3.2.6: Inaccurate/Out of date AQs – Different rates of AQ Change to inform discussion on meter read frequency

Summary of Findings

Findings Status	**Closed**
UIG Impact Peak Volatility %	**N/A**
UIG Impact Annual Average %	**N/A**
Confidence in Percentages	**N/A**

Area & Ref #	Inaccurate/ Out of date AQs - Different rates of AQ Change to inform discussion on meter read frequency (Ref # 3.2.6)
UIG Hypothesis	The analysis task '13.3.2 NDM Sample Data Outliers' identified significant disparities between AQ and actual annual usage. The AQ Update rate – the number of days (interval) between meter readings / AQ updates – might feed into UIG. This task intends to investigate whether AQ is ever truly representative of predicted annual demand.
Data Tree References	EUC, Meter Reading, Annual Quantity

Findings

Decreasing the interval between readings below the existing monthly period was found not to reduce UIG or UIG volatility in the sample set for EUCs 3-8. In EUCs 1 & 2, however, reducing the reading interval below the current average of approximately one year to a shorter period was found to reduce both UIG and UIG volatility – the optimum period for reading will be analysed later in this pack, along with the AQ sub-bands in EUCs 1 & 2 which would most affect UIG by having shorter read intervals. It should be noted, however, that some of the UIG which could be addressed by having more frequent readings could also be reduced with modelling improvements in the NDM algorithm.

It was also found that for a reading interval of one year, the time of year at which the reading is taken significantly affected the UIG and UIG volatility in the sample set. Readings taken in the summer were found to lead to greater UIG values, likely because lower usage and decreased weather sensitivity mean that recent long-term changes in gas usage are not observable.

Approach to analysis

A simulation of AQ estimations was created from the daily energy usage data available in the sample data set for a given read interval and time of year. These AQs were then run through the NDM Allocation model in order to produce predicted NDM Energy profiles for each user based on the simulated AQs. It was then possible to calculate the modelling errors (equivalent to sample UIG). In this way, the effect of meter reading interval and time of year on UIG was investigated.

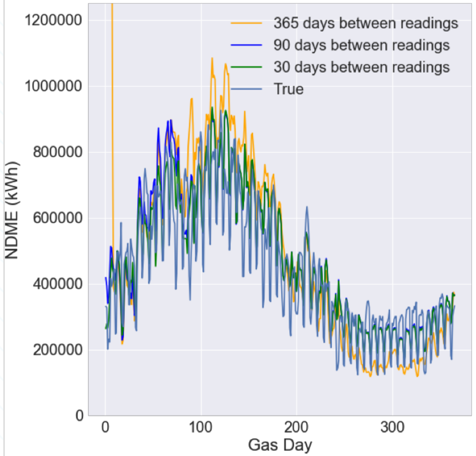
DM meters were excluded from the data used for simulation.

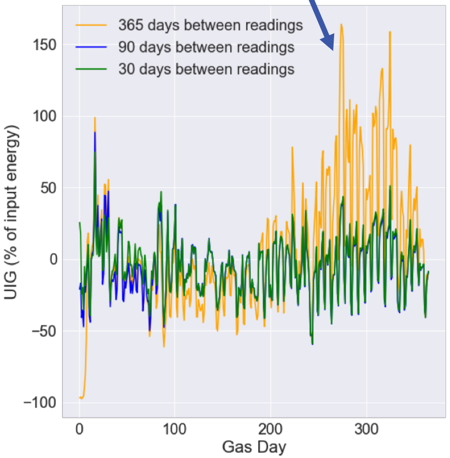
Supporting Evidence – NDM Energy ("NDME") & UIG profiles

The figures below show simulated total EUC 1 & 2 NDM Energy (left) and UIG (right) of meters present in the sample for all gas years from 2014-2016, and the true NDM Energy of the sample for comparison. The profiles were created using the existing demand model and simulated AQs, using a range of intervals between readings, from the existing average of approximately one year to one month. The longer intervals show a greater disparity from the true demand, and therefore larger UIG values – this is explored further in the next slide.

Note UIG improvement from yearly readings (interval = 365 days) to quarterly readings (interval = 90 days)

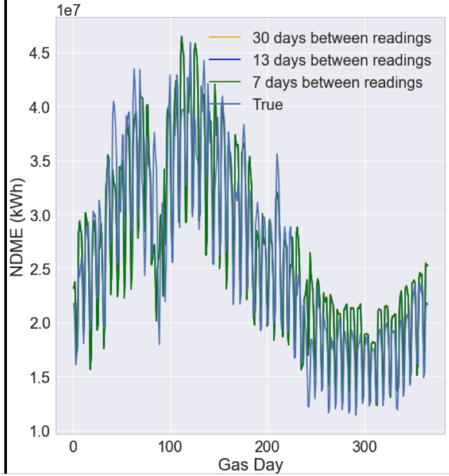
EUCs 1-2

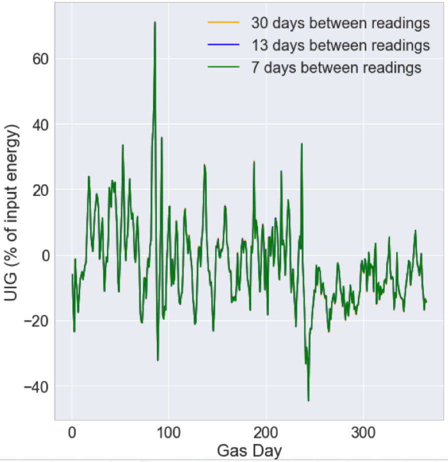




The figures below show simulated total EUC 3-8 NDM Energy (left) and UIG (right), and the true NDM Energy of the sample for comparison. As for EUCs 1 and 2, meters present in the sample for all gas years from 2014-2016 were used, and the profiles were created using the existing demand model and simulated AQs, using a range of intervals between readings, from the existing interval of one month to one week. Changing to a smaller interval does not significantly affect the UIG – this is explored further in the next slide.

EUCs 3-8





Summary of Findings

Findings Status	Closed
UIG Impact Peak Volatility %	N/A
UIG Impact Annual Average %	N/A
Confidence in Percentages	N/A

Area & Ref #	Inaccurate/ Out of date AQs - Different rates of AQ Change to inform discussion on meter read frequency (Ref # 3.2.6)
UIG Hypothesis	The analysis 'Does simulated rate of AQ change influence the UIG volatility?' illustrated the potential improvement to UIG base and volatility by taking more regular meter readings, especially at low EUCs in which the interval between readings is an average of around a year. This investigation will attempt to better characterise the trade-off between a reduction in UIG and UIG volatility and the increased demand in meter readings at a EUC 1 subgroup level (as the dominant contributor to total UIG at low EUCs). Should model improvements not be feasible or effective, this will provide industry with the ability to identify the trade-off between increased meter read frequency, UIG performance improvement and cost.
Data Tree References	EUC, Meter Readings

Findings

The results suggest that reducing the reading interval for EUC 1 and 2 meters to 120 days could reduce UIG and volatility by relatively small amounts. In the sample set, the UIG of EUC 1 and EUC 2 were reduced by around 1% and 3% respectively, whilst standard deviation (volatility) were reduced by around 1% and 4% respectively. Intervals shorter than 120 days only offers relatively small gains (reducing UIG and standard deviation of the sample set only by a further <0.2%).

Consistent with other findings: the higher per-meter contribution to both UIG and volatility in the lower sub-bands suggests that metering those with lower AQs would have a greater impact than increasing the reading intervals those with higher AQs.

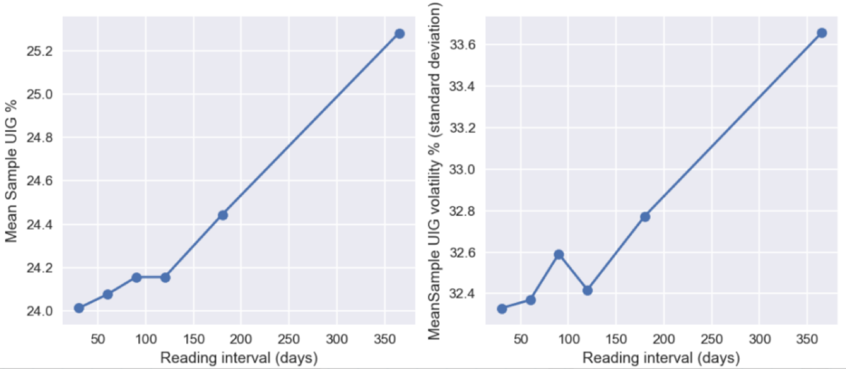
Note: that UIG levels shown in this analysis are simulated and are higher than UIG levels seen in the full population. This is a result of the small number of Meter Points in the NDM sample with enough data to be included in this simulation. The scale of improvement should scale to the wider market and is the key finding from this analysis.

Approach to analysis

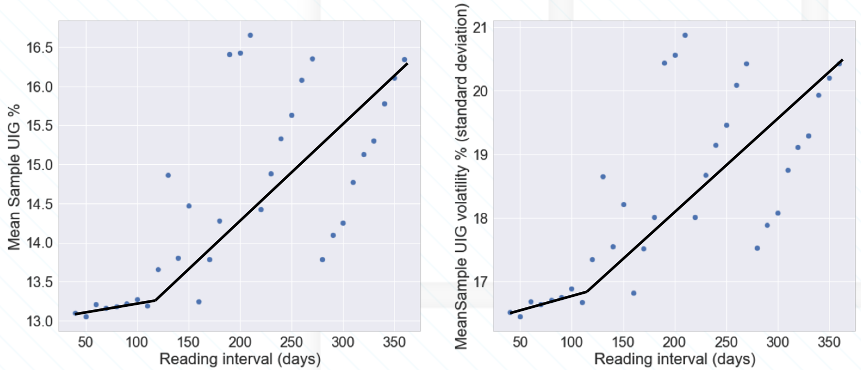
Using the same approach as the analysis 'Does simulated rate of AQ change influence the UIG volatility?', AQs were simulated for meters in the sample set by simulating readings at a given interval, with some random variation around that period (e.g. 30 +/- 5 days). Readings always started around the first day of the gas year (1st October), thus for a 365-day interval, the readings subsequently also took place around that time of year (the effect of the time of year readings are taken was investigated previously). Meters used for the simulations were limited to those in EUC 1 and EUC 2 only. Calculation of the sample UIG (i.e. modelling error for meters in the simulation) was then calculated for 5 AQ sub-bands, spaced logarithmically between 0 and the threshold between EUC 1 and EUC 2, to allow comparison of their relative contributions to total UIG and volatility. The sub-band boundaries used were 0, 7320.0, 13017.0, 23147.9, 41163.4, 73200.0.

Supporting Evidence (1/2) – Detailed effect of meter reading interval on UIG & volatility

EUC 1 reading interval UIG



EUC 2 reading interval UIG



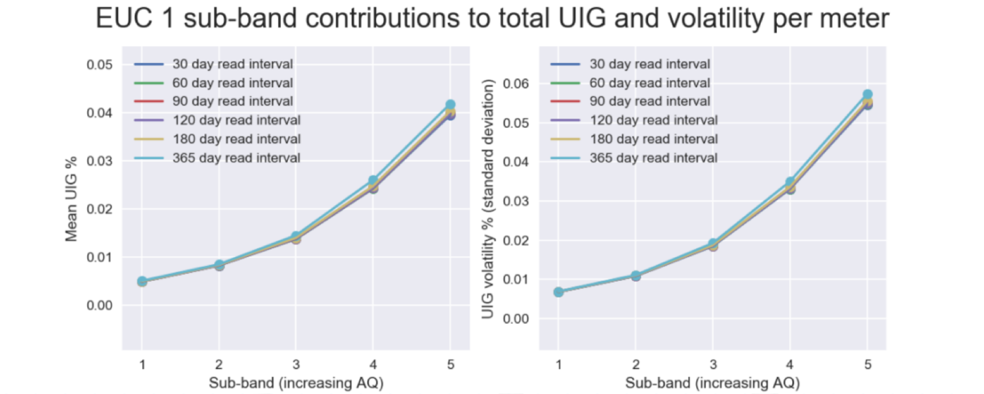
The figures on this slide and the next were created by comparing the true usage of EUC 1 and EUC 2 sample meter readings from the 2016/17 gas year to predicted usage for those meters using simulated AQs calculated using the current method, with different intervals between meter readings.

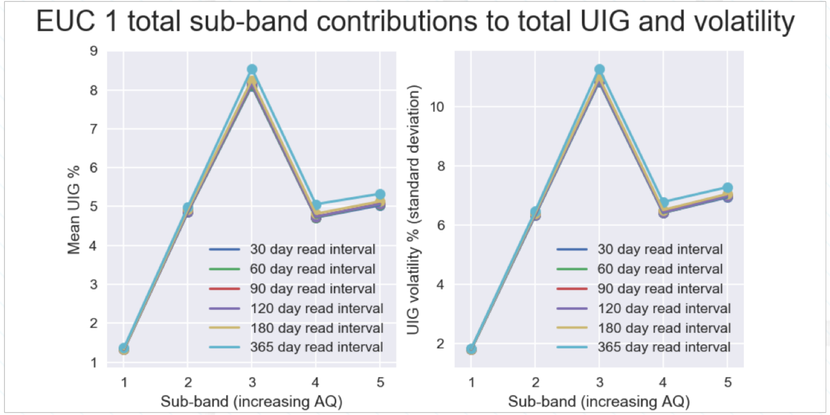
- **'Sample UIG' in this case refers to the modelling error, i.e. the difference between the NDM allocation and actual usage of the sample meters in the simulation, represented as a percentage of the total energy usage across the meters in the simulation.**
- **'Sample UIG volatility' in this case is the standard deviation of the percentage UIG.**

The *top* and *bottom* figures on this slide show the mean sample UIG and sample UIG volatility across the gas year for meter reading intervals between 30 and 365 days, for EUCs 1 and 2 respectively. An approximate trend line is added to the EUC 2 data as a visual aid. The reduction in sample UIG with decreasing reading interval is smaller for intervals below 120 days, implying that reading meters more often than this would be significantly less worthwhile for both EUC1 and 2.

There is also significantly more variation in the UIG for a given read interval above 120 days – this is most likely to be due to the variations caused by taking readings at different times of year shown in the previous analysis, together with the fact that the cadences of reading intervals between 120 and 365 days are such that the fraction of readings at a given time of year changes rapidly as the interval changes. (e.g. an interval of 180 days will result in two winter readings around days 1 and 360, and one in the summer around day 180, whilst an interval of 190 will have only one winter reading around days 1, and one in the summer around day 190).

Supporting Evidence (2/2) – Contributions of EUC 1 sub-bands to UIG and volatility





The *top* figure on this slide shows the contribution of different sub-bands in EUC 1 to the overall level of EUC 1 UIG in the sample set, on a per-meter basis. This plot therefore gives an indication of which groups in EUC 1 it is more important to have accurate reads for.

The trend appears to be largely driven by the average energy use of users in the sub-band, meaning the higher sub-bands contribute more UIG on an individual basis.

The *bottom* figure shows the total contributions of all meters in each sub-band to UIG and UIG volatility in the sample. As there are more meters in the middle sub-bands, they contribute more UIG and volatility in the sample as a whole than the higher-sub-bands, despite the higher sub-bands using more energy per meter.

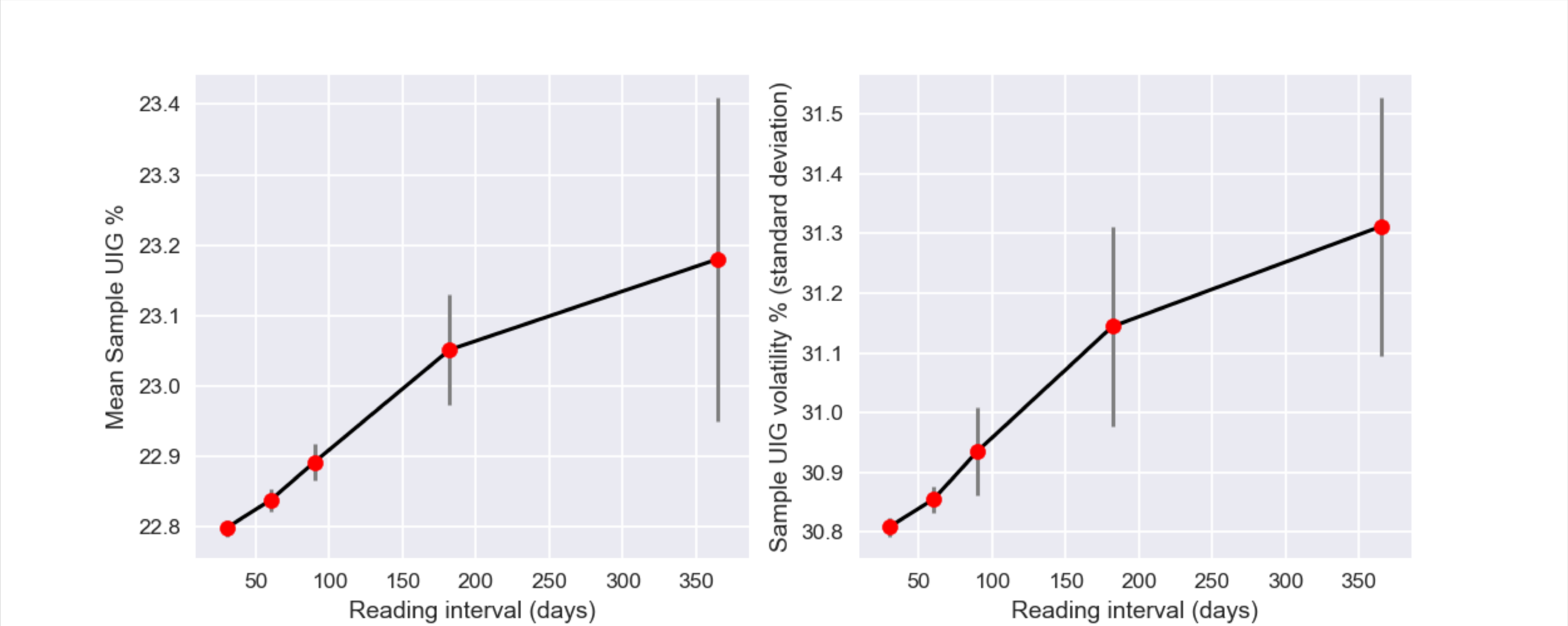
Summary of Findings

Area & Ref #	Inaccurate/ Out of date AQs - Different rates of AQ Change to inform discussion on meter read frequency (Ref # 3.2.6)
UIG Hypothesis	The analysis 'Improving UIG by changing meter reading intervals' showed the change in UIG is likely to occur if the interval between meter readings was changed, using simulations based on the existing sample data set, and assuming reading dates starting around the beginning of the gas year. This investigation will involve carrying out a large number of simulations with readings occurring at any time of year, in order to establish the average change UIG with change in reading interval, regardless off the time of the reading.
Data Tree References	EUC, Meter Readings

Findings Status	**Closed**
UIG Impact Peak Volatility %	**<1%**
UIG Impact Annual Average %	**<1%**
Confidence in Percentages	**M**

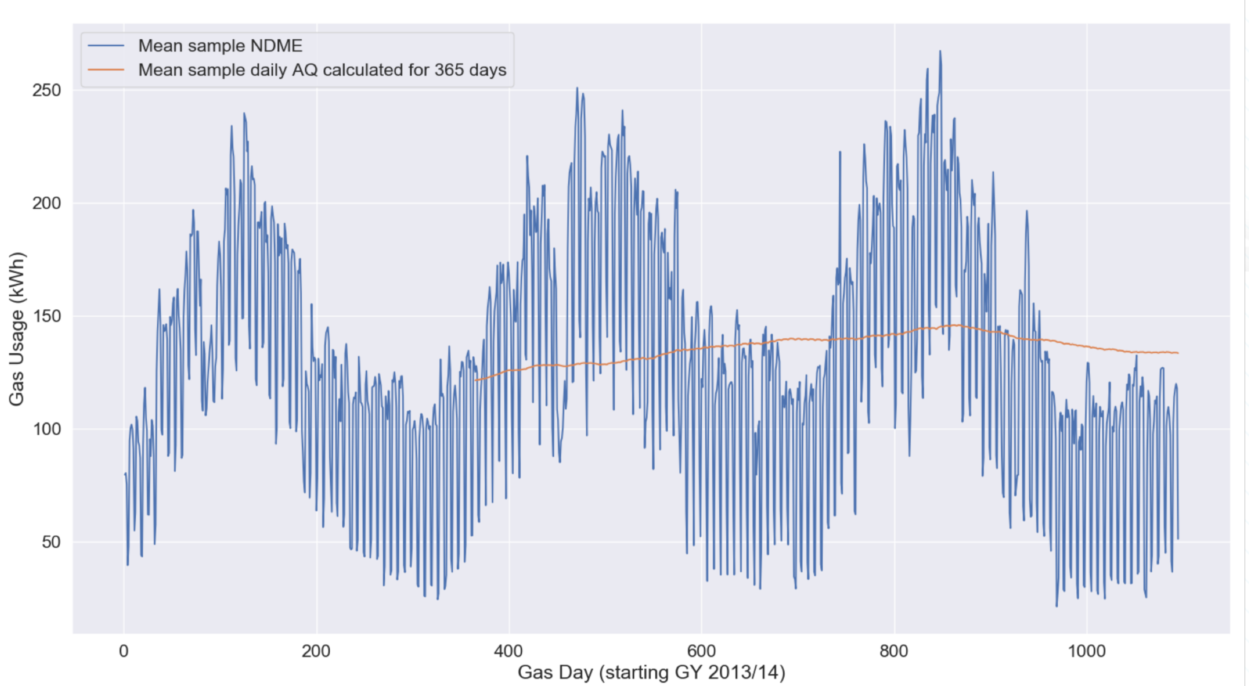
Findings	**Approach to analysis**
The results suggest a similar effect to that predicted in 'Improving UIG by changing meter reading intervals', though the total likely reduction on average is shown to be smaller still – the time of the readings is seen to be important to the improvement in UIG. This task shows that there is a small improvement in UIG when varying the read frequency coupled with the timing of the reading.	Using the same approach as 'Does simulated rate of AQ change influence the UIG volatility?' analysis, AQs were simulated for meters in the sample set by simulating readings at a given interval, with some random variation around that period (e.g. 30 +/- 5 days). Readings were simulated to occur at all times of year. Meters used for the simulations were limited to those in EUC 1 only. Calculation of the sample UIG (i.e. modelling error for meters in the simulation) was then calculated in order to quantify the likely reduction in UIG in the full dataset for a given reading interval.

Supporting Evidence (1/2) – Effect of meter reading interval on UIG & volatility in EUC 1



The above figure shows the mean change in the UIG and volatility of the sample for EUC 1 when changing the interval of meter readings. The error bars show the limits of the variation in the UIG and volatility caused by taking the readings at different times of year. The effect of reducing the meter reading interval was found to be small, aligning with analysis 'Rate of AQ Change – define 'optimum' benefit. (read rate and subgroup)'. This is likely to be mostly due to the AQ calculation window being an average of 368 days, meaning short term variations are lost regardless of the read interval (see next slide).

Supporting Evidence (2/2) – Effect of meter reading interval on UIG & volatility in EUC 1



The above figure shows the average NDME for meters in EUC 1 in the sample set for gas years 13/14-15/16, i.e. those used in the AQ simulations (blue), and the AQ calculated for *every day.* As the period used for AQ calculations is an average of 368 days, the AQ line does not start until 368 days in to the data. Due to the long period used for the AQ calculation, it is smoothed over this time scale, meaning all variation on e.g. daily, weekly and monthly timescales is almost entirely smoothed out, leaving only very long-term variations. Whilst this is mostly desirable when trying to calculate an accurate annual usage, it also leads to any shorter term shifts in behaviour not being reflected by the AQ, and leads to a 368 day delay until the change in behaviour is fully reflected in the AQ. As these properties are determined by the calculation period, the meter reading interval has very little effect on modelling error.