applied by the OECD.<sup>33</sup>

Ofwat developed a water affordability and debt measure in 2015 that used *AHC* data<sup>34</sup> and Citizens Advice Scotland relied on *AHC* income to investigate affordability of water and sewerage charges in Scotland.<sup>35</sup>

Work undertaken by the National Energy Action (NEA) on a common measurement of water poverty<sup>36</sup> recommended that a household should be defined as in water poverty if it spent more than 3% of the household disposable income on their combined water and sewerage bills. Their definition of household disposable income was based on that of a Minimum Income Standard (MIS) – the minimum income required for a household to achieve a decent standard of living. It was defined as household income after housing and childcare costs.

More generally, as discussed above, various poverty measures on disposable income are in common use within the UK. A House of Commons library briefing paper on Poverty statistics in the UK<sup>37</sup> discusses the various sources of income for individuals and households, including earnings from employment, cash benefits<sup>38</sup>, investments, private

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<sup>31</sup> For a detailed discussion of fuel poverty across years, refer to UKWIR and CEPA (2019), “Defining Water Poverty and Evaluating Existing Information and Approaches to Reduce Water Poverty”, Annex D.

<sup>32</sup> BEIS (2019), Fuel Poverty Methodology Handbook, p.1.

<sup>33</sup> BEIS (2019), Fuel Poverty Methodology Handbook, p.10.

<sup>34</sup> Ofwat (December 2015), “Affordability and debt 2014-2015 – supporting information”, p.69.

<sup>35</sup> Fraser of Allander Institute (November 2017), “The affordability of water and sewerage charges in Scotland”, p.4.

<sup>36</sup> NEA (August 2019), “Water Poverty: a Common Measurement”, available at: <https://www.nea.org.uk/wp-content/uploads/2019/09/Water-poverty-a-common-measurement-PRINT-VERSION.pdf>

<sup>37</sup> House of Commons Library (September 2019): ‘Poverty in the UK: statistics’, Number 7096 available at: <https://researchbriefings.parliament.uk/ResearchBriefing/Summary/SN07096#fullreport>

<sup>38</sup> For example, the State Pension, housing benefit, tax credits etc.

pensions and other forms of income. It notes that in the context of poverty statistics “we generally look at household income measured after adding on benefits and after deducting direct taxes (that is disposable income) as a guide to the resources available to the household.”<sup>39</sup>

The same House of Commons report also notes that household income can be measured before and after housing costs are deducted and that both measures are commonly used in official poverty statistics, noting that in some cases one measure may be more appropriate than others. The report notes that a “BHC measure acknowledges that some households may choose to spend more on housing in order to enjoy a better quality of accommodation. On the other hand, variations in housing costs may not always reflect differences in the quality of accommodation (for example, geographical differences mean two households could face very different costs for a comparable standard of housing). In this case, an AHC measure is arguably more illuminating.”<sup>40</sup>

While it is not possible to draw a definitive conclusion on the issue of AHC or BHC – in part for the reasons outlined in the House of Commons and DWP publications – we would make the following observation.

The precedent above suggests a number of key public stakeholders in the water sector have tended to rely on a measure of household income AHC – including Ofwat, Citizens Advice Scotland, the BEIS LIHC indicator and a series of independent studies and analyses of water poverty in the UK. This would suggest that an AHC measure of income could be perceived to be the ‘fairest’ definition for measuring the industry’s strategic ambition and progress towards reducing water poverty across England and Wales over the next decade.

### 4.3. AVAILABILITY OF PUBLIC DATA

#### 4.3.1. Household Income

The ONS use several types of income definitions to determine its statistics on average annual income at MSOA level. Specifically, the ONS released average annual income (and its confidence interval) for 2011/2012, 2013/2014 and 2015/2016 for total income, net income, net income BHC and net income AHC. These are defined as follows:

- **Total income** is the sum of the gross income of every member of the household plus any income from benefits such as Working Families Tax Credit.
- **Net income** has the same components of total income, but it is net of income tax payments, national insurance contributions, domestic rates/council tax, contributions to occupational pension schemes, all maintenance and child support payments and parental contributions to students living away from home.
- **Net income before housing cost** is composed of the same elements of net income but it is “equivalised” using OECD’s equivalisation scale and, therefore, captures that higher level of resources are needed to maintain larger households.
- **Net income after housing costs** removes housing costs from “net income before housing” to capture that higher incomes might be explained by more expensive housing costs across different regions. ONS includes rents, water rates, community water charges, council water charges, mortgage interest payments, structural insurance premiums, ground rents and service charges in its definition of housing costs. Again, the data is equivalised.<sup>41</sup>

<sup>39</sup> Ibid., p. 8

<sup>40</sup> We understand the Department of Work and Pensions (DWP) presents analyses of disposable income as part of its Households Below Average Income (HBAI) both BHC and AHC. “This is principally to take into account variations in housing costs that themselves do not correspond to comparable variations in the quality of housing.” See DWP, Households Below Average Income, 2010/11, 11 June 2012, Appendix 2: Methodology, p 266

<sup>41</sup> ONS website, Small income estimates for middle layer super output areas, England and Wales, URL:<https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/smallareaincomeestimatesformiddlelayersuperoutputareaseotlandandwales>, visited on 30 January 2020.

There is, therefore, a strong link between the decision on income definition and equivalisation, since AHC data at MSOA level, using ONS published statistics, is only readily available as equivalised. In contrast, BHC data is available both equivalised and unequivalised.

#### 4.4. DISABILITY ALLOWANCES

Individuals who have personal care or mobility needs as a result of mental or physical disability can be eligible for monetary support known as Disability Living Allowance and Personal Independent Payment (DLA and PIP) that increases households income.<sup>42</sup> It was agreed in principle at the 27<sup>th</sup> January workshop with water companies that income should be defined excluding any such payments, since they are income that is provided as a benefit to address increased costs. These payments should, therefore, not be classed as part of a household's disposable income.

Our understanding is that the ONS data on average income at MSOA level does *not* remove disability allowance as part of the net income calculation though. To avoid a potential overestimation of disposable income and, therefore by extension an *underestimation* of water poverty, we would then in principle need to remove DLA and PIP from the ONS data. However, despite being theoretically correct, this operation is practically not straightforward, given that DLA and PIP allowances and numbers of claimants are not easily available at MSOA levels for 2015/2016<sup>43</sup>. In addition, the available data is individual rather than household-based, and the public data that is necessary for the reconciliation refers to different years than the ONS average income statistics.

There are, therefore, practical challenges in making an adjustment for disability allowances. We have performed some preliminary analysis using some of the available sources to estimate the order of magnitude that DLA and PIP deductions could have on average disposable income and the expected robustness of the water poverty estimates produced<sup>44</sup>. We discuss our findings in Section 4.6 below. As part of the development of the proof of concept modelling, we have also identified simple and more sophisticated approaches that could be used to make a deduction for disability allowances (DLA and PIP).

#### 4.5. CHILDCARE COSTS

A National Energy Action (NEA) discussion paper on the common and consistent measurement of Water Poverty within the UK<sup>45</sup> proposed that a deduction to disposable income should also be made for childcare costs to reflect households' basic needs.

We consider that a decision on making a deduction for childcare costs is linked to three points:

- **Availability of data** – Our understanding is that the ONS do not publish data on childcare costs, although there is material published by the Family and Childcare Trust.

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<sup>42</sup> (1) GOV.UK, Disability Living Allowance (DLA) for adults. URL:<https://www.gov.uk/dla-disability-living-allowance-benefit>, visited on 4 February 2020. (2) GOV.UK, Personal Independence Payment (PIP), URL: <https://www.gov.uk/PIP>, visited on 4 February 2020.

<sup>43</sup> Recall that average income at MSOA level for 2015/2016 is the benchmark dataset for income. As we discuss in Section **Error! Reference source not found.**, disability claimants can be retrieved at LSOA and LA data depending on the type of benefit but monetary benefits are somewhat more difficult to retrieve.

<sup>44</sup> ONS website, Small area income estimates for middle layer super output areas, England and Wales, URL:<https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/incomeandwealth/bulletins/smallermodelbasedincomeestimates/financialyearending2016>, visited on 30 January 2020.

<sup>44</sup> This exercise is for illustration purposes and should not be considered as a statistical

<sup>45</sup> NEA (August 2019): 'Water poverty: A common measurement'

- **Practicality of incorporation** – The deduction from disposable income, may require breakdowns of the number of children per household as a minimum and ideally the ability to link this to specific deciles.
- **Crossover with equivalisation** – Applying a deduction for childcare costs, as well as equivalisation, could result in double counting.

We expect the practical issues with developing a fair and proportionate adjustment methodology for household childcare costs may be significant.

If it was agreed that the impact of childcare costs on disposable household income should be accounted for in the water poverty calculation, then there might be an argument for making a deduction if income equivalisation is *not* applied, but not if the decision is made to equivalise income. This is because both adjustments are seeking to adjust for the variation in basic needs of households with different occupancy levels and larger household’s capacity to translate a given level of resources into a basic standard of living. We expect the degree to which there is ‘double counting’ may depend on the equivalisation scale that is used.

## 4.6. IMPACT

The estimated impact of moving from a BHC to AHC definition of income, based on our proof of concept model, is depicted in Table 11.

Table 11: Impact of income definition

Metric	Company A	Company B	Company C	Company D	Average
Average Income (BHC)	£27,000	£28,900	£27,600	£31,400	<b>£28,700</b>
Bill / Income above 3% (BHC)	22.2%	16.0%	14.9%	12.7%	<b>16.4%</b>
Bill / Income above 5% (BHC)	6.6%	4.7%	4.4%	3.9%	<b>4.9%</b>
Average Income (AHC)	£24,200	£26,100	£24,800	£28,200	<b>£25,800</b>
Bill / Income above 3% (AHC)	29.4%	21.4%	20.6%	16.5%	<b>22.0%</b>
Bill / Income above 5% (AHC)	9.5%	6.6%	6.1%	5.1%	<b>6.8%</b>
<b>Increment<sup>46</sup> in Bill / Income above 3%</b>	<b>7.2%</b>	<b>5.4%</b>	<b>5.7%</b>	<b>3.8%</b>	<b>5.5%</b>
<b>Increment in Bill / Income above 5%</b>	<b>2.9%</b>	<b>1.9%</b>	<b>1.8%</b>	<b>1.2%</b>	<b>1.9%</b>

Source: CEPA analysis

Table 11 demonstrates that the impact of applying AHC, rather than BHC, is substantial. The impact of these choices on the possible level of cross-subsidy between “standard” and “social” tariffs that may be necessary to meet the Public Interest Commitment, and whether this level of cross-subsidy is compatible with the current policy framework, should be assessed before making a final decision.

<sup>46</sup> So, for example, if % of customers with bill / income ratio above 3% was 15% without equivalisation and the increment is 2%, the % of households with a Bill/Income ratio above 3% would be 17%.

Our proof of concept modelling includes a simplified adjustment for DLA and PIP. This has a relatively small impact – in particular, relative to the decision on AHC – on water poverty levels, but the adjustment is considered appropriate in light of the discussion in Section 4.4 above that conceptually it is appropriate to make this deduction. A more sophisticated approach to this deduction could be investigated within the Monte Carlo simulation that forms part of our top-down modelling approach.<sup>47</sup>

#### **4.7. SUMMARY**

The options for the definition of incomes within a common industry water poverty measure has been considered through discussions with stakeholders and the analysis set out above.

Overall, both the water companies and other stakeholders appear to agree that **taxes should be removed and that an adjustment should be made for disability allowances**. The rationale for these adjustments were that:

- Taxes are not a discretionary spend, and so any fair assessment of “disposable” income should remove them.
- Disability allowances such as DLA and PIP are intended to offset the increased costs of households that are associated with disabilities. Any additional income is therefore offset by an additional cost and so it would be unfair to include them as additional income.

The impacts of childcare and housing costs were considered in more detail, examining references such as House of Commons briefings on poverty measures and precedents set in the water and other industries.

For housing costs, we found that, while a BHC measure acknowledges that some households may *choose* to spend more on a better quality of accommodation, an AHC measure may be more illuminating where geographical differences mean that two households could face very different costs for comparable standards of housing. In addition, all external measures of poverty that we could find, whether from the water industry or elsewhere, applied AHC measures of income. Stakeholders generally agreed that a disposable definition of **AHC should be used** for the common measure of water poverty.

However, the impact on the “monetary gap”<sup>48</sup> that would need to be bridged to meet the PIC if using an AHC definition, needs further investigation.

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<sup>47</sup> We could apply two income distributions; one for households that receive DLA/PIP and one for those that don’t. ONS data is available that gives the proportion of households that receive DLA and PIP by MSOA and we could use this, together with the two income distributions to simulate incomes for individual households rather than averaging the effects of DLA/PIP over all households.

<sup>48</sup> I.e. how much is the minimum amount of cross subsidy between standard and social tariffs likely to be required to eliminate water poverty at 3% or 5% bills to income level.

## 5. EQUIVALISATION

This section discusses the application of an income equivalisation adjustment within a bills-to-income water poverty metric. First, we consider the conceptual underpinning for such an adjustment in poverty statistics. We then consider why it might be appropriate in principle in a water poverty metric calculation.

Finally, we consider some of the practical issues associated with making such an adjustment and some preliminary analysis of its potential impact.

### 5.1. CONTEXT

Equivalisation is the process of adjusting income-based statistics to capture the impact that household size (i.e. number of individuals) and composition (e.g. number of earning individuals and children) have on the standard of living that is available for a given level of income.

General poverty statistics are seeking to understand poverty by comparing a household's resources with their needs. Resources are relatively easy to measure, needs are not. Ideally, we would identify what a household's basic needs are, but this is difficult to measure and subjective.<sup>49</sup> However, we can proxy needs through resources.<sup>50</sup>

For example, we can establish a social norm that a household is in poverty if it is below 60% of a definition of disposable median income. When comparing a household's disposable income to median income we are reaching a social normative conclusion whether a household is in 'poverty' if they are below that 60% line – i.e. that they do not have sufficient "resources" to meet their "needs". As the Social Metrics Commission states:

*"this approach is based on developing a social norm level of spending power in society and comparing a family's own spending power to this level. The intuition being that if spending power is below a fraction of that norm, a family is unlikely to be meeting their needs."*<sup>51</sup>

Income equivalisation is used in this context because: *"the ability of families to translate a given level of resources into living standards will vary based on a range of factors including the size of the family. For example, a four-person family would be unlikely to gain the same standards of living from £10,000 as a single person might. However, taking the median of family resources and setting a fixed poverty line with reference to it would not take account of these variations. For example, a four-person family at the poverty line would be assumed to be able to enjoy the same standard of living as a single adult with the same resources, which clearly would not be the case ...*

*Equivalisation is the approach used to take account of this. It is the process through which we are able to **compare the resources of families of different sizes and structures on a consistent basis** and determine whether those **resources are sufficient to provide equivalent standards of living**."* CEPA emphasis added.

The water industry is developing a water poverty metric that relies on information on household expenditure on water bills and the households' level of income to calculate a ratio between the two.

Again, the basic purpose is to compare household resources and needs: does a household have sufficient resources to meet their water consumption needs?

Any adjustment to account for different households' composition will affect this calculation, and hence the number of households that are expected to be estimated as in water poverty. Any adjustment would affect the distribution of water poverty as well as the overall national level, since it would be expected to have a larger effect in areas where there are households that are typically either much larger or smaller than the average.

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<sup>49</sup> Social Metrics Commission (2019): 'Equivalisation in poverty measures: can we do better?'

<sup>50</sup> There are other methods – e.g. constructing a relevant basket of goods as originally proposed by Joseph Roundtree.

<sup>51</sup> Ibid., 9

## 5.2. WHY EQUIVALISE INCOME WHEN MEASURING WATER POVERTY?

It is common for income to be equivalised in assessing poverty. For example:

- The ONS uses equivalised income across all the statistics on income and poverty that we assessed for our report on income definition report (e.g. nation-wide MSOA income, MSOA poverty, LSOA income deciles with DLA information), though some income data is also available without equivalisation (e.g. incomes before housing costs);
- The Department for Work and Pensions (DWP) equivalises household income within the Households Below Average Income (HBAI) measure.<sup>52</sup>
- BEIS relies on equivalised income for calculating fuel poverty (albeit, we understand using a bespoke methodology).

While it may be applied in other contexts, is income equivalisation needed when seeking to measure water poverty? In this section we explore the issue from two perspectives:

- First, by considering the issue from first principles: why conceptually might it be appropriate (or not) to equivalise incomes in a water bills to income metric?
- Second, by considering the implementation issues that income equivalisation raises: can methodological challenges be overcome and is the additional complexity worthwhile?

### What is the conceptual justification for equivalisation in water poverty?

Ofwat – on the advice of DWP – has previously suggested an equivalisation adjustment should not be made: *“water and sewerage bills are (effectively) relative to the number of occupants in the household. This is either explicitly through metered charges or implicitly in the rateable value of the home. Using equivalised income would result in adjusting for occupancy in our ‘income’, but not in our ‘bills’. Because it is important for us to be able to explore the impact of the charging system on water affordability, using unequivalised income is the more appropriate choice.”*

In our opinion, Ofwat’s justification for not applying an income equivalisation adjustment is not fully clear, at least in the original source documentation we have reviewed. The Fraser of Allander Institute’s interpretation of Ofwat’s argument is that *“because larger households tend to have larger bills, there is no point in adjusting the incomes of these households without adjusting the bills correspondingly. Adjusting income only would bias the results to suggest that larger households face greater affordability constraints than they actually do.”*<sup>53</sup>

However, Ofwat also argue (see above) that bills are related to the number of household occupants. This is either explicitly through metered charges or implicitly through the rateable value of the home water bills.

Therefore, one alternative interpretation of Ofwat’s conclusion on income equivalisation, is that effectively, the water bill reflects the relative water needs of different households (though possibly to differing degrees depending on metering arrangements). The question of affordability is whether each household has sufficient disposable resources to fulfil that need, where ‘sufficient’ is defined as the water bill not exceeding a percentage (e.g. 3 or 5%) of available resources (again, a social norm of an expected standard of living). Water needs (bills) are ‘adjusted’ for occupancy, while income is not, because the purpose of measuring water poverty is to assess the affordability of water charges from the adopted definition of household disposable income.

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<sup>52</sup> GOV.UK, households below average income (HBAI) statistics, URL:<https://www.gov.uk/government/collections/households-below-average-income-hbai--2>, visited on 5 February 2020.

<sup>53</sup> FAI (2017): ‘The affordability of water and sewerage charges in Scotland’

The question is whether this is a fair assessment of affordability and the pressures a water bill places on UK households? Consider an example with two households – one with two adults and one with two adults and two children. Both have the same level of resources (£35k p.a.) and both are metered (see Table 12).

In this example, Ofwat’s recommended approach results in neither household being in water poverty – if that is defined using the social norm that households shouldn’t be spending more than 3% of their disposable income on funding their water needs. However, an alternative perspective is that the (larger) family household has more mouths to feed, more people to clothe etc. and it is “unfair” to say that they face the same water affordability stresses and pressures as the two person household in this example, even though the water bill already accounts for each household’s relative water consumption needs, and correspondingly, higher water bill.

Once account is taken of “other needs” the sufficiency of spending power to cover a household’s water bill from a given level of disposable resources (income) may vary by household occupancy. Put another way, a simple ratio of bills / disposable income (e.g. BHC or AHC) without income equivalisation may not capture the relative affordability pressures that the water bill places on households of different occupancy sizes. This is illustrated in Table 12 by the fact that the family household is found to be in water poverty once incomes are equivalised using a simple income equivalisation scale, but was not considered to be in water poverty without equivalisation.

*Table 12 - Example of impact of income equivalisation*

	Family household	Two-person household
Quantity of water (units)	100	50
Price of Water per unit	10	10
Adults	2	2
Children	2	-
Bill	1000	500
Income	35000	35000
Bill / income ratio	2.9%	1.4%
Equivalisation scale <sup>1</sup>	2.1	1.5
Equivalisation income (£)	16,667	23,333
Bill / income ratio	6.0%	2.1%

*Source: CEPA analysis*

*Note 1 – illustration uses simple equivalisation scale, First adult = 1, Second Adult = 0.5, Child = 0.3*

Similar to childcare, housing etc. costs, we could in principle make deductions for things we consider are basic needs and should be accounted for before we start to consider the affordability of the water bill. This is complex and is subjective of what those deductions should be for each type of occupancy household. Equivalisation is a simple way of accounting for this but requires an appropriate equivalisation scale.

However, is it the water industry’s responsibility (its companies, regulator and consumer bodies) to judge how affordable its charging system and current bill levels currently are – for an agreed level and quality of service after taking account of other pressures on household disposable income? Should the industry account for the fact that these wider pressures and constraints on household budgets are likely to vary by the occupancy of households?

One answer might be no. It is a general societal problem that households don’t have enough resources to meet a variety of basic needs, i.e. the problem is not the water bill, it is the inequality and general poverty within the UK in general. If there is a general poverty problem, this is for Government to address (so the argument would go). Some may also suggest that household or family size is a lifestyle or discretionary choice.

Why might the answer be yes?

Water is an essential service. It is a basic need and, because companies cannot disconnect the customer, may be one of the last bills that is paid. Water companies are trying to develop a social commitment – to make water bills affordable for all. We can’t deal with general poverty and inequality issues within the UK in general, so the

proposition would go, but we do want to make sure that all households, independent of their size and occupancy, consider their water bills to be affordable in the context of their household budget constraints and pressures. Equivalisation (of income) within the bills / income calculation would help to ensure the water poverty metric reflects this, i.e. it leads to a “fairer” assessment of relative water affordability pressures and spending power.

Looked at from this perspective, an income equivalisation adjustment would effectively set a more ambitious goal for the industry to reduce water poverty. Companies would be seeking to measure water affordability pressures considering a range of additional pressures larger households face, for a given level of disposable income.

### **What implementation issues are there with income equivalisation?**

While the discussion above sets out the arguments for equivalising income in principle, it is also important to consider how income equivalisation could be applied in practice, including any methodological challenges.

Considering the history of the fuel poverty metric provides some insight on the challenges of developing an appropriate equivalisation scale. The interim report of the Hills Review<sup>54</sup> proposed using the same equivalisation scale for both income and bills. This was one of the most disputed elements of the report and led to the development of a separate and unique equivalisation scale in the Final Report<sup>55</sup>, noting that there are “problems with using equivalisation factors that are not specific to spending on domestic energy”. In this case, it was argued that energy bills should be equivalised in order to reflect economies of scale in the heating requirements of higher-occupancy households, although we understand that energy bills were estimated in this case.

An appropriate equivalisation scale for the water poverty metric must ensure that it enhances the fairness of the metric. If applied incorrectly, an equivalisation scale could achieve the opposite and reduce fairness. For example, an appropriate scale may need to take account of the following factors:

- The proposed “water bills to income” water poverty metric is likely to use a measure of income after the deduction of certain household costs (see discussion in previous sections of the report). The equivalisation scale may need to account for the fact that the income measure does not cover household needs that are already deducted from the definition of income.
- Some definitions of equivalised income already reflect differences in water bills for households of different sizes. This could introduce some level of ‘double counting’ of income equivalisation which may need to be considered. However, given the small proportion of income which is used for the water bill in comparison to other household costs, we would expect the impacts of this ‘double counting’ to be small, only impacting on whether households fall into water poverty at the margin.
- Household water usage is reflected in the bills of metered and non-metered customers to differing degrees and rates of metering differ regionally. This implies that the extent to which bills reflect household size is not consistent between regions. However, income equivalisation would be used to reflect the needs of households for costs other than the water bill. After equivalising income, it may be argued that whether or not a household falls into water poverty relates to the size of their water bill, regardless of whether this bill is based on metered water consumption or not.

### **5.3. OPTIONS FOR EQUIVALISATION**

In light of the above, various options for equivalisation might in principle be considered, depending on data availability and magnitude of the marginal impact of household size (and composition) on income and water bills:

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<sup>54</sup> Hills, J. (2011). Hills Fuel Poverty Review Interim Report: assessing proposals and implications

<sup>55</sup> Hills, J. (2012). Getting the Measure of Fuel Poverty: Final Report.

- **Standard equivalisation of income.** The simplest approach, if in part the logic set out in the previous section is accepted, would be to apply a standard equivalisation scale (e.g. as adopted by the ONS). Given that this is the approach used elsewhere we consider that we would need a compelling reason (either from a point of principle or data availability) to move to an alternative approach.
- **Non-equivalisation of income.** As discussed above, this is the solution that Ofwat took to determine its “affordability and customer debt” measure, under the advice of Department of Work and Pensions’ statisticians.<sup>56</sup> This approach has possible limitations (see discussion above) despite not running the risk of “overestimating” affordability pressures for large households.
- **Compare the impact of both equivalised and non-equivalised.** Citizens Advice Scotland has calculated “affordability of water and sewerage charges” in Scotland using both equivalised and unequivalised income after housing costs.
- **Equivalisation of both income and water bills.** Water bills are a mix of occupant dependent and independent factors due to the mix of metered and un-metered bills. The balance of these factors would determine the extent to which equivalisation is appropriate. As a result, it is in principle possible to eliminate or minimise the bias by applying an equivalisation factor specific to water bills that would align the overall impact of occupancy at numerator and denominator. BEIS uses this approach for its fuel poverty index.<sup>57</sup>
- **Development of a bespoke equivalisation scale (either only for income or for both income and bills).** Given some of the considerations set out above in relation to the practical development of an equivalisation scale, an ‘off-the-shelf’ scale may not be appropriate. In this case, a bespoke scale may need to be developed to reflect the interaction between bills, incomes and household size and to reflect the broader design of the water poverty metric<sup>58</sup>.

#### **5.4. AVAILABILITY OF PUBLIC DATA**

This is a key issue for equivalisation. Average income data is only available from the ONS at MSOA level for:

- Net Income before housing costs – unequivalised and equivalised
- Net Income after housing costs – equivalised only

Given that this data is likely a key component of our approach, it may constrain the options that are available to us for equivalisation, provided publicly available data on income is used within the water poverty calculation.

#### **5.5. IMPACT**

Notwithstanding the arguments in principle, in practice our proof of concept model indicates that the impact on calculated water poverty if using ONS income data (equivalised and unequivalised) is relatively small. This is due to lower income households, which are of most interest for water poverty, being smaller than average: the lowest income decile actually has its income increased by 3% from equivalisation. The estimated impact of moving from Net Income (unequivalised) to BHC (equivalised) is depicted in Table 13.

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<sup>56</sup> Ofwat (December 2015), Affordability and debt 2014-2015, p.68 and 69.

<sup>57</sup> BEIS, “Fuel Poverty Methodology Handbook, Statistical Methodology”, p.60-62.

<sup>58</sup> We note that two separate bespoke equivalisation scales are used for bills and for incomes within the existing fuel poverty metric.

Table 13: Impact of equivalisation

Metric	Company A	Company B	Company C	Company D	Average
Average Income (Net Income)	£28,800	£30,700	£29,300	£33,600	<b>£30,600</b>
Bill / Income above 3% (Net Income)	20.6%	15.1%	13.6%	11.7%	<b>15.3%</b>
Bill / Income above 5% (Net Income)	6.6%	4.8%	4.5%	3.9%	<b>5.0%</b>
Average Income (BHC)	£27,000	£28,900	£27,600	£31,400	<b>£28,700</b>
Bill / Income above 3% (BHC)	22.2%	16.0%	14.9%	12.7%	<b>16.4%</b>
Bill / Income above 5% (BHC)	6.6%	4.7%	4.4%	3.9%	<b>4.9%</b>
<b>Increment in Bill / Income above 3%</b>	<b>1.6%</b>	<b>0.9%</b>	<b>1.3%</b>	<b>1.0%</b>	<b>1.2%</b>
<b>Increment in Bill / Income above 5%</b>	<b>0.0%</b>	<b>-0.1%</b>	<b>-0.1%</b>	<b>0.0%</b>	<b>-0.1%</b>

Source: CEPA analysis

## 5.6. SUMMARY

In reviewing the approaches used in the water industry and elsewhere it is clear that there is not a clear-cut technically “correct” decision as to whether incomes (and / or bills) should be equivalised when measuring water poverty. Rather, it is a decision for the water industry and its stakeholders to make taking into account considerations such as the sector’s ambition for reducing water poverty over the next decade, the impacts on the accuracy of the measure of water poverty and what might be perceived as the “fairest” approach<sup>59</sup>.

The work undertaken in this project suggests that:

- There are a range of views amongst stakeholders within the industry on the appropriate basis to reach a decision on how to apply equivalisation.
- The impact on water poverty of using equivalised or non-equivalised ONS incomes data and equivalisation scale appears small. However, further analysis is needed to test the validity of this finding.
- Equivalisation has been a contentious issue in measuring poverty in other sectors – e.g. for fuel poverty – and so the water industry should be cautious in being too definitive on this issue without due consideration.
- Further analysis may be needed of the appropriate equivalisation scale in a water poverty metric, with regard to the context in which it might be applied.

<sup>59</sup> For example, by key consumer advocacy stakeholders.

## **6. NEXT STEPS**

This project has set out a high-level modelling methodology that satisfies the Principles that have been developed for this work. For the approach to be able to be used to assess and track progress toward the water companies' PIC we suggest the following next steps:

- Comparison of results from the proof of concept model (existing or refined) to more detailed calculations undertaken by companies.
- Estimation of the monetary “size of the water poverty gap”: how much is the minimum amount of cross subsidy likely to be required to eliminate water poverty at 3% or 5% bills to income level, and is this compatible with the current policy framework?
- Extension of approach to Water Only Companies.
- Application of alternative sources of income data, particularly at low incomes.
- Development of understanding and application of correlations between bills and incomes.
- Further testing of the impact of the decision on equivalisation and, if deemed appropriate, the appropriate • equivalisation scale that should be used.

Finally, we note that this paper was developed predominantly in February and the first half of March 2020 before the impacts of Coronavirus (Covid-19) on UK households, water industry operations and the wider economy. Covid-19 is expected to have short and longer-term impacts on household incomes and circumstances, and the water industry's capacity to deliver programmes at the same time as responding to the challenges of Covid-19.

Water poverty – both the ambition for its reduction in the next decade and this project to measure it on a common basis – will need to remain under review in light of this changing and challenging operating environment.



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