



# Unaccounted for Gas Report

April 2019

nationalgrid

## Executive Summary

This report provides a review of National Grid's Unaccounted for Gas (UAG) management since April 2013, the start of the RIIO-T1 price control, with particular emphasis on 1<sup>st</sup> September 2018 to 28<sup>th</sup> February 2019 inclusive, the period since the publication of the October 2018 UAG report. It is published to meet National Grid Gas Plc (NTS) Gas Transporter Licence Special Condition 8E.

The total assessed UAG quantity for the September 2018 to February 2019 period is higher than for the previous six month period. In addition, total monthly assessed UAG values have been greater than the long-term average monthly assessed UAG for four of the last six months.

It is expected that for Formula Year 2018/19 annual assessed UAG will be significantly greater than for 2017/18. Despite this increase, a decline in the annual assessed UAG over the period since April 2013 continues to be observed.

National Grid has started to report post-reconciliation assessed UAG enabling a more accurate representation of UAG performance. National Grid has also continued to improve its understanding of the causes of UAG through its baseline UAG and NTS linepack change analysis work.

Continued support from meter owners has enabled National Grid to obtain and review meter validation information for NTS entry and exit facilities. This data is being used to support the identification of causes of UAG, to enhance National Grid's ability to detect meter error and to inform the preparation of future meter witnessing programmes.

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# Unaccounted for Gas Report - April 2019

## Introduction

This report provides a review of National Grid's Unaccounted for Gas (UAG) management. The report provides information on assessed Unaccounted for Gas quantities since April 2013, the start of the RIIO-T1 price control, with particular emphasis on 1<sup>st</sup> September 2018 to 28<sup>th</sup> February 2019 inclusive, the period since the publication of the October 2018 UAG report. It also describes the various activities and initiatives that National Grid has been undertaking or is planning to undertake to investigate the causes of UAG.

UAG is one of the three components of NTS Shrinkage together with Own Use Gas (OUG) and CV Shrinkage (CVS). Further information on the components of NTS Shrinkage can be found on the National Grid website via the following link: <https://www.nationalgridgas.com/balancing/unaccounted-gas-uag>.

To compliment this report, National Grid also provides a range of UAG related data including:

- all previous UAG reports;
- daily data on the components of NTS Shrinkage including UAG

which are available on the National Grid website via the above link.

This report and the UAG related data published on the National Grid website discharge National Grid Gas's responsibilities under the Gas Transporter Licence Special Condition 8E: Requirement to undertake UAG Projects to investigate the causes of Unaccounted for Gas (UAG). Special Condition 8E is reproduced in Appendix I of the report. The relevant data used to produce the tables and graphs included in the report is provided or referenced in Appendix II.

If you have any feedback or questions on this document, please contact National Grid's Meter Assurance team via the following email address: [meterassurance@nationalgrid.com](mailto:meterassurance@nationalgrid.com). Meter Assurance, who are part of the Energy Balancing team within the National Grid UK Gas System Operator directorate, are responsible for investigating the causes of and reporting upon UAG.

## National Transmission System Unaccounted for Gas Trends

This section of the Unaccounted for Gas report provides information on assessed Unaccounted for Gas quantities since April 2013, with particular emphasis on the period September 2018 to February 2019.

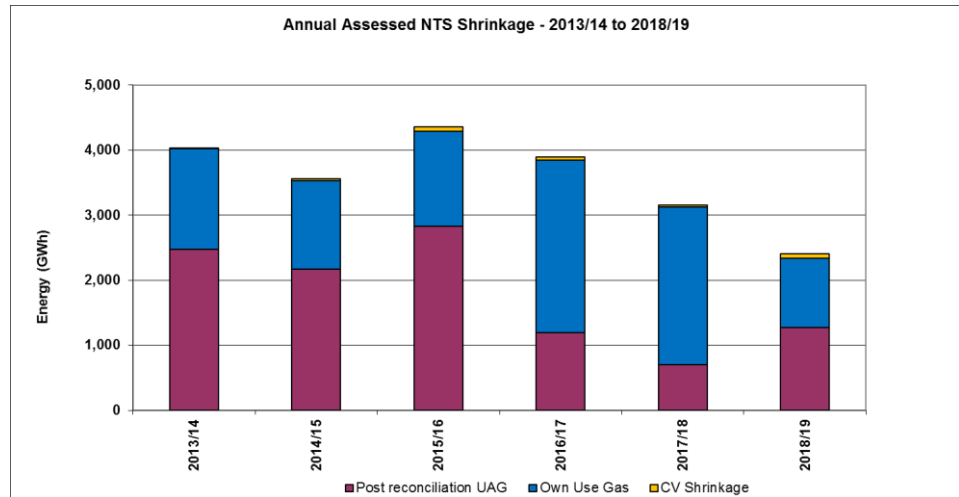


Figure 1: Annual assessed NTS Shrinkage – 2013/14 to 2018/19

Figure 1 provides the annual assessed UAG, OUG and CVS quantities for Formula Years 2013/14 to 2018/19. A Formula Year refers to the period from 1<sup>st</sup> April to 31<sup>st</sup> March of the following year. The quantities provided in Figure 1 for 2018/19 cover the 11 month period from 1<sup>st</sup> April 2018 to 28<sup>th</sup> February 2019.

Figure 1 demonstrates that assessed NTS Shrinkage has reduced over the period since April 2013 with the 2018/19 quantity currently expected to be approximately 40% less than the 2013/14 quantity. The figure also indicates that for 2013/14, 2014/15 and 2015/16 UAG was the predominant element of NTS Shrinkage whereas for 2016/17 and 2017/18 OUG was the predominant element. It appears that UAG will again be the principal element of NTS Shrinkage for 2018/19 accounting for approximately 55% of total shrinkage.

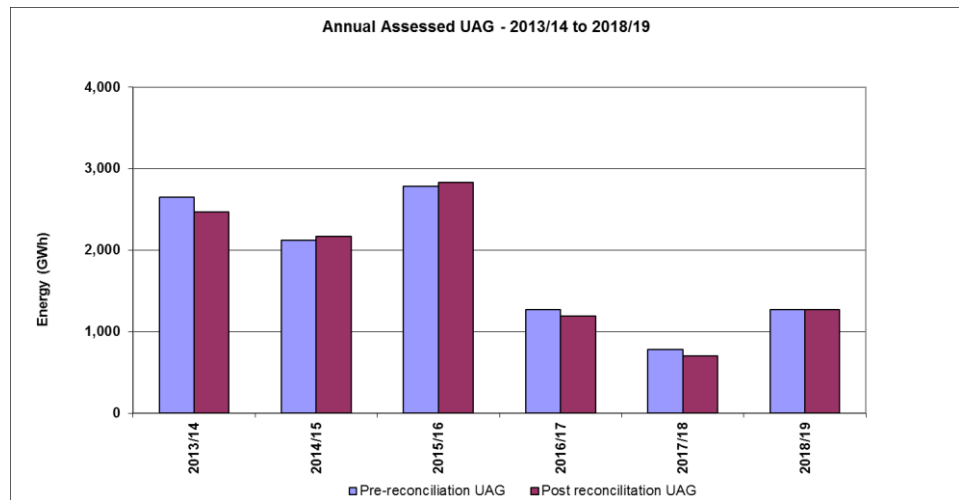


Figure 2: Annual assessed UAG – 2013/14 to 2018/19

Figure 2 provides the annual assessed quantities of UAG for Formula Years 2013/14 to 2018/19. As with Figure 1, the quantities provided for 2018/19 cover the 11 month period from 1<sup>st</sup> April 2018 to 28<sup>th</sup> February 2019.

The above figure represents, for the first time in an Unaccounted for Gas report, both pre-reconciliation and post-reconciliation annual assessed UAG quantities. Pre-reconciliation UAG is calculated using the energy measurements reported in the Gemini commercial system at closeout for the NTS entry and exit points. If following closeout, a meter or data error is identified for one of these points the correct measurements are determined. Post-reconciliation UAG is then calculated using the corrected measurements. Further information on reconciliation is provided in the UAG Management Activities section of this report.

As described in previous reports, which have just referred to pre-reconciliation UAG quantities, a year on year reduction in annual assessed UAG has, with the exception of 2015/16, been observed. This pattern has also been observed with post-reconciliation UAG quantities. Assessed UAG for 2018/19 is expected to be higher than that observed for 2017/18 with post-reconciliation UAG estimated to be approximately 80% greater than for the previous year. This increase in assessed UAG was not anticipated at the time of publication of the October 2018 UAG report and has been due to a significant increase in daily and monthly assessed UAG levels observed during the September 2018 to February 2019 period.

Figure 2 also indicates that for the majority of the years during the 2013/14 to 2018/19 period annual post-reconciliation UAG quantities have been less than the annual pre-reconciliation quantities for the same year. In total during this period, post-reconciliation assessed UAG has been 231 GWh (approximately 2%) less than the pre-reconciliation quantity.

Unless stated otherwise the remainder of this report will refer to post-reconciliation assessed UAG quantities.

Table 1 provides the annual and daily average assessed UAG quantities for Formula Years 2013/14 to 2018/19. The table also provides the annual assessed UAG quantities as a percentage of annual NTS Throughput.

UAG Statistics	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
Annual Assessed Level (GWh)	2,472	2,173	2,833	1,194	700	1,273
Assessed Daily Average (GWh/d)	6.77	5.95	7.74	3.27	1.92	3.81
Percentage of NTS Throughput	0.28	0.24	0.31	0.12	0.07	0.16

Table 1: Statistical performance of UAG - 2013/14 to 2018/19

The values provided in the above table for 2018/19 cover the 11 month period from 1<sup>st</sup> April 2018 to 28<sup>th</sup> February 2019 and indicate that the daily average assessed UAG quantity for the year is expected to be higher than that for the previous two years. UAG as a percentage of annual NTS Throughput for 2018/19 is also expected to be higher than that for 2017/18. This indicates that the increase in UAG is in excess of any increase in observed NTS Throughput.

Figure 3 provides the total monthly assessed UAG from April 2013 to February 2019. It also provides the average monthly assessed UAG for this period (149.92 GWh) together with the average monthly assessed UAG for each Formula Year.

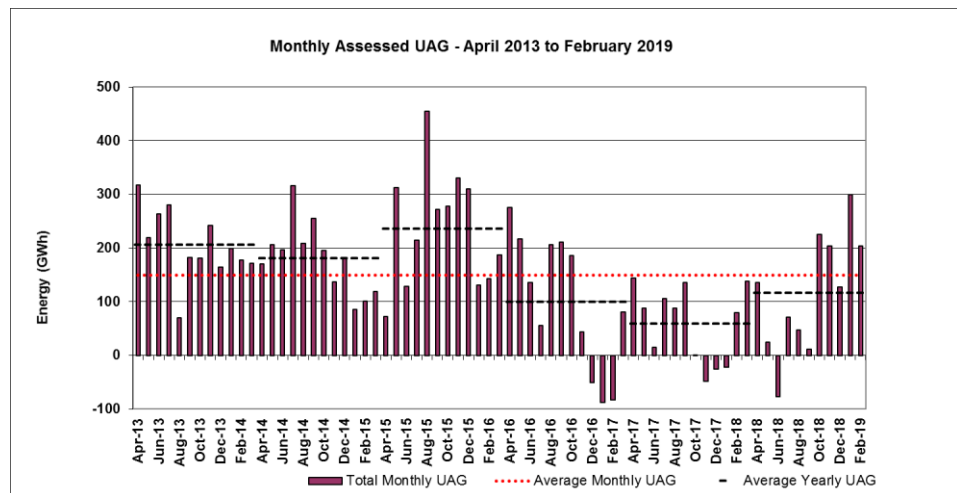


Figure 3: Monthly assessed UAG - April 2013 to February 2019

After a 23 month period, from October 2016, when monthly assessed UAG was less than the long-term average, monthly UAG has been higher than this average for four of the past five months. The levels of monthly UAG observed in January 2019 have not been seen since December 2015.

It is these high levels of monthly assessed UAG observed during the second half of 2018/19 that have resulted in the increased annual assessed UAG.

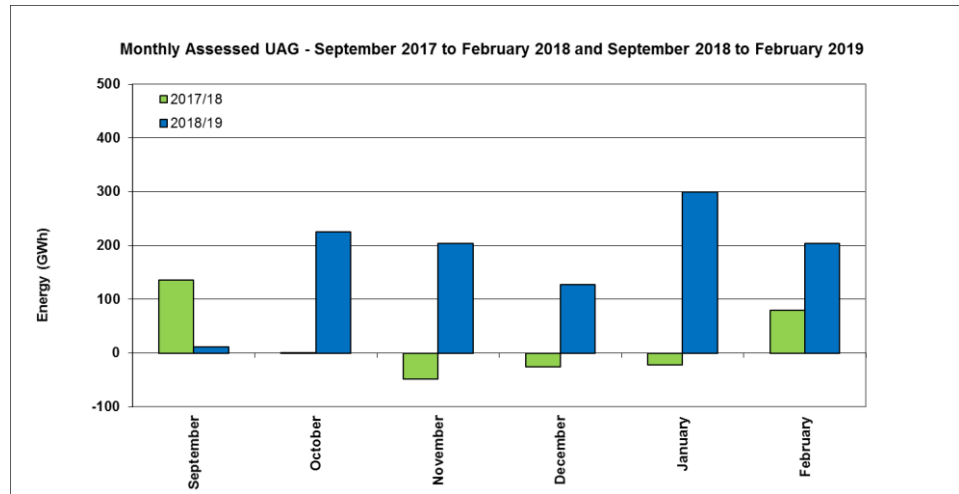


Figure 4: Monthly assessed UAG - September 2017 to February 2018 and September 2018 to February 2019

Figure 4 provides the total monthly assessed UAG for September 2018 to February 2019 compared with the equivalent months of 2017/18. The figure indicates a very different pattern of UAG behaviour. High levels of positive monthly UAG have been observed for the majority of the last 6 months in comparison to the periods of negative monthly UAG that were observed during the same period last year. During the last six months the total monthly assessed UAG varied from +11.3 GWh to +300.0 GWh with a monthly average of 178.5 GWh. In comparison during the September 2017 to February 2018 period total monthly assessed UAG varied from -47.7 GWh to +135.9 GWh with a monthly average of 20.1 GWh.

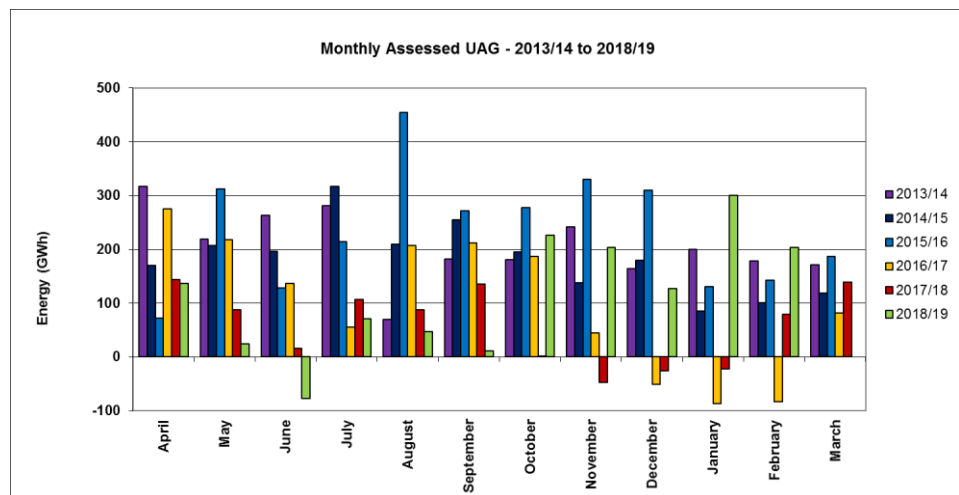


Figure 5: Monthly assessed UAG – 2013/14 to 2018/19



Figure 5 provides the total monthly assessed UAG quantities for Formula Years 2013/14 to 2018/19 grouped by month. The values provided in the above figure for 2018/19 cover the 11 month period from April 2018 to February 2019. The figure indicates that monthly UAG quantities vary considerably from one year to another, e.g. for the month of June total assessed UAG varied from +264.0 GWh to -76.8 GWh between 2013 and 2018. The figure also provides evidence that there is unlikely to be a seasonal trend in assessed UAG.

Figure 6 below provides the daily assessed UAG values for 1<sup>st</sup> April 2018 to 28<sup>th</sup> February 2019. Figure 6 indicates that there continues to be large day to day variability in the daily assessed UAG values. During the September 2018 to February 2019 period daily UAG varied from -38.4 GWh to +47.3 GWh.

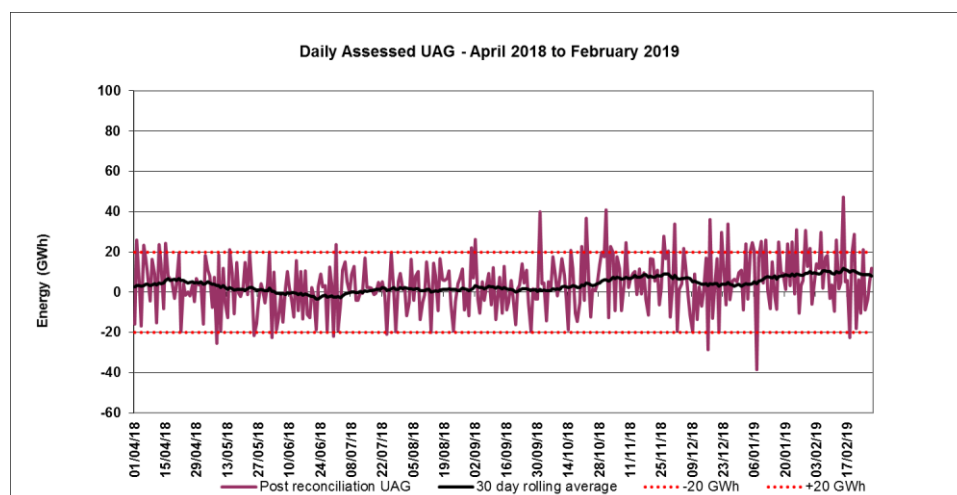


Figure 6: Daily assessed UAG – April 2018 to February 2019

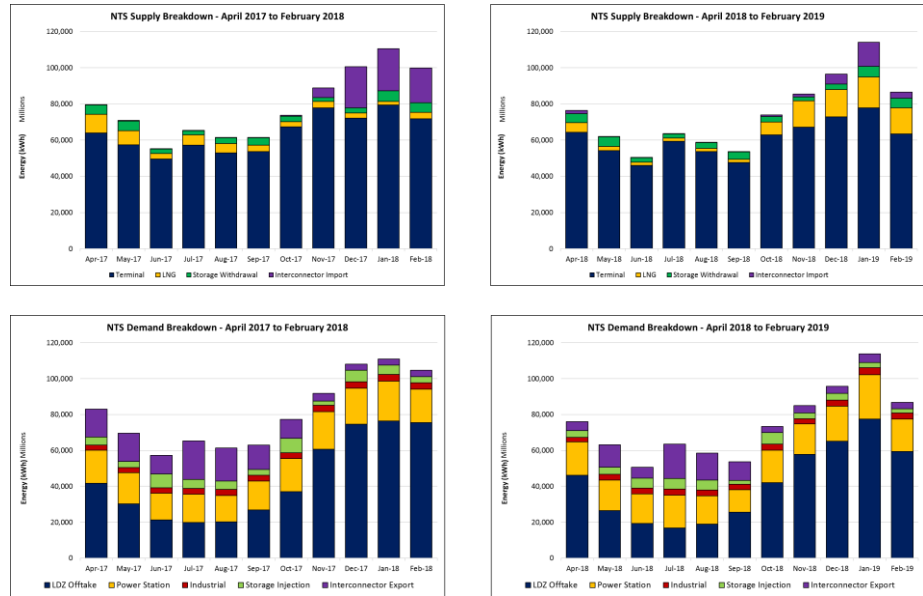
The above figure indicates a significant increase in the days in the October 2018 to February 2019 period when high levels of positive UAG were observed. This is confirmed by the 30 day rolling average included in the figure.

National Grid reviews and investigates the assessed UAG values on a daily basis paying particular attention to any values that exceed  $\pm 20$  GWh. These baseline UAG quantities are provided as red dotted lines in the above figure. During the period of September 2018 to February 2019 there were 37 days when daily assessed UAG exceeded  $\pm 20$  GWh (20.4% of occasions). This is considerably more than the 16 days observed when daily assessed UAG exceeded  $\pm 20$  GWh (8.8% of occasions) during the same period in 2017/18.

National Grid has investigated each of the 37 days with high levels of positive or negative UAG. UAG has been identified on 10 of these days. This includes gas day 15<sup>th</sup> February 2019, the day with the highest observed UAG during the last six months, when approximately 15 GWh of UAG was identified as a result of a data error associated with the Bacton interconnector.

National Grid is also paying particular attention to January 2019 when 13 days with high levels of positive or negative UAG were observed. This is the most instances of high levels of UAG observed in any month since April 2013.

National Grid has investigated a number of possible causes for the increased levels of UAG observed during the second half of 2018/19 including analysing changes in NTS supply and demand patterns.



Figures 7 to 10: NTS supply and demand breakdown – April 2017 to February 2018 and April 2018 to February 2019

Figures 7 to 10 above provide the monthly NTS supply and demand breakdowns for the periods April 2017 to February 2018 and April 2018 to February 2019. These figures indicate that the principal changes in the supply and demand patterns during the second half of 2018/19, in comparison to the same period during 2017/18, are the increased quantities of liquefied natural gas (LNG) delivered to the NTS from the Isle of Grain and Milford Haven LNG importation facilities combined with reduced imports to the system from the Bacton interconnectors. National Grid is planning to undertake further analysis on the impact of LNG deliveries on the levels of positive UAG observed during the October 2018 to February 2019 period.

## UAG Management Activities

This section of the Unaccounted for Gas report describes the various activities and initiatives that National Grid has been undertaking or is planning to undertake to investigate the causes of UAG.

### Meter Validation Report Reviews

Meter owners are obliged to undertake meter validations for each of their metering installations on at least an annual basis to confirm that the metering equipment is functioning correctly. The results of these tests should be documented within a meter validation report and provided to National Grid.

The validation reports provide essential information that allows National Grid to assess the asset health and accuracy of the metering connected to its network. This enables a better understanding of the impact that meter error will have on assessed UAG.

For Formula Year 2018/19 National Grid has to date received meter validation reports for 93% of all the NTS entry and exit facilities. These reports were for validations that had taken place between April 2018 and February 2019.

The Meter Assurance team has reviewed the majority of the reports received and, where necessary, raised queries with meter owners. Only four meter installations (1.7% of all NTS entry and exit facilities accounting for less than 1% of typical NTS input and output quantities) were assessed to have failed their meter validations. National Grid has been liaising with these meter owners to agree actions to rectify the identified issues and assess the impact of these metering issues on assessed UAG levels.

The Meter Assurance team will continue to request and review the remaining 2018/19 meter validation reports and use the data provided to assist with the identification of causes of UAG and to inform the preparation of future meter witnessing. The team will also begin obtaining meter validation reports for 2019/20.

During meter validations the meter installation equipment is interfered with by the personnel undertaking the testing. This may include making modifications to the metering system in order to simulate and record values which entails disconnecting physical instruments, wires and software. There is a risk that meter error could be introduced through these activities. National Grid has, therefore, begun focussing on the assessed UAG observed during periods when meter validations are known to be taking place.

Figure 11 provides the daily assessed UAG for the period April 2017 to January 2018 and indicates the dates when the validations of the Top 20 NTS entry and exit facilities (based upon typical NTS input and output quantities) took place. The validation dates were obtained from the meter validation reports provided by the meter owners of these sites.

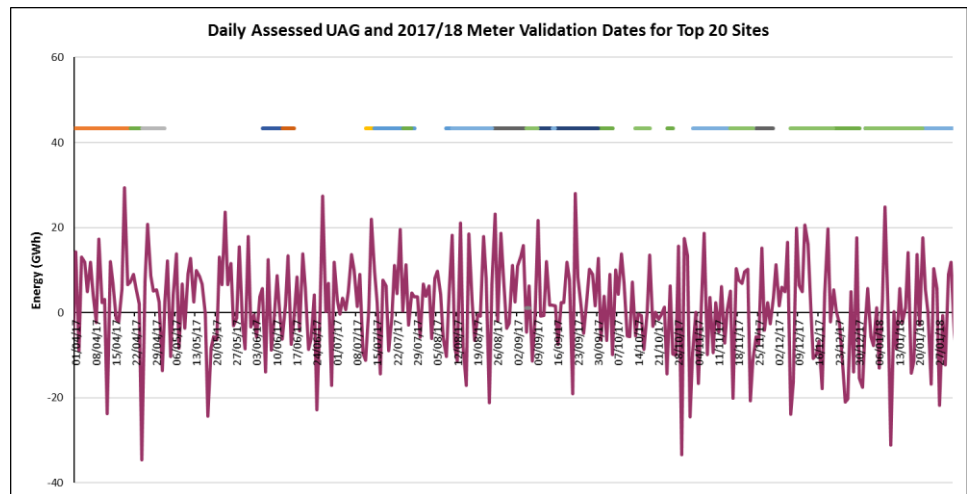


Figure 11: Daily assessed UAG and 2017/18 meter validation dates for Top 20 sites

This analysis will allow any occurrences of high levels of positive or negative UAG or any step changes in the assessed UAG during periods when meter validation activities were taking place to be investigated as possible meter error.

Over the next six months National Grid is intending to develop its ability to investigate potential meter errors using the information provided in meter validation reports.

### Meter Witnessing

National Grid plans and undertakes an annual meter witnessing programme. This involves National Grid personnel attending metering installations throughout the UK during meter validations to observe and document the testing taking place. This is to gain assurance that the measurement equipment within the metering installation continues to measure the gas delivered to or taken from the NTS without bias and within the agreed measurement uncertainties.

For Formula Year 2018/19 the annual meter witnessing programme comprises 17 visits to a range of different metering installations.

Eight of the 10 witnessing visits, scheduled during the September 2018 to February 2019 period, were completed to metering installations which included terminal, power station and gas distribution network facilities. The Meter Assurance team cancelled the witnessing visit scheduled for January 2019 after the meter owner provided a late but valid meter validation report. The other visit to a power station metering facility was postponed until later this year due to overrunning project work leading to the meter validation being delayed. The meter installations which were visited by National Grid were all observed to be measuring accurately.

Figure 12 provides a summary of the annual meter witnessing programme for 2018/19.

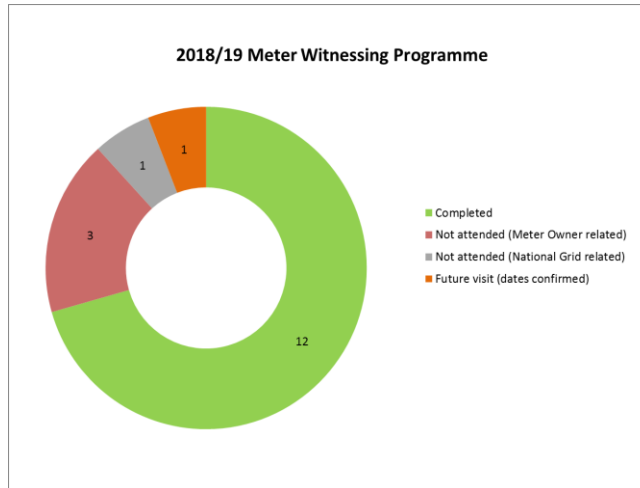


Figure 12: Meter witnessing programme for 2018/19

During the next six months National Grid is planning to attend the remaining meter witnessing visit of the 2018/19 annual meter witnessing programme and prepare a new programme for 2019/20. The meter installations to be included in this programme will be identified from the 2018/19 meter validation report reviews discussed in the previous section of this report.

### Reconciliation

National Grid has an obligation to reconcile NTS related meter and data errors on behalf of the shipping community.

Over the past six months National Grid has processed 87.2 GWh of reconciliations in absolute energy terms. This comprises 21 instances of reconciliation at individual NTS entry and exit facilities, each instance comprising of one or more days of reconciliation. The majority of these reconciliations concern days in Formula Year 2018/19, however, reconciliations have also been processed for 2016/17 and 2017/18.

Figure 13 provides the annual reconciliation quantities, in absolute energy terms, for 2013/14 to 2018/19. The red coloured bars indicate the reconciliation quantities processed since the publication of the October 2018 UAG report.

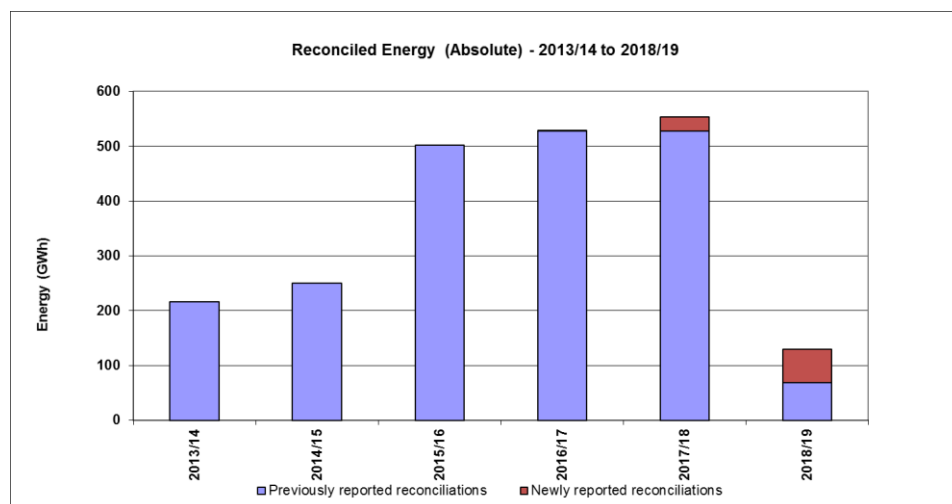


Figure 13: Reconciled energies (absolute) – 2013/14 to 2018/19

Of the 21 instances of reconciliation processed seven related to meter error (33% of instances) and fourteen related to data error (67% of instances).

National Grid is continuing to improve its validation of end of day measurements to help address data quality challenges experienced during the pre-closeout period.

National Grid is currently processing a further 60 meter or data error reconciliations which will be included in future Unaccounted for Gas reports.

### Baseline UAG Analysis

An independent assessment of the baseline level of UAG, which could be expected from the network operating under normal measurement uncertainties, is being undertaken by Manchester University's mathematics department. A PhD student has been appointed under a National Grid sponsored ICASE (Industrial Cooperative Awards in Science and Technology) award to undertake this assessment. As discussed earlier in this report National Grid currently uses UAG baseline values of  $\pm 20$  GWh as triggers to investigate potentially high levels of positive or negative UAG. This study is intended to provide a more dynamic UAG baseline quantity which will assist in the future management of UAG. It is also expected to provide a range of improved mathematical methods for identifying potential causes of UAG.

Over the past months the PhD student has continued his studies into UAG behaviour focussing on:

- an assessment of the advantages and disadvantages of both simplistic and more complex models for baseline UAG analysis;
- the modelling of UAG behaviour in a multivariate setting;
- the use of statistical process control and changepoint analysis techniques for systematic error identification, i.e. identifying occurrences of meter error;
- the use of various approaches including causality, correlation, transfer entropy, regression based, multivariate changepoint for systematic error attribution, i.e. identifying the causes of meter error; and

- the use of various anomaly detection techniques for random error attribution, i.e. identifying the causes of UAG on an individual gas day with a high level of positive or negative UAG.

These studies have again confirmed the challenges of reliably identifying meter errors from assessed UAG in light of the very large number of variables associated with the day to day operation of the NTS.

The PhD student’s work to date has concluded that UAG in the UK does not follow a seasonal pattern in contradiction to a number of previously published academic works.

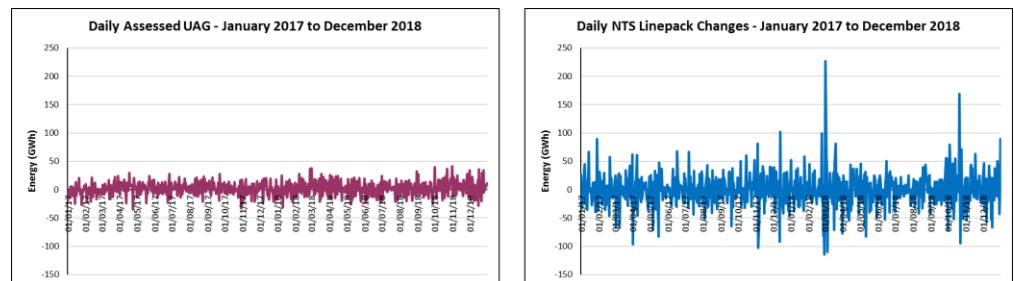
During January and February 2019 the student spent another month with National Grid. During this time he continued developing a prototype of an application to undertake change points analysis on the assessed UAG values published on the National Grid website. The application was developed on Shiny, an open source R statistical computing package. Based on his work on the application the PhD student had concluded that no statistically significant meter errors are currently being detected for the period since April 2013.

Over the next six months it is intended that the PhD student will continue his research activities into UAG behaviour. Any practicable applications of these studies will be incorporated into the prototype application which will then undergo testing by National Grid. The student is also progressing the publication of a paper on his UAG research work in an academic journal.

### NTS Linepack Changes Analysis

The amount of gas within the NTS at any time is known as linepack. Linepack changes within a gas day due to imbalances between the instantaneous inputs into and outputs from the system. National Grid are incentivised to minimise day to day changes in NTS linepack. The daily linepack change is included in the calculation of assessed UAG.

Over the last six months National Grid has been investigating the impact of day to day NTS linepack changes on assessed UAG levels for the two year period from January 2017 to December 2018.



Figures 14 to 15: Daily assessed UAG and daily NTS linepack changes – January 2017 to December 2018

Figures 14 and 15 compare, using the same energy (y) axis scale, daily assessed UAG and daily assessed NTS linepack change values for the January 2017 to December 2018 period. The figures demonstrate that daily linepack change values are typically larger in magnitude than daily UAG values. Daily linepack change values can also be negative similar to daily UAG values. Negative linepack change values occur when there is less linepack in the system at the end of the gas day than at the start.

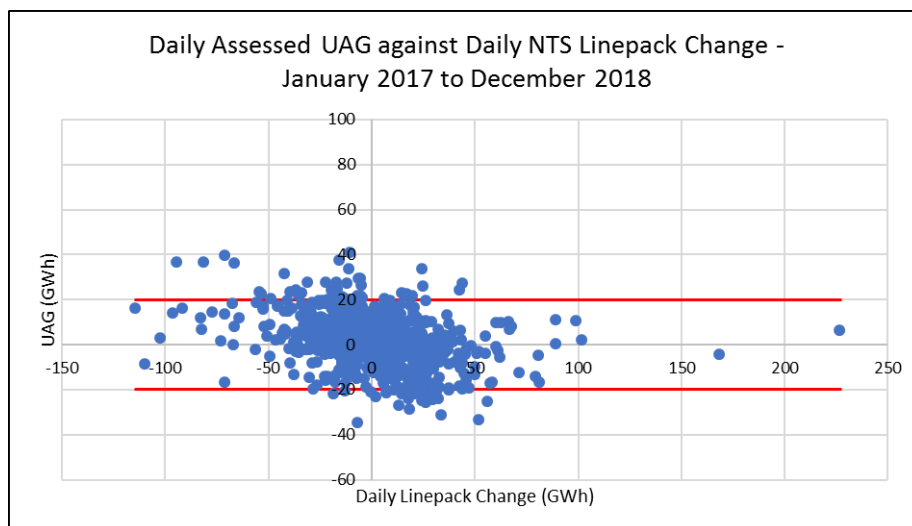


Figure 16: Daily assessed UAG compared to daily NTS linepack changes – January 2017 to December 2018

Figure 16 compares the assessed UAG values with the daily NTS linepack change values for the January 2017 to December 2018 period. The red lines in the figure are the  $\pm 20$  GWh limits National Grid uses to investigate days with high levels of positive or negative UAG. The figure indicates that there appears to be no linear correlation between assessed UAG and daily linepack change. It also appears that days with high levels of positive or negative UAG do not necessarily correspond with those days when large linepack changes are observed.

Figure 17 compares the daily NTS linepack change values against the daily assessed UAG values ranked from lowest to highest observed values for the January 2017 to December 2018 period.



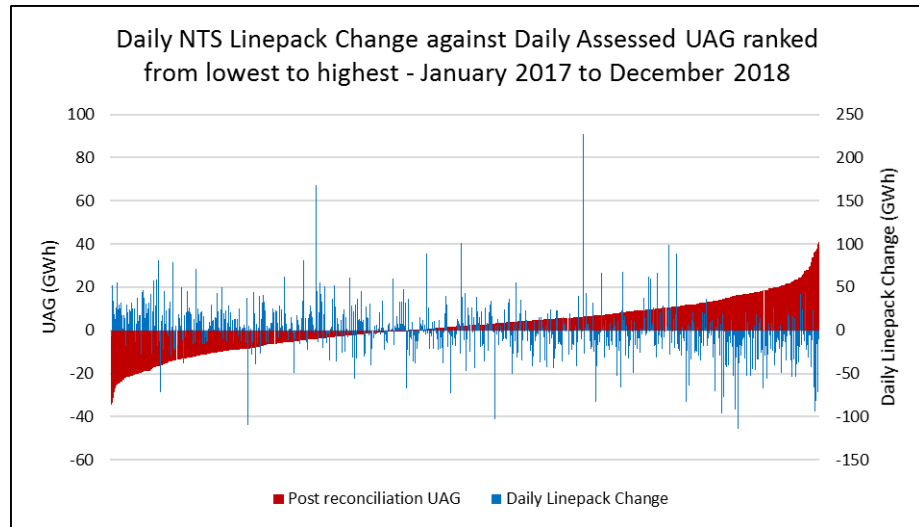


Figure 17: Daily NTS linepack changes compared to daily assessed UAG ranked from lowest to highest – January 2017 to December 2018

The figure indicates that a positive NTS linepack change is more likely to be observed on a day when negative assessed UAG is observed and a negative NTS linepack change more likely to be observed on a day when positive assessed UAG is observed. Over the next six months National Grid is intending to investigate this possible relationship in further detail.

## Conclusion

The total assessed UAG quantity for the September 2018 to February 2019 period is higher than for the previous six month period. In addition, total monthly assessed UAG values have been greater than the long-term average (April 2013 to February 2019) monthly assessed UAG for four of the last six months.

It is expected that for Formula Year 2018/19 annual assessed UAG will be significantly greater than for 2017/18. Despite this increase, a decline in the annual assessed UAG over the period since April 2013 continues to be observed.

National Grid has started to report post-reconciliation assessed UAG enabling a more accurate representation of UAG performance. National Grid has also continued to improve its understanding of the causes of UAG through its baseline UAG and NTS linepack change analysis work.

Continued support from meter owners has enabled National Grid to obtain and review meter validation information for NTS entry and exit facilities. This data is being used to support the identification of causes of UAG, to enhance National Grid's ability to detect meter error and to inform the preparation of future meter witnessing programmes.

## Appendix I - National Grid Gas Plc (NTS) Gas Transporter Licence Special Condition 8E

### Special Condition 8E: Requirement to undertake UAG Projects to investigate the causes of Unaccounted for Gas (UAG)

#### Introduction

8E.1 The purpose of this condition is to set out the obligations of the Licensee in respect of undertaking projects for the purposes of investigating the causes of Unaccounted for Gas (UAG) and the publication of the findings of these projects, including relevant data.

#### Part A: Licensee's obligations under this condition

8E.2 The Licensee shall use reasonable endeavours to undertake the UAG Projects as specified in this condition for the purposes of investigating the causes of Unaccounted for Gas in respect of Formula Year  $t$  commencing on 1 April 2013 and each subsequent Formula Year  $t$  until 31 March 2021. The UAG Projects shall include but need not be limited to those set out in paragraph 8E.5. Where the Licensee does not undertake certain UAG Projects it shall clearly set out its reasoning in the UAG Reports referred to in paragraph 8E.3.

8E.3 The Licensee shall publish UAG Reports of the findings of these UAG Projects on its website and provide a copy of the UAG Reports to the Authority. The Licensee shall publish the UAG Reports by 1 May 2013, 1 October 2013 and every subsequent six months thereafter or such other dates as agreed by the Authority.

8E.4 Within one month of publishing a UAG Report the Licensee shall publish on its website all the relevant data referred to in the UAG Report. Where there are legitimate reasons for not publishing certain data on the website the Authority may consent for the Licensee not to do so.

#### Part B: Interpretation

8E.5 For the purposes of this condition:

##### UAG Projects

means the projects currently undertaken by the Licensee including:

(a) the witnessing by the Licensee of the validation of Measurement Equipment at NTS System Entry Points or Supply Meter Installations at NTS Exit Points; and

(b) investigation and analysis of data in order to seek to identify causes of UAG.

#### UAG Report

means the report of the findings of the UAG Projects undertaken by the Licensee. The UAG Report shall detail the UAG Projects the Licensee has undertaken in the previous period, the UAG Projects it proposes to undertake in the next period and the Licensee's views on whether, and if so how, the findings of the UAG Projects may be taken forward in order to reduce the volume of UAG. The UAG Report shall also detail the reasons why any UAG Projects that the Licensee proposed to undertake have not been undertaken. The UAG Report shall summarise any relevant discussion concerning UAG at industry fora and with interested parties on a one-to-one basis.

#### Unaccounted for Gas (UAG)

means the amount of gas (GWh) that remains unaccounted for after the Entry Close-out Date following the assessment of NTS Shrinkage performed in accordance with the network code.

Measurement Equipment; NTS System Entry Points; Supply Meter Installations; NTS Exit Points; Entry Close-out Date; NTS Shrinkage shall bear the same meanings as are given to those terms in the network code.

## Appendix II - Relevant data referred to in April 2019 Unaccounted for Gas Report

This appendix provides the relevant data used to prepare the figures and tables provided in the report. The assessed UAG, OUG and CVS values used in the figures and tables are calculated from daily assessed values published on the National Grid website.

**Figure 1:**

Formula Year	Annual post-reconciliation assessed Unaccounted for Gas (GWh)	Annual assessed Own Use Gas (GWh)	Annual assessed CV Shrinkage (GWh)
2013/14	2,472	1,548	6
2014/15	2,173	1,358	27
2015/16	2,833	1,458	71
2016/17	1,194	2,650	51
2017/18	700	2,427	23
2018/19	1,273	1,065	67

The annual assessed values for 2018/19 cover the period from 1<sup>st</sup> April 2018 to 28<sup>th</sup> February 2019.

**Figure 2:**

Formula Year	Annual pre-reconciliation assessed Unaccounted for Gas (GWh)	Annual post-reconciliation assessed Unaccounted for Gas (GWh)
2013/14	2,648	2,472
2014/15	2,121	2,173
2015/16	2,782	2,833
2016/17	1,272	1,194
2017/18	783	700
2018/19	1,270	1,273

The annual assessed values for 2018/19 cover the period from 1<sup>st</sup> April 2018 to 28<sup>th</sup> February 2019.

**Figure 3:**

Month	Monthly post-reconciliation assessed Unaccounted for Gas (GWh)	Long-term average monthly post-reconciliation assessed Unaccounted for Gas (GWh)	Average monthly post-reconciliation assessed Unaccounted for Gas for Formula Year (GWh)
Apr-13	317.44	149.92	205.96
May-13	219.73	149.92	205.96
Jun-13	263.95	149.92	205.96
Jul-13	280.72	149.92	205.96
Aug-13	70.32	149.92	205.96
Sep-13	182.42	149.92	205.96
Oct-13	181.28	149.92	205.96
Nov-13	242.19	149.92	205.96
Dec-13	164.73	149.92	205.96
Jan-14	199.55	149.92	205.96
Feb-14	178.06	149.92	205.96
Mar-14	171.13	149.92	205.96
Apr-14	170.10	149.92	181.05
May-14	206.87	149.92	181.05
Jun-14	196.66	149.92	181.05
Jul-14	316.85	149.92	181.05
Aug-14	209.14	149.92	181.05
Sep-14	255.07	149.92	181.05
Oct-14	195.17	149.92	181.05
Nov-14	137.43	149.92	181.05
Dec-14	180.02	149.92	181.05
Jan-15	85.04	149.92	181.05
Feb-15	101.03	149.92	181.05
Mar-15	119.23	149.92	181.05
Apr-15	72.17	149.92	236.07
May-15	312.16	149.92	236.07
Jun-15	128.85	149.92	236.07
Jul-15	214.60	149.92	236.07

Aug-15	455.12	149.92	236.07
Sep-15	271.54	149.92	236.07
Oct-15	277.77	149.92	236.07
Nov-15	330.28	149.92	236.07
Dec-15	309.72	149.92	236.07
Jan-16	131.19	149.92	236.07
Feb-16	142.45	149.92	236.07
Mar-16	186.92	149.92	236.07
Apr-16	275.75	149.92	99.54
May-16	217.46	149.92	99.54
Jun-16	136.15	149.92	99.54
Jul-16	55.72	149.92	99.54
Aug-16	206.86	149.92	99.54
Sep-16	211.65	149.92	99.54
Oct-16	186.34	149.92	99.54
Nov-16	44.16	149.92	99.54
Dec-16	-50.61	149.92	99.54
Jan-17	-87.28	149.92	99.54
Feb-17	-83.14	149.92	99.54
Mar-17	81.41	149.92	99.54
Apr-17	143.65	149.92	58.33
May-17	87.73	149.92	58.33
Jun-17	15.41	149.92	58.33
Jul-17	106.45	149.92	58.33
Aug-17	87.55	149.92	58.33
Sep-17	135.90	149.92	58.33
Oct-17	0.64	149.92	58.33
Nov-17	-47.69	149.92	58.33
Dec-17	-25.83	149.92	58.33
Jan-18	-22.41	149.92	58.33
Feb-18	79.85	149.92	58.33
Mar-18	138.66	149.92	58.33
Apr-18	136.23	149.92	115.73

May-18	24.64	149.92	115.73
Jun-18	-76.78	149.92	115.73
Jul-18	70.77	149.92	115.73
Aug-18	47.00	149.92	115.73
Sep-18	11.25	149.92	115.73
Oct-18	225.73	149.92	115.73
Nov-18	203.40	149.92	115.73
Dec-18	127.11	149.92	115.73
Jan-19	300.05	149.92	115.73
Feb-19	203.60	149.92	115.73

**Figure 4:**

Month	Monthly post-reconciliation assessed Unaccounted for Gas (GWh)	Month	Monthly post-reconciliation assessed Unaccounted for Gas (GWh)
Sep-17	135.90	Sep-18	11.25
Oct-17	0.64	Oct-18	225.73
Nov-17	-47.69	Nov-18	203.40
Dec-17	-25.83	Dec-18	127.11
Jan-18	-22.41	Jan-19	300.05
Feb-18	79.85	Feb-19	203.60



**Figure 5:**

<b>Monthly post-reconciliation assessed Unaccounted for Gas (GWh)</b>						
<b>Month</b>	<b>2013/14</b>	<b>2014/15</b>	<b>2015/16</b>	<b>2016/17</b>	<b>2017/18</b>	<b>2018/19</b>
April	317.44	170.10	72.17	275.75	143.65	136.23
May	219.73	206.87	312.16	217.46	87.73	24.64
June	263.95	196.66	128.85	136.15	15.41	-76.78
July	280.72	316.85	214.60	55.72	106.45	70.77
August	70.32	209.14	455.12	206.86	87.55	47.00
September	182.42	255.07	271.54	211.65	135.90	11.25
October	181.28	195.17	277.77	186.34	0.64	225.73
November	242.19	137.43	330.28	44.16	-47.69	203.40
December	164.73	180.02	309.72	-50.61	-25.83	127.11
January	199.55	85.04	131.19	-87.28	-22.41	300.05
February	178.06	101.03	142.45	-83.14	79.85	203.60
March	171.13	119.23	186.92	81.41	138.66	-

The annual assessed values for 2018/19 cover the period from April 2018 to February 2019.

**Figure 6:**

Daily assessed UAG values are published on the National Grid website via the following link: <https://www.nationalgridgas.com/balancing/unaccounted-gas-uag>. The upper and lower baseline UAG quantities provided in Figure 6 are respectively -20 GWh and +20 GWh.

**Figures 7 to 10:**

Daily actual energy values for the NTS entry and exit points are published on the National Grid website via the following link: <https://www.nationalgridgas.com/data-and-operations/transmission-operational-data>.

**Figure 11:**

Daily assessed UAG values are published on the National Grid website via the following link: <https://www.nationalgridgas.com/balancing/unaccounted-gas-uag>.

**Figure 12:**

Criteria	2018/19 Meter Witnessing Programme
Completed	12
Not attended (meter owner related)	3
Not attended (National Grid related)	1
Future visit (dates confirmed)	1

**Figure 13:**

Formula Year	Number of instances of reconciliation published in October 2018 UAG report	Reconciled energy (absolute) published in October 2018 UAG report (GWh)	Number of instances of reconciliation processed since publication of October 2018 UAG report	Reconciled energy (absolute) processed since publication of October 2018 UAG report (GWh)
2013/14	45	216.49	0	0.00
2014/15	47	250.71	0	0.00
2015/16	61	502.19	1	0.00
2016/17	122	527.65	2	0.05
2017/18	43	527.46	7	26.42
2018/19	8	68.89	11	60.76

The reconciliation values for 2018/19 cover the period from 1<sup>st</sup> April 2018 to 28<sup>th</sup> February 2019.

**Figures 14 to 17:**

Daily assessed UAG values are published on the National Grid website via the following link: <https://www.nationalgridgas.com/balancing/unaccounted-gas-uag>. Daily actual linepack values are published on the National Grid website via the following link: <https://www.nationalgridgas.com/data-and-operations/transmission-operational-data>.

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