

Unaccounted for Gas (UAG) Report

National Grid

Gas Transmission

April 2016

Target audience

Ofgem and other interested industry parties

About this document

This document sets out the work undertaken by National Grid Gas in its role as System Operator, to investigate potential causes of Unaccounted for Gas (UAG).

It is published to meet National Grid Gas Plc (NTS) Gas Transporter Licence Special Condition 8E: Requirement to undertake UAG Projects to investigate the causes of UAG.

If you have any feedback or questions on this document please get in contact with us at:

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Background

This report provides a review of National Grid's Unaccounted for Gas (UAG) management covering the period up to and including the 1st of October 2015 to the 29th February 2016.

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

- All the previous UAG reports
- Daily UAG data

which are available at:

<http://www2.nationalgrid.com/uk/industry-information/gas-transmission-system-operations/balancing/unaccounted-for-gas>

This report discharges National Grid Gas's (NGG's) responsibilities under the Gas Transporter Licence Special Condition 8E: "Requirement to undertake UAG Projects to investigate the causes of Unaccounted for Gas (UAG)", available via the following link:

<https://epr.ofgem.gov.uk>

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1. Executive Summary

UAG is currently continuing to trend around the levels conveyed in the October 2015 report. Over the past year, we have experienced two months of high UAG in August and November which can largely be attributed to errors which have occurred as a result of the introduction of new EU code, required for National Grid to comply with EU regulations. The system code introduced unexpected anomalies however as a result of rigorous investigation, the errors have been identified and corrected. All data presented within this report includes corrections as a result of this work. This puts average UAG levels for the 15/16 year in line with that seen in the previous three years.

Although UAG data has been volatile over this period, UAG analytical tools have not highlighted any obvious meter anomaly or underlying issues.

To assist ongoing UAG analysis, National Grid is continuing to manage its innovation funded projects. 'NGage', National Grid's free meter validation tablet application is nearing completion, the beta version will be available to all NTS meter asset owners by the end of April 2016 and 'NGageCALC' is a free mobile gas properties calculator which is already free to download from the AppStore (iOS) and Play Store (Android).

A 3 year project with Manchester University to explore new mathematical techniques to provide further insight into UAG behaviour is now underway.

For further information on any of the teams activities, please contact:

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2. National Transmission Unaccounted for Gas Trends

2.1 Annual NTS Shrinkage

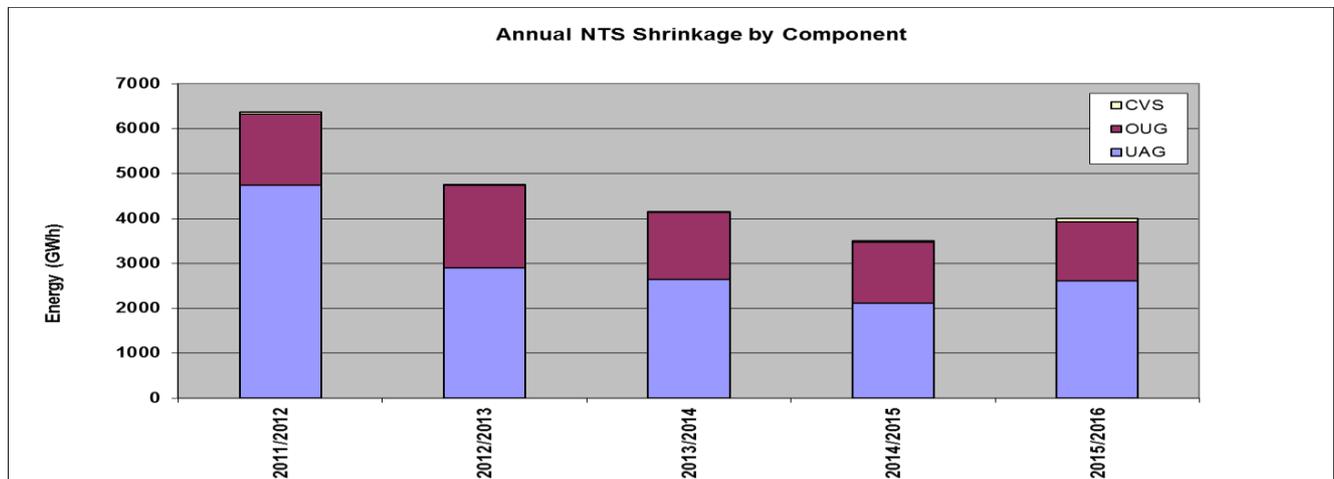


Figure 1: Annual NTS Shrinkage by component since 2011.

The component breakdown of the annual shrinkage¹ trend presented in Figure 1 is summarised as:

- The slight reduction in Own Use Gas (OUG) over the period has been due to a combination of changes in underlying supply patterns and the introduction of electric drive compression which equates to around 10% of this reduction.
- Low levels of CV Shrinkage (CVS) with annual levels less than 50 GWh have been a feature of NTS Shrinkage throughout this period. However the recent introduction of numerous bio-methane sites embedded within the gas distribution zones has resulted in a slight increase in total NTS CVS volumes² as the commissioning and operation of these sites is refined.
- Unaccounted for Gas (UAG) levels continue to remain stable since the 2011/12 peak, which was influenced by the subsequent discovery of an error of significant magnitude.

UAG volumes since 2012 are largely considered to be more representative of typical NTS behaviour. Despite these reductions, UAG has consistently contributed over 65% of the total NTS Shrinkage budget since 2012 and National Grid continues to develop initiatives and activities (see Section 1.3.3) to further the understanding of the behaviour of this volatile shrinkage component. These initiatives and activities will be discussed in further detail in the following sections of this report.

¹ Definitions of the components of the NTS Shrinkage are to be found at: [Unaccounted for Gas | National Grid](#)

² The treatment of bio-methane sites with respect to the NTS Flow Weight Average CV (FWACV) process is the subject of

2.2 Unaccounted for Gas

UAG has always been closely associated with data and meter error. A considerable amount of effort has been invested to improve the validation process ensuring the same issues would not reoccur. Due to enhanced validation techniques and a suite of measurement system upgrades across NTS connected sites, meter errors in general have significantly reduced.

There will be more focus this year on the root causes of data error as annual UAG behaviour has remained below 3000GWh/pa since 2012. National Grid are implementing a new Gas Control Suite this summer which will offer improved analysis capability in support of the continuous improvement of the process our team undertake. Our aim is to identify data error within the close out period (M+15 Entry Sites, D+5 Exit Sites) with the least number of data changes as possible thus reducing the amount of after the day balancing actions currently undertaken by Shippers and National Grid in its shrinkage provider role.

UAG Statistics	2011/12	2012/13	2013/14	2014/15	2015/16*
Assessed Annual Level (GWh)	4737	2894	2648	2121	2765
Daily Average (GWh)	12.941	7.929	7.254	5.811	7.555
Percentage of NTS Throughput	0.45	0.29	0.29	0.23	0.29

* 2015/16 includes March values which are subject to change as per close out rules

Table 1: The statistical performance of UAG since 2011.

The Assessed Monthly UAG graph (Figure 2 below) highlights the volatility in UAG data, but also illustrates that since November 2015, the monthly UAG has reduced significantly.

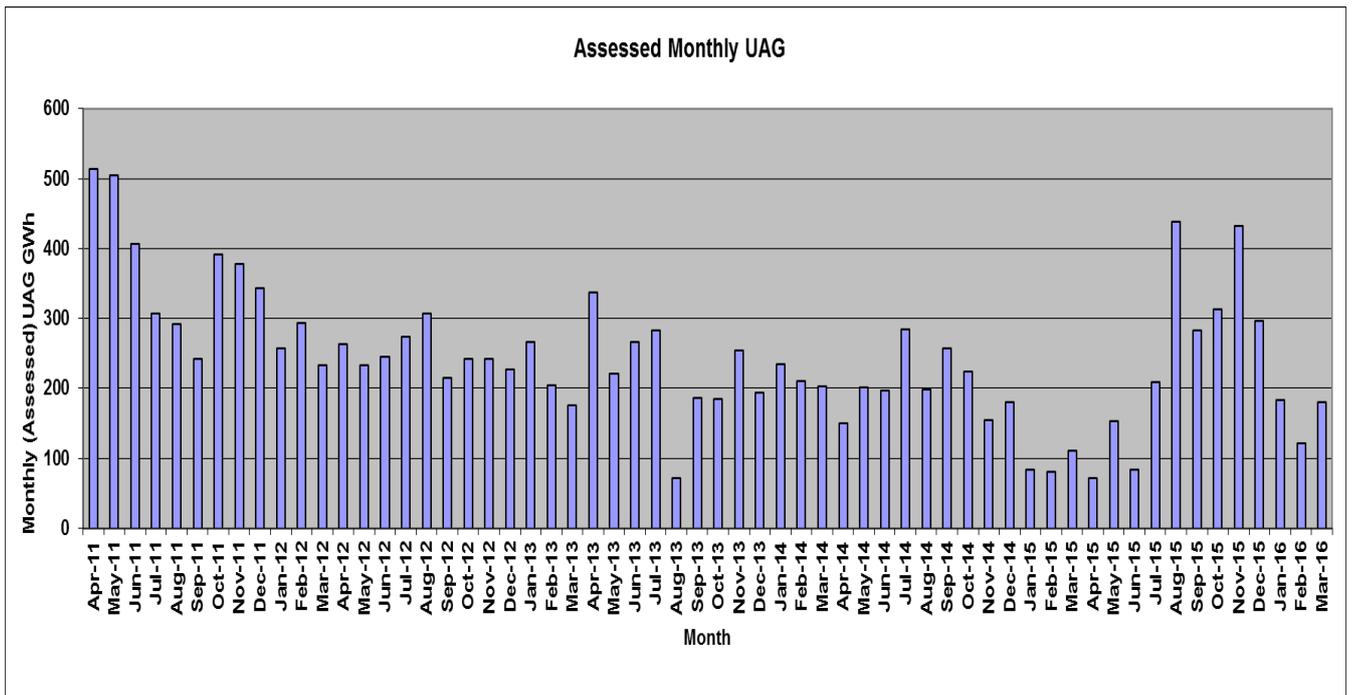


Figure 2: Monthly UAG since February 2011 (note data includes data corrections following the resolution of the aforementioned system issues)

This report concentrates on the events and reconciliations since the previous UAG report published in October 2015.

There has been considerable efforts to identify the large UAG spike in August 2015. Energy reconciliations have occurred over this period, however the majority of unaccounted for gas in August 2015 has yet to be identified. Measurement errors are typically detected during the meter validation with the majority of metering equipment being inspected annually; therefore the error may not be detected until the next validation.

In September 2015, National Grid’s Integrated Gas Management system (iGMS) underwent changes to facilitate the release of new EU regulation in October 2015. Rigorous testing was carried out before the code was implemented into the live system, and no issues were detected. The deployment to the live system however, introduced anomalies in UAG that were not anticipated.

Extensive work has been undertaken by National Grid to identify any impacts on UAG by the EU code changes. Following this analysis a number of issues have been identified all of which have been corrected in our core systems. Amendments have been made to the systems and accompanying processes to ensure that the reliability of UAG data is maintained. This vigilance will continue to be applied to all future implementations.

2.3 Recent UAG Activities

Due to the data anomalies from September 2015 to February 2016, extensive work has been undertaken to identify these errors along with their root causes and any energy variances have been reconciled. The corrected data was used to ensure the trading strategy was not adversely affected by these errors. The reconciliation of energy differences is currently taking priority.

Despite the large volumes of UAG over that period, of which the causes can be accounted for, there is a consistency of lower UAG volumes over the past 4 years. This is to the credit of all asset owners through the management and upgrade of their meter assets and in conjunction with National Grid to continue to build our strong relationships enabling the close and trusted cooperation between all stakeholders.

A general review of all National Grid's UAG management activities are presented in the following sections.

2.4 UAG Management Activities

National Grid undertakes a holistic UAG management programme. This programme falls into three main categories:

1. Meter Witnessing
2. Meter Reconciliation
3. Future Initiatives

2.4.1 Meter Witnessing

National Grid continues to undertake an annual meter validation witnessing campaign which plays an important part in the continuing engagement between National Grid and the meter asset owners across the NTS network and in the general management of UAG. The range and number of sites witnessed since 2011 is presented in Table 2.

Year	DNO Offtakes	VLDMC	Terminal/ Storage/ Interconnectors	Total
2011/2012	16	6	9	31
2012/2013	16	13	5	34
2013/2014	10	14	5	29
2014/2015	12	6	8	26
2015/2016	5	5	9	19*

Table2: National Grid's Meter witnessing record.

National Grid's witnessing campaign and review of ME2 documentation confirms that the asset owners' commitment to improve and maintain their measurement equipment is a testament to the decline in the number of measurement errors over the past few years.

*This reduction of measurement errors detected through meter validation and the high standard of technical expertise witnessed across the metering community has allowed the number of sites that National Grid witness to relax slightly as reflected in Table 2. Face to face communication has helped to nurture and uphold the strong relationships National Grid have with the asset owners so will still remain a key activity.

For 2016/17 the witnessing campaign has been aligned to the financial (regulatory) year and its scope and current status is presented in more detail in Table 3.

Site Type	Planned
Terminals	3
Storage	2
Interconnectors	0
VLDMC	
Third Party	4
NGGT	3
DNO	
NGGD	4
WWU	3
SGN	2
NGN	3
Total	24

Table 3: Summary of National Grid's 2016/17 Meter Witnessing Campaign.

The National Grid meter witnessing campaign is carefully coordinated to take full advantage of the potential of this activity.

The site selection considers the following metrics:

- Meter Error history
- Validation record
- Witness history
- Potential UAG impact

Although National Grid receives the majority of meter validation results, there are still areas that are not transparent which affects the management of UAG and the compliance of the meter asset owner.

National Grid are developing a meter validation app which will automatically send the validation results from the meter asset owners to National Grid. This will ensure the meter asset owners meet their obligation and will provide National Grid with the data required in an appropriate format and timely fashion to carry out effective UAG analysis.

Please refer to section 2.4.3.2 within Future initiatives for further details.

2.4.2 Meter Reconciliation

National Grid has an obligation to reconcile all NTS related meter and data errors on behalf of the community to ensure financial equality between the Shrinkage Provider (NGGT) and the shipping community. It provides a key indicator as to the underlying UAG levels and although the reconciliation process is a solely financial readjustment, it is still possible to present a consequential net annual UAG energy figure. These are presented in Table 4 for the financial years since 2011.

The absolute number of meter reconciliations reported each year may not be a true UAG indicator because a single error can be of significant magnitude while a number of others may be very small in magnitude.

National Grid is committed to processing meter error reports (MERs) as efficiently as possible and the current MER status is: **two** on-going Joint Office notified meter errors still being reconciled and

two MERs for sites (Unique Sites/ VLDMC³) which are outside the Joint Office notification process with the oldest outstanding reconciliation relating to an error in 2014 and notified to National Grid in 2016.

Year	Annual No of Reported Meter Errors	Assessed UAG (GWh)	Net Energy Reconciled (GWh) ⁴	Net UAG (GWh)
2011/2012	52	4737	52	4789
2012/2013	52	2894	-151	2743
2013/2014	33	2648	19	2667
2014/2015	49	2121	25	2146
2015/2016	44	2765	-77	2694

Table 4: Meter Reconciliation Statistics inclusive of UAG Net of Meter Error.

³ Unique Site & VLDMC (Very Large Daily Metered Consumer) refer to directly connected sites to the National Transmission System (NTS) whose reconciliations are conducted by National Grid.

⁴ Net Energy Reconciled represents the balance of gas costs to the community (negative) and from the community (positive).

2.4.3 Future Initiatives

Over the past 6 months National Grid have been working on a number of new initiatives which are at various stages of completion. Details of the three main areas of work are outlined below.

2.4.3.1 Enhancing UAG Analysis Tools

National Grid's UAG tools continue to be used to highlight areas for further analysis. The current models include a Composite Weather Variable (CWV) tool which uses factors such as weather conditions, windspeed and temperature to predict demand at Gas Offtakes along with a Power Station Efficiency Tool (PSET) which compares the gas usage against its electricity output.

Both these current tools are focused on investigating retrospective data. The focus for the future is to channel UAG analysis into investigating more recent, ideally unclosed out data. This analysis could also provide indicators for potential areas for future investment.

2.4.3.2 Meter Validation App



Figure 3:- National Grid's NGage and NGageCALC Brand Icons.

NGage is the National Grid Meter Validation and Analysis App that will be available on iOS® and Android platforms. The beta version is currently in the user acceptance testing phase and the app will be rolled out to Asset owners at the end of April 2016. NGage will be freely available to all NTS connected parties, with the main function of facilitating the collection of meter validation data in accordance with the current ME2 standard and sharing this with National Grid to fulfil their contractual obligation. The NGage app has been designed to be used in the safe confines of the flow computer building.

The validation software will simultaneously perform the necessary gas property calculations in accordance with the respective international standards (ISO 6976, GS(M)R parameters, AGA8, AGA10) and flow equations (ISO 5167, ISO 9951) as necessary during the data collection.

The application will also provide a detailed review of the meter performance in terms of the individual validation test tolerances. Upon completion of the validation, the data will be automatically uploaded to a dedicated secure Cloud server where the asset owner can view their full history of uploaded validation results. This validation data portal will enable efficient offline data analysis for National Grid and for each registered asset owner.

A gas property and flow calculator 'NGageCALC' has already been released on the AppStore and PlayStore which again is in accordance with the international standards ISO 6976, AGA8, AGA10 (gas properties), ISO 5167-1991, 2003 (flow) standards. This has been offered as a standalone package for both mobile/tablet formats as well as a Microsoft® Excel add-in. This again is freely available to any interested party.



Figure 4:- NGage: Screenshot of a meter validation test

Status:-

The NIA⁵ funding for NGage Validation App was secured in November 2014 and the programme commenced in January 2015. Further features to enhance the suite of tests (version 2) will be rolled out midsummer this year.

The key progress can be summarised as:

- Version 1 of the tablet App for both iOS and Android platforms has been released to National Grid.
- The calculation and data handling and core functionality have been developed and is available to download.
- Full Cloud Hosting features have been developed and the secure Validation Data Portal is available to National Grid in the test environment.
- A webinar took place on the 23rd of March which highlighted the features and benefits, a walkthrough of the app and a Q&A session. Profile-raising mailshots have also been sent to potential users to increase the apps visibility along with presentations at the Operational Forum, the System Operator Forum and during the Customer liaison visits.
- Further funding to enhance the apps suite of tests is currently being requested from the innovation sanctioning committee. This includes: a measurement bias calculation (PTZ method) that will give clear indication of the measurement system's health, an extension to the Differential Pressure tests that includes the foot printed table of static values, and functionality to export and save calculations.
- Funding allowing, version 2 for both NGage and NGage_{CALC} would be forecast for release this summer.

For further details, please contact the team via email⁶.

⁵ NIA :- Network Innovation Allowance is the RIIO mechanism that allows National Grid (Gas & Electricity) to spend 0.7% of its turnover on Innovation. The Network Innovation Allowance encourages wide collaboration with all project learning being shared across the gas community.

⁶ DataAssuranceandQualityTeam@nationalgrid.com

2.4.3.3 Baseline UAG Analysis

An independent assessment of the baseline level of UAG that could be expected from the network operating under normal measurement uncertainties is being undertaken by Manchester University's mathematics department. This independent study will enable National Grid to quantify UAG volumes in terms of this baseline which will assist in the future management of UAG. The determination of a baseline will potentially provide a UAG management tolerance that will allow the suitable deployment of appropriate UAG analysis techniques.

The baseline analysis will be combined with the development of other mathematical techniques outside the statistical approaches already employed, such as matrix and dynamical mathematics.

Status:

The iCASE⁷ funding was approved for this mathematical based study during 2015 and will enable a full time PhD student to be employed to undertake the programme. Initial discussions with Manchester University have been conducted to outline the scope direction of the programme. The recent UAG behaviours of high volatility in-between more stable months along with a range of historical data, where discovered meter errors were subsequently found, would be a good test to assess and calibrate the effectiveness of the techniques and approaches being developed.

A PhD student was appointed in January 2016 and the analysis will commence in September 2016, the results will be articulated via the NIA portal⁸ and subsequent UAG reports when complete. The project is planned to be undertaken over 3 years.

⁷ Industrial Cooperative Awards in Science & Technology (CASE) provides funding for PhD studentships where businesses take the lead in arranging projects with an academic partner of their choice

⁸ <http://www2.nationalgrid.com/UK/Our-company/Innovation/Gas-transmission-innovation/NIA-Projects/>

3. Summary

While we have experienced two months of high UAG in August and November 2015 this can largely be attributed to the errors which have occurred as a result of the known system issues. The issues have been fixed and reconciliation has taken place over this period.

As a result of this work, overall values continue to trend downwards as indications of UAG daily volumes are now returning to pre August rates; as Figure 2 demonstrates.

The healthy relationships between National Grid and meter asset owners continues to flourish through the continued meter witnessing programme and these strong relations have enabled the development of the NGage app to be supported by the expertise of various metering engineers and technicians.

Major initiatives have been progressed this year with NGage_{CALC} now freely available to download from the AppStore & PlayStore whilst NGage Meter Validation app is due to be rolled out at the end of April with revised upgraded versions of both apps due to be released this summer (funding permitting).

The instigation of work with Manchester University will be exploring new mathematical techniques that may provide further insight into UAG behaviour.

National Grid continues to broaden its engagement with all asset owners and will further enhance this activity by providing more opportunities and would always welcome any feedback⁹ related to its UAG management.

⁹ DataAssuranceandQualityTeam@nationalgrid.com