ALLOCATION OF UNIDENTIFIED GAS

Allocation of Unidentified Gas Statement for 2017/18

Xoserve Ltd

Report No.: 16819, Rev. 1
Date: 1st February 2017

Project name:	Allocation of Unidentified Gas	DNV GL - Software
Report title:	Allocation of Unidentified Gas Statement for 2017/18	Software Consulting
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Date of issue:	1st February 2017	Loughborough
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Report No.:	16819, Rev. 1	

Objective: This document is the first draft AUG Statement for 2017/18 and contains details of the methods developed by the AUG Expert for allocating daily UG between product class/EUC including details of the data requested to support this analysis, data received following such requests and any assumptions made. This document also contains the first estimate of the AUG weighting factors.

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Keywords:

Unidentified Gas, AUGE, AUGS

Rev. No.	Date	Reason for Issue	Prepared by	Verified by	Approved by
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EXECUTIVE SUMMARY

Project Nexus is currently scheduled for implementation in readiness for the 2017 gas year. This involves the replacement of key IT systems ('UKLink') for gas settlement and supply point administration in the gas industry and changes the way that the gas settlement is handled. Project Nexus will introduce individual meter point reconciliation for all meter points including those on CSEPs (previously SSP meters were subject to reconciliation by difference) and a rolling monthly AQ process. It also introduces 4 new meter point 'classes'.

As a result of these changes, there is a requirement to fairly apportion the daily total UG estimate between product classes and EUC. Mod 0473 was raised to allow the appointment of an independent expert (AUG Expert) to develop a methodology to do this and provide a table of weighting factors that will target the correct amount of UG to different classes of meter points, based on an assessment of their relative contribution to UG. The table of weighting factors will be used in the daily gas nomination and allocation processes.

This document is the first draft AUG Statement for 2017/18 and contains details of the methods developed by the AUG Expert for allocating daily UG between product class/EUC including details of the data requested to support this analysis, data received following such requests and any assumptions made. This document also contains the first estimate of the AUG weighting factors.

Following publication of this first draft there will be a 42 day consultation period allowing the industry to provide feedback to the AUG Expert and raise any questions/issues. Where appropriate, the methodology will be updated based on this feedback.

In addition to the above, this document describes how the AUG Expert has followed the published guidelines.

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1 INTRODUCTION

1.1 Background

The majority of gas consumed in Great Britain is metered and registered. However, some gas is lost from the system, or not registered, due to theft, leakage from gas pipes, consumption by Unregistered supply points and other reasons. Some elements of the gas that is not directly consumed/measured are currently modelled, and hence the gas consumed by these can be estimated. The gas that is lost and not recorded or modelled is referred to as Unidentified Gas (UG).

Currently, the Great Britain gas industry is segmented into two market sectors; Larger Supply Points (LSP) and Smaller Supply Points (SSP). Prior to April 2012 there was no methodology in place to determine the allocation of UG between the LSP and SSP market sectors: UG was ultimately borne by the SSP market sector following reconciliation (an interim amount was allocated for 2011/12). Through the approval of UNC Modification 0229 and the appointment of DNV GL as the Allocation of Unidentified Gas Expert (AUGE) in 2011, a methodology was developed to calculate and apportion UG equitably to the relevant gas market sectors. This approach involved an annual estimate of UG and a monthly transfer of costs between market sectors to address the misallocation of UG that occurs under the current regime. DNV GL carried out this annual process until 2014 when it became clear that the requirements for the AUGE would change given the upcoming implementation of project 'Nexus' (Mod 0432).

Project Nexus involves the replacement of key IT systems ('UKLink') for gas settlement and supply point administration in the gas industry. This is currently scheduled for implementation in readiness for the 2017 gas year and involves a change in the way that gas settlement is handled. Project Nexus will introduce individual meter point reconciliation for all meter points (previously SSP meters were subject to reconciliation by difference) and a rolling monthly AQ process. It also introduces 4 new meter point 'classes.'

After project Nexus implementation, an amended NDM Algorithm (with scaling factor removed) will use actual weather data to derive a bottom-up estimate of NDM Demand. This allows the calculation of a daily total of 'Unidentified Gas'. This UG will be shared out to all live sites, on the basis of their recorded/estimated throughput for the day.

As a result of these changes, the industry noted a requirement to be able to fairly apportion this total UG between product classes and EUC. Mod 0473 was raised to allow the appointment of an independent expert (AUG Expert) to develop a methodology to do this and provide a table of weighting factors that will target the correct amount of UG to different classes of meter points, based on an assessment of their relative contribution to UG. The table of weighting factors will be used in daily gas allocation processes. Daily measured or estimated gas throughput in each sector will be weighted using the AUG table factors to assign daily UG to Shippers based on their throughput by meter point class and EUC.

Mod 0473 was approved for implementation on the project Nexus go-live date. DNV GL were appointed to the new role of AUG Expert in July 2016.

1.2 High Level Objectives

The AUG Expert's high level objectives are:

- To assess the sources of UG and the data available/required from industry bodies to evaluate UG

- To gather data as required from Xoserve, from Gas Shippers, or drawn from other sources, as deemed appropriate by the AUG Expert
- To develop the methodology to assess the relative contribution to UG of different Classes and sizes of sites
- To publish the methodology in the AUG Statement (this document) and present findings to the industry
- To consult with the industry bodies and respond to questions/issues raised, assess the impact of questions on the methodology and update as appropriate
- Produce the table detailing the weighting factors for each Class and End User Category (EUC)

1.3 Scope

This document is the first draft AUG Statement for 2017/18 and contains the following:

- A detailed description of the proposed methodology
- A summary of data requested, received and used, and associated assumptions
- The table of weighting factors for apportioning UG between Product Classes and EUCs
- Details of the database used to hold information associated with UG and used to develop the methodology

This document will be published to the industry for review and comment during the consultation period.

The following are out of scope.

- The AUG Expert is not concerned with issues regarding the deeming algorithm or the RbD mechanism.
- The AUG Expert is not concerned with resolution of fundamental gas industry business process issues.
- The AUG Expert process is not an opportunity to deal with/investigate issues within the gas industry that should be addressed by other workgroups (e.g. Shrinkage Forum).
- The AUG Expert is not concerned with transportation charges.

2 COMPLIANCE TO GENERIC TERMS OF REFERENCE

This section describes how DNV GL has adhered to the Generic Terms of Reference described in Section 5 of the AUGE Guidelines [1].

The AUG Expert will create the AUG Statement by developing appropriate, detailed methodologies and collecting necessary data.

The AUG Expert has developed a detailed methodology for estimating factors to apportion UG between EUC and product classes. To calculate the factors, total UG is also estimated using meter read and consumption data for all meters which has been obtained from Xoserve. Further detailed datasets are used to directly estimate some components of the total UG where this is possible e.g. Shipperless sites. The AUG Expert has also developed a methodology to account for elements of UG which are Temporary in nature.

Additional data regarding theft of gas and likely take up rates of product classes was sought from the industry. Requests for information were also submitted to the Theft Risk Assessment Service (TRAS) and Smart Energy GB.

The decision as to the most appropriate methodologies and data will rest solely with the AUG Expert taking account of any issues raised during the development and compilation of the AUG Statement.

The proposed methodology and assessment of what constitutes UG has been decided solely by the AUGE based on available information. Comments raised by shippers relating to the AUG Statement will be considered and responses issued as part of the consultation process. Having considered all views, the final decisions will be the AUG Expert's own.

The AUG Expert will determine what data is required from Code Parties (and other parties as appropriate) in order to ensure appropriate data supports the evaluation of Unidentified Gas.

The AUG Expert has assessed what data is required to support the proposed methodology and has requested information from relevant parties. For the 2016 analysis, updated data sets have been requested from Xoserve for all items.

The AUG Expert will determine what data is available from parties in order to ensure appropriate data supports the evaluation of Unidentified Gas.

The AUG Expert has determined what data is available following discussions with Xoserve. A request was also made to shippers to establish if further information is available regarding theft and potential uptake of product classes.

The AUG Expert will determine what relevant questions should be submitted to Code Parties in order to ensure appropriate methodologies and data are used in the evaluation of unidentified error.

Questions regarding the relative ease of theft and detection of theft from Smart Meters vs mechanical meters have been submitted to the industry. Further communication will take place as and when necessary.

The AUG Expert will use the latest data available where appropriate.

Xoserve have provided all the latest available data as requested by the AUG Expert. Further updates will be provided if available for use in the calculation of the final table of factors.

Where multiple data sources exist the AUG Expert will evaluate the data to obtain the most statistically sound solution, will document the alternative options and provide an explanation for its decision.

For the consumption method of estimating total UG, both meter reads and metered volumes are provided. Over time LSP metered volumes may be corrected, but the meter reads are not. The AUG Expert's analysis has shown that metered volumes can be erroneous, particularly for non-corrected SSP data. The decision was therefore taken to use meter reads for SSP and metered volumes for LSP.

Where data is open to interpretation the AUG Expert will evaluate the most appropriate methodology and provide an explanation for the use of this methodology.

Throughout the statement the AUG Expert has described how data will be used and why.

Where the AUG Expert considers using data collected or derived through the use of sampling techniques, then the AUG Expert will consider the most appropriate sampling technique and/or the viability of the sampling technique used.

The consumption method for estimating the UG total is the only part of the analysis where a sample rather than the full dataset is used. This calculation will be at its most accurate when the largest possible representative subset of the meter point population is used. To achieve this, a validation process was developed that was designed to maximise the sample size whilst removing any meter points with invalid data. Appropriate methods are then applied to scale up for any meter points which have been excluded.

The AUG Expert will present the AUG Statement in draft form (the "Draft AUG Statement"), to Code Parties seeking views and will review all the issues identified submitted in response.

The AUG Expert will present the methodology described in this document (Draft AUG Statement) to code parties and will seek feedback. Any issues or queries raised will be documented and reviewed. The AUG Expert will then provide responses to be published on the Joint Office of Transporters website.

The AUG Expert will provide the Draft and final AUG Statement to the Gas Transporters for publication.

This document is the first draft AUG Statement for publication. Following industry consultation, the document will be updated and published as the Final AUG Statement.

The Committee's final determination in this process shall be binding on Users.

Not relevant to AUG Expert.

The AUG Expert will undertake to ensure that all data that is provided to it by all parties will not be passed on to any other organisation, or used for any purpose other than the creation of the methodology and the AUG Statement.

On receipt of data, the AUG Expert stores the data in a secure project storage area with limited access by the consultants working on the project. The AUG Expert can confirm data used in the analysis has not and will not be passed on to any other organisation. The data used will be made available to all bona fide industry participants in order to review the methodology, and in this dataset all MPR information has been replaced by 'dummy' MPR references by Xoserve so that the anonymity of the consumer is protected.

The AUG Expert shall ensure that all data provided by Code Parties will be held confidentially, and where any data, as provided or derived from that provided, is published then it shall be in a form where the source of the information cannot be reasonably ascertained.

Data is stored in a secure project storage area with access limited to those working on the project. Any data that contains market share or code party specific information has been and will be made anonymous to ensure the source of the information cannot be ascertained.

3 HIGH LEVEL OVERVIEW OF METHODOLOGY

This section provides a high-level overview of the methodology. For each of the areas of UG presented here a more detailed discussion is given in Section 6.

3.1 LDZ Load Components

The unidentified gas calculations described in this report are complicated by the fact that the UG Factors, which are the ultimate output of the work, are required to be split by post-Nexus market sector definitions, whilst all currently available information and data is from the existing regime with its associated market sectors. The load components are different in these two scenarios, and this creates a requirement to map from one to the other in as accurate a manner as possible as part of the calculation process.

Therefore, the analysis deals with both load components as they exist under the current regime and load components as they will exist post-Nexus, and so both are described in this section.

3.1.1 Current Regime

Daily load (as measured or calculated at the Supply Meter Point) falls into three relevant categories as far as the reconciliation process is concerned. These are as defined in Section A of the Uniform Network Code (UNC) [2]:

1. **Smaller Supply Point Component Load**

   Load from Supply Point Components (SPCs) which are part of a Smaller Supply Point (SSP). This is defined as a supply point where the AQ is not greater than 73,200 kWh.

2. **Larger Non-Daily Metered Supply Point Component Load**

   Load from Non-Daily Metered (NDM) SPCs which are part of a Larger Supply Point (LSP). This is defined as a supply point where the AQ is greater than 73,200 kWh but less than the mandatory daily metering threshold of 58,600,00 KWh. Note that historically (prior to the implementation of Mod 0428), Larger NDM SPCs may have contained individual meters that fell below the SSP AQ threshold.

3. **Daily Metered Supply Point Component (DM SPC) Load**

   Load from Daily Metered (DM) SPCs. This includes Daily Metered Mandatory (DMM) sites which are above the 58,600,000 kWh threshold), Daily Metered Voluntary (DMV) and Daily Metered Elective (DME) sites.

3.1.2 Post-Nexus Regime

Following project Nexus implementation, the population of supply points will instead be split into four different product classes, each of which have different meter read frequency requirements and reconciliation rules. A list of products and associated details (including approximate equivalence to current services) is shown in the table below. Information in this table is taken from UNC Modification 0432 [3].

Process Description	Basis of Energy Allocation	Basis of Energy Balancing	Shipper Read Submission	Market Sector	Current Service Equivalent
Product 1: Daily Metered Time Critical Readings	Daily Read	Daily Read	Daily by 11 am on GFD+1	DM	DM Mandatory
Product 2: Daily Metered not Time Critical Readings	Daily Read	Daily Read	Daily by end of GFD+1	DM	DM Voluntary / DM Elective
Product 3: Batched Daily Readings	Allocation Profiles	Allocation Profiles	Periodically in batches of daily readings	NDM	Non-Daily Metered
Product 4: Periodic Readings	Allocation Profiles	Allocation Profiles	Periodically	NDM	Non-Daily Metered

Table 1: Product Classes

Post-Nexus, each site will be classified as subscribing to one of these products, and meter read submissions, settlement and reconciliation will then be carried out for each site in the manner suitable for its product class.

In addition to splitting the UG figure between the four products, Mod 0473 also includes a requirement to include a split between End User Categories (EUCs) [4]. The final output of the AUGE process will therefore be a table of UG factors with the following structure:

Supply Meter Point Classification	Unidentified Gas Weighting Factor			
	Class 1	Class 2	Class 3	Class 4
EUC Band 1				
EUC Band 2				
EUC Band 3				
EUC Band 4				
EUC Band 5				
EUC Band 6				
EUC Band 7				
EUC Band 8				
EUC Band 9				

Table 2: Example UG Weighting Factor Table

3.1.3 Unidentified Gas

DM load (product classes 1 and 2 post-Nexus) is, by definition, metered and known on an ongoing daily basis. Like all metered load it can be subject to metering error, and data for known errors is used to correct it. NDM load (product classes 3 and 4 post-Nexus) for a given day can be estimated from available meter reads (and corrections). This uses a method based on the NDM deeming algorithm, to which reconciliation is applied when the meter readings become available. The estimation process is described in Section H of the UNC for the current regime [2] and Mod 0432 for project Nexus [3].

The sum of these load components does not equal the gas intake into the LDZ due to the presence of two further factors:

1. **Shrinkage**

   LDZ shrinkage occurs between the LDZ offtake and the end consumer (but not at the Supply Meter Point - the LDZ shrinkage zone stops immediately before this point). It covers:

   - Leakage (from pipelines, services, AGIs and interference damage)
   - Own Use Gas
   - Transporter-responsible theft

   The majority of shrinkage is due to leakage, and the overall LDZ shrinkage quantity is calculated using the standard method defined in the UNC [2].

2. **Unidentified Gas**

   UG occurs downstream of shrinkage, i.e. at the Supply Meter Point. It potentially covers:

   - Unregistered and Shipperless sites
   - Independent Gas Transporter Connected System Exit Point (IGT CSEP) setup and registration delays
   - Errors in the shrinkage estimate
   - Shipper-responsible theft
   - Meter errors – this includes both LDZ offtakes and consumer meters

   UG is currently unknown and hence must be estimated.

The relationship between these components of daily load can therefore be expressed as follows:

Total UG = Aggregate LDZ Load – DM Load – Shrinkage – NDM Load (3.1a)

This can be reformulated for the post-Nexus regime as:

Total UG = Aggregate LDZ Load – Product 1 to 4 Load – Shrinkage (3.1b)

3.2 Permanent and Temporary Unidentified Gas

Unidentified gas can be divided into two categories:

Permanent UG is consumed in an unrecorded fashion and costs are never recovered.

Temporary UG is initially consumed in an unrecorded fashion, but volumes are later calculated directly or estimated and the cost is recovered via back billing or reconciliation.

3.3 Unidentified Gas Methodology

3.3.1 Estimation of Total UG for Historic Years

The overall concept of calculating total UG using metered consumption data is simple, and is centred on the basic principle of the allocation process. Note that all available historic data will necessarily be from the pre-Nexus period and hence be based on the principles of the current regime. The NDM Allocation is calculated as follows:

$$\textit{NDM Allocation} = \textit{Aggregate LDZ Load} - \textit{DM Load} - \textit{Shrinkage}$$

This is shown graphically in **Figure 1**.

As the NDM load in equation 3.1a is the sum of all metered NDM consumptions, this allows us to rewrite as

$$\textit{Total UG} = \textit{NDM Allocation} - \textit{Metered NDM Consumption} \qquad (3.2)$$

This is based on the assumption that there is no significant Permanent UG arising from errors in aggregate LDZ load, DM load or shrinkage.

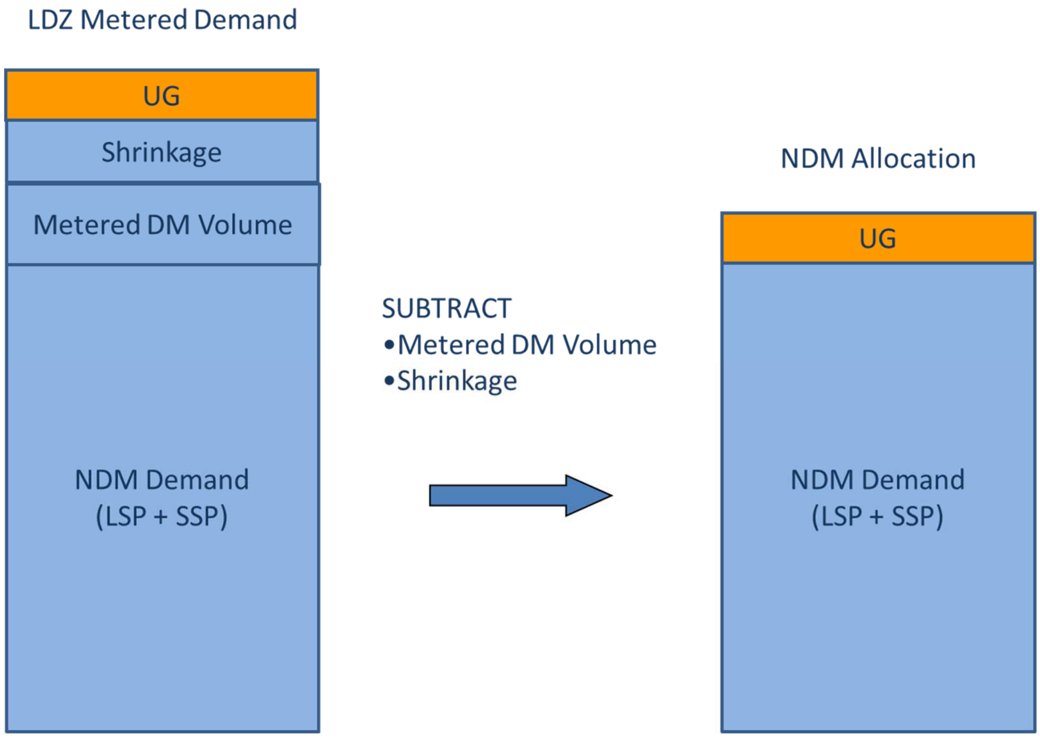

Figure 1: NDM Allocation and Unidentified Gas

The metered NDM consumption is calculated for each meter point and gas year using meter reads or metered volumes, and meter asset information. There are several complexities in this calculation that must be accounted for in the methodology and a fall-back approach must be developed for those meter points without sufficient data of suitable quality. This is summarised in Figure 2. The full details of the consumption methodology can be found in Section 6.2.

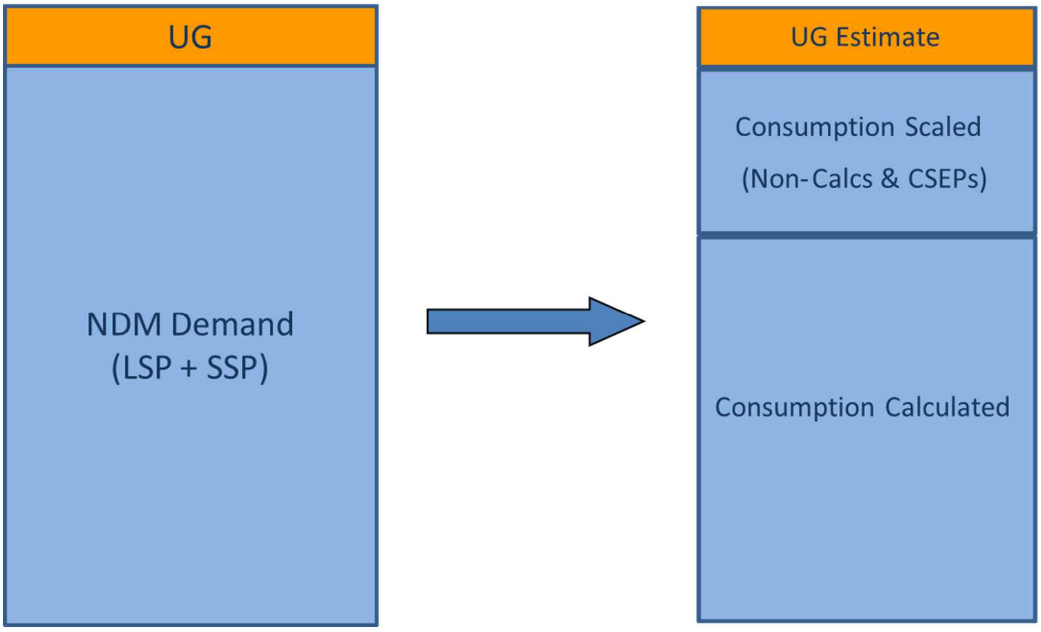

Figure 2: Calculation of Unidentified Gas from Consumptions and Allocations

This method is used to estimate total UG on a gas year basis. This is initially done on an LDZ by LDZ basis due to the very high volume of data required (i.e. all meter reads for all sites). The process is used to estimate the total UG for each of the six most recent historic years for which reliable data is available. This excludes the most recent year because the number of meters where consumption can be successfully calculated is much lower due to fewer meter reads being available. The use of data from this year could therefore be subject to a large degree of uncertainty.

Note that at this stage the total UG figure contains both Permanent and Temporary UG.

3.3.2 Calculating Components of Total UG

Having obtained the total UG figure using the consumption methodology described above, the value of individual components that make up the UG total are calculated where this is possible. This also includes the calculation of the amount of this UG which is temporary for each component and how the UG is split between market sectors. The definition of "market sector" at this stage moves to the post-Nexus one of products and EUCs. Splitting each directly calculated source of UG by EUC/Product in this way allows calculations for both the historic period (pre-Nexus) and forecast period (post-Nexus) to be carried out as follows:

1. Pre-Nexus data is required as a total for each UG component (but split into permanent and temporary elements). Therefore, the market sector split used does not matter: the output is the sum of whatever categories are used.
2. The post-Nexus UG forecast must be carried out separately not only for each UG component but every individual EUC/Product combination within each component. This is because each EUC/Product combination can follow its own trend over time (depending on market conditions, Mods that have been created to address individual issues, and so on). Therefore, each must be calculated across the whole historic period so that the trend can be identified and extrapolated to the forecast period. A full split into EUC/Product categories is required for this work.

It is known that data for each of the five potential components of UG (Unregistered and Shipperless sites, iGT errors, shrinkage error, Shipper-responsible theft and metering errors) is available. The availability and quality of this data varies from component to component, and the AUGE has therefore identified the best method of calculating each UG component based on the quality of information available for that component.

Brief descriptions of each UG element are given below.

1. **Unregistered and Shipperless Sites**

   The data available for this element consists of the details for every site that is either Shipperless or Unregistered at a given point in time. This point in time is the snapshot date, and snapshots are provided on a monthly basis, allowing the trends in each such UG category to be monitored over time. The details for each site include AQ, which allows each site to be assigned to the correct EUC and also allows its gas usage whilst Unregistered/Shipperless to be estimated. Unregistered and Shipperless sites that contribute to UG are split into the following sub-categories:

   - Shipper Activity
   - Orphaned Sites
   - Unregistered <12 Months
   - Shipperless Passed to Shipper (PTS)
   - Shipperless Shipper Specific Report (SSrP)
   - Sites Awaiting GSR Visit

2. **IGT CSEP Setup and Registration Delays**

   Gas consumed in an unrecorded manner due to iGT CSEP setup and registration delays is also included in the UG calculation. UG from this source is due to gas networks owned by iGTs but not present in Xoserve's records, and also comes from Unregistered sites on known CSEPs. The data available for this analysis consists of the number and composition of these unknown projects (number of sites and AQ split by EUC), and the number and AQ of each Unregistered site associated with a known project. Unknown Project data is again provided in monthly snapshots, allowing trends over time to be established.

3. **Shrinkage Error**

   Shrinkage errors affect the total UG calculation in that estimated shrinkage is deducted from the LDZ input total (along with DM load) to give the total NDM allocation from which metered load is then removed to calculate total UG. The shrinkage estimate comes from the Shrinkage Model, and if this is biased it will affect the UG estimate.

   Shrinkage Model errors are very hard to quantify, given that actual shrinkage is unknown and that the models are built on the most accurate data available. At the time they were trained they were, by definition, unbiased, and this may remain the case. If this is true, each individual instance of shrinkage model error may affect the UG total that relies upon it, but these errors will even out over time, leaving a net effect of zero. If changing conditions over time have led to the shrinkage model becoming biased, these effects will be picked up by the Balancing Factor (see 6 below), and this is therefore where this element will be captured.

4. **Shipper-Responsible Theft**

Very little reliable data on theft exists, and whilst information for detected and alleged theft is available, theft by its nature is often undetected. Undetected theft levels are very difficult to quantify accurately, and estimates from different sources vary widely, from 0.006% of throughput (based on detected theft only) to around 10%. As it is difficult to accurately estimate theft levels directly, undetected theft will be calculated by subtraction once known levels of detected theft have been accounted for. Undetected theft is part of the Balancing Factor (see 6 below), and considered over time, it forms the vast majority of that figure (based on an assumption that the shrinkage models are unbiased, so their individual contribution can be positive or negative but will sum to a value close to zero over time).

5. **Meter Errors**

Meter errors affect UG in different ways depending on their source. Errors in LDZ offtake metering and DM supply metering affect the estimate of total NDM demand including UG, whilst NDM LSP and SSP metering errors contribute to UG by affecting the NDM metered total. Corrections are applied to LDZ offtakes, DM and unique site meters using detected error data supplied by Xoserve. In addition, the effects of consumer meters (all EUC/Product combinations) under- and over-reading due to operating at the extremes of their range are modelled and included in the calculations.

6. **Balancing Factor**

The Balancing Factor is calculated by taking the difference between the calculated total UG and the sum of the directly estimated components. The Balancing Factor is comprised of UG elements that cannot be calculated directly because data is either unavailable or unreliable, and is believed to be mostly undetected theft.

The Permanent component of total UG is then given by the sum of the Balancing Factor and the Permanent components of the directly calculated components (see Figure 3).

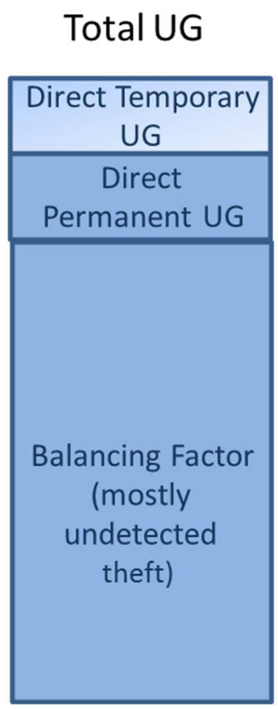

Figure 3: UG Components

3.3.3 Mapping to post-Nexus Product Classes

The classification of UG into EUC/Product classes is referenced in several places in the descriptions above. The reason for having to create this split is described in Section 3.3.2. The need to do this creates a challenge, however, in that all of the training data comes from historic (i.e. pre-Nexus) years, during which time the Product Classes did not exist.

Therefore, a method of mapping existing sites to future products is required. For the current (pre-Nexus) time, this is entirely based on a system of rules that estimate the likely breakdown of sites by Product based on asset information and a number of assumptions. As the post-Nexus period begins, these will be replaced by actual Product information for each site where it is available.

The rules are as follows:

1. At project Nexus go-live, Product 1 will be equivalent to the current DMM category.
2. Only sites with a Smart Meter or AMR are eligible for products 2 and 3. All sites with traditional meters are assigned to Product Class 4.
3. For Smart Meter and AMR sites, take-up rates for products 2 and 3 are assumed (Table 3.
4. The magnitude of Product Class 3 is defined by the eligible Smart Meter and AMR population with the relevant take-up rate applied.
5. The magnitude of Product Class 2 is defined by the eligible Smart Meter and AMR population with the relevant take-up rate applied, plus any existing DMV or DME sites.
6. The Standard Conditions of Gas Supply License [5] states that all sites in EUC 04B and above must have an advanced meter. Therefore, for these EUCs, the entire population is assumed to be AMR.
7. For EUC 01B, a value for the expected proportion of the Smart Meter installation programme complete as of the start of the forecast year is assumed (see Table 3). This proportion of 01B sites are assumed to have Smart Meters.
8. For EUCs 02B and 03B, the existence of AMR or Smart Meters is defined according to existing records.

These rules allow the existing meter population and market sector definition, and the UG that arises from them, to be mapped onto project Nexus product classes

Values for the following key parameters must be estimated in order to allow these rules to be applied. The values applied to each one, which are used throughout this analysis, are shown in Table 3 below. The take up rates for product 2 and 3 are derived from the volumetric assumptions used by Xoserve and presented to the project Nexus workgroup [15]. Xoserve suggested around 75% of smart meter sites with AQ < 732,000 kWh will remain in product class 4. The remaining 25% have been split between product classes 2 and 3.

Note that there is no assumption that all Smart Meter sites are precluded from being in Product Class 4: whilst the CMA Gas Settlements document [6] requires Smart Meter reads to be submitted monthly it does not require the readings themselves to be daily, and hence such sites are still eligible for Product Class 4. This is currently being reviewed under UNC Modification 0594R [11].

Parameter	Value
Smart Meter Installation Programme Completion (start of forecast year)	20%
Product 2 Take Up (for Smart Meter and AMR Sites)	10%
Product 3 Take Up (for Smart Meter and AMR Sites)	15%

Table 3: Product Class Assignment Key Parameters

3.3.4 Projection of Permanent UG to Forecast Period

Having calculated the best estimates of Permanent and Temporary UG for each historic year for which reliable data is available (the training period), it is then necessary to calculate the projected values of Permanent UG for the forecast year (see **Figure 4**). Note that the estimated values for the forecast year are calculated based on seasonal normal weather. The projection is carried out individually for each UG component category and EUC/Product class, in each case using the most suitable data and extrapolation technique. Extrapolation to the forecast period is carried out for each of:

- Shipperless and Unregistered
- iGT CSEPs
- SSP and LSP Metering Errors
- Balancing Factor

The methods used differ based on the observed behaviour of each category of UG, and are in many cases affected by a number of UNC modifications introduced in order to address various UG issues. The Balancing Factor is calculated for each of the six historic years with reliable meter read data (2009/10 to 2014/15) and projected forward based on the pattern observed in this time period. Input data for the directly estimated components of UG is reliable throughout and so all available data is used. Properties of the Balancing Factor and full details of the extrapolation techniques used in all cases are described further in Section 6.

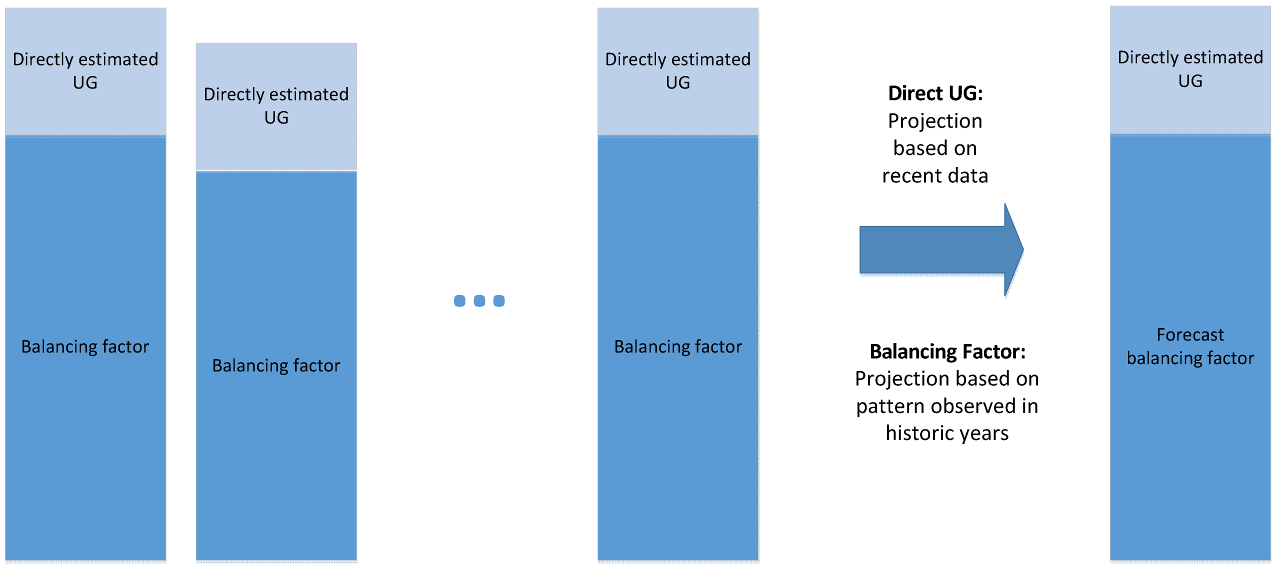

Figure 4: Projecting UG

As part of the estimation of the directly calculated UG components for the training years, an estimate of the amount of Temporary UG for each component is made as described above. The values projected forward to the forecast year are the permanent part of the UG only, however, for each EUC/Product combination. Note that detected theft (up to 3-4 year cut-off date) is treated as a directly measured component of UG (100% Temporary and hence not taken forward to the forecast year).

3.3.5 Unidentified Gas Factors

The final output of the UG analysis is a set of UG factors rather than direct estimates of the magnitude of UG itself. These factors can be applied to the population (defined in terms of the aggregate AQ for each EUC/Product) to give the relative magnitude of UG from each: these relative figures can then be applied to the independent daily UG estimate that is made post-Nexus to give the final UG breakdown (in energy terms) by EUC and product class.

The advantage of this approach is that this allows the effect of changing population to be taken account of in the UG split without the need for the factors to change: when the number (and hence AQ) of sites for a particular EUC/product category goes up or down, the fact that this AQ is then multiplied by the relevant UG factor ensures that the value of UG from this source also goes up or down accordingly. This means that fixed factors can be generated that last a full year, until the results of the subsequent AUGE analysis become available, with the effects of changing population during that year still taken into account.

The factors themselves are a fundamental link between population and the UG from it, however, and so they must be calculated using the detailed estimates of the value of UG (for the year in which the factors will be in force) described above. Once the UG for each EUC/Product combination for the forecast year has been estimated, this is converted into a factor by dividing by the relevant aggregate AQ (i.e. the best estimate of the AQ for that EUC/Product combination for the forecast year):

$$UG\ Factor_{PRODUCT,EUC} = UG\ (GWh)_{PRODUCT,EUC}\ /\ Aggregate\ AQ\ (TWh)_{PRODUCT,EUC} \qquad (3.3)$$

Note that the UG and Aggregate AQ have different units. This ensures that the resulting factors give sufficient precision when expressed to 2 decimal places as required.

4 SUMMARY OF ANALYSIS

For future versions of the AUG Statement, this section will contain details of analyses carried out and updates made to the UG calculation methodology since the last published document.

5 DATA USED

This section describes the data requested, received and used to derive the methodology to calculate the UG factors. The AUGE has taken care to ensure that all datasets include all components of NDM consumption, i.e. CSEPs and Scottish Independent Networks are included throughout.

Section 5.1 below gives a summary of the data items requested and their current status. The subsequent sections give more detail about the data items for each individual element of the analysis.

As part of the AUGE's quality control process, a number of standard data checks have been defined which are run prior to performing any consumption calculations. Any anomalous data is reported to Xoserve for further investigation. At the current time, not all issues identified have yet been resolved, so by necessity the values contained in this document are based on the best data available. There are also a number of checks during the calculation process to ensure that where data is unreliable it will not be used in the estimation of the UG factors.

5.1 Summary

Analysis Area	**Required Dataset**	**Status**
Total UG Calculation (Consumption Method)	Allocated NDM allocations	Received
	Metered SSP and LSP loads	Received
	LDZ, DM and Unique Sites Metering Errors	Received
	Meter Asset Information	Received
	Algorithm data (ALPs, DAFs, EWCFs)	Received
	CV data	Received
	CSEP AQ data	Received
	Non-CSEP AQ data	Received
	MMSP details	Received
	Prime and Sub-Prime meter details	Received
	New and Lost Sites	Received
Unregistered and Shipperless Sites	Connection details for orphaned sites	Received
	Gas Safety Regulations visit data	Received
	Further investigation results for large/suspicious sites	Supplied on request
	Mod 0410A supporting data	Ongoing
	Shipperless sites supporting data	Supplied on request
	Snapshot files (including MPR details)	Ongoing

Analysis Area	Required Dataset	Status
iGT CSEPs	Known CSEP data	Received
	Snapshot files	Ongoing
Meter Error	Meter capacity report	Received
Theft	Detected and alleged theft updated to end June 2016	Received

Table 4: Data Status Summary

5.2 Total UG Calculation (Consumption Method)

Data has been requested from Xoserve in the following formats. In all cases, data has been provided for gas years 2008/09 to 2014/15 with partial data for 2015/16.

- Allocation data on a day-by-day basis, split by End User Category (EUC). This data includes CSEP allocations.
- Meter read data on an MPRN-by-MPRN basis, with one record for each meter read. Therefore, the volume of data supplied for each MPRN is dependent on the meter read frequency for that meter.
- Aggregate meter error adjustments for LDZs, DMs and Unique Sites.
- Meter asset information on a MPRN-by-MPRN basis. This includes meter installation dates, metric/imperial flag, numbers of meter dials, meter index units and T&P correction factors. This information is used in several different parts of the consumption algorithm.
- NDM Deeming Algorithm factors and CVs for the analysis period.
- Aggregate MPRN count and AQ data by EUC for CSEPs. Meter read data is not available for these sites, but knowledge of the number and AQ of MPRNs allows them to be included in the total UG calculations when the sample consumption is scaled up to cover the full population.
- A history of AQ and EUC data for each MPRN so that calculated consumptions can be validated against AQs and failed meter points can be replaced with an appropriate EUC average.
- Details of all meter points which have been part of a Multi-Meter Supply Point (MMSP) during the analysis period.
- Details of all meter points which are or have been part of a Prime and Sub configuration during the analysis period. This includes re-confirmation data to track the potential disaggregation of prime and sub configurations.
- Lists of all new sites and lost sites during the analysis period, including start/end dates. These are used to accurately track the population over time and to ensure that each new or lost site is only included in calculations for the period for which it was active.

The provision of this data allows the consumption for each individual meter point, for each gas year of interest, to be calculated using the method described in Section 6.2. The exact format of the data provided is described in Appendix A.

5.3 IGT CSEP Setup and Registration Delays

Data for iGT CSEP setup and registration delays consists of two elements, as follows:

- **Unknown projects summary, including**
  - the number of unknown projects by LDZ
  - a count of supply points and aggregate AQ of unknown projects by LDZ

This data is supplied by Xoserve in monthly snapshot files on an ongoing basis.

- **Known CSEP Data**

  This file contains data for both registered sites on known CSEPs and Unregistered sites on known CSEPs. It is supplied on an annual basis and contains the following data fields:

  - LDZ
  - EUC
  - Number of supply points
  - Aggregate AQ

5.4 Unregistered/Shipperless Sites

The following information is supplied by Xoserve for all Unregistered and Shipperless sites (data supplied on a site by site basis). Xoserve have created a regular report to ensure that new data is collated and sent to the AUGE every month. This report covers the following categories of Unregistered and Shipperless sites:

- **Shipper Activity**

  These are new sites created more than 12 months previously, that a Shipper has declared an interest in (such as by creating the MPRN), but are nevertheless not registered to any Shipper. This data is split into sites believed to have a meter and those believed to have no meter.

- **Orphaned**

  These are new sites created more than 12 months previously, that no Shipper is currently declaring an interest in. This data is split into sites believed to have a meter and those believed to have no meter.

- **Shipperless Sites PTS (Passed to Shipper)**

  These are sites where a meter is listed as having been removed and 12 months later the gas transporter visits the site to remove or make the service secure (the GSR visit), but finds a meter connected to the service and capable of flowing gas. If it is the same meter as supposedly removed 12 months previously it is passed to the Shipper concerned to resolve.

- **Shipperless Sites SSrP (Shipper Specific Report)**

  Similar to Shipperless (Passed to Shipper) sites, these are sites where the GSR visit finds a new meter fitted and capable of flowing gas, in which case it is reported to all Shippers.

- **No Activity**

  These are sites currently being processed. They will end up in one of the other categories.

- **Legitimately Unregistered**

  These are sites believed to have no meter and hence are not capable of flowing gas.

- **Unregistered <12 Months**

  These are new sites that have been in existence less than 12 months and are not registered with a Shipper. Action is not taken on such sites until they have been in existence for 12 months. At this point they will move to either the Shipper Activity or the Orphaned category.

For all of these Unregistered/Shipperless UG categories, the following information is supplied for each site:

- Dummy MPRN
- LDZ
- AQ
- Meter Point Status

In addition, the following data is supplied for individual UG categories:

- Meter Attached Y/N
  - Shipper Activity, Orphaned, No Activity, Legitimate
- Meter Point Effective Date
  - Shipper Activity, Orphaned, Unregistered <12 Months, No Activity, Legitimate
- Shipperless Date
  - Shipperless PTS, Shipperless SSrP
- Isolation Date
  - Shipperless PTS, Shipperless SSrP

In addition, the following information is supplied on an annual basis:

- A summary of the remaining Shipperless sites, i.e. those that have been recorded as Isolated for less than 12 months and are awaiting their GSR visit. These sites do not yet appear in the Shipperless PTS or Shipperless SSP lists because sites only qualify for these after the GSR visit has found a meter at the site. This data comes from GSR visit records.
- Connection details for Orphaned sites, including asset and Shipper meter reads and information on whether the confirming Shipper is the same as the Shipper whose Supplier requested asset installation. This data is used to determine the proportion of sites that have been flowing gas prior to becoming registered and the proportion of these that can be back-billed.
- Shipperless sites supporting data. This is used to ascertain the final outcome for each Shipperless site that has appeared in any snapshot but has subsequently been either disconnected or

(re)confirmed. This is used to determine whether the UG arising from them is temporary or permanent under the terms of Mods 0424 [7] and 0425 [8].

5.5 Meter Errors

Data for meter error calculations consists of meter capacity, AQ and LDZ for all commercial sites. This report is supplied on an annual basis, with the latest one having been received by the AUGE in August 2016. This data is used to identify sites that due to the combination of AQ and meter capacity are likely to be operating at either a high or low extreme of their range, where bias in the readings starts to occur.

5.6 Theft

This data consists of all recorded detected and alleged thefts from 2008 to June 2016. For each theft, the following key data items are supplied:

- Dummy MPRN
- Theft start and end dates
- LDZ
- Meter AQ
- Estimate of energy value of theft (kWh)

6 METHODOLOGY

This section describes in detail the methodology for estimating each element of Unidentified Gas.

The first stage in the calculation process is to use the Consumption Method to estimate the total UG for each year in the training period. This process is very similar to that used by the AUGE previously [10] but has been updated to account for the change in definition of the AUG year to align with the gas year following implementation of Mod 0572 [12]. The method has also been updated to allow for the disaggregation of meter points in a prime/sub configuration.

All directly estimated UG categories are then calculated for the same period: this allows the amount of Temporary UG within the Consumption Method total for each year to be ascertained, and also allows the Balancing Factor (mostly undetected theft) to be calculated. All UG in the Balancing Factor is Permanent.

The data patterns observed in the training period for each UG component, including the Balancing Factor, are used to extrapolate to the forecast year (currently 2017/18) and provide the best estimate of each Permanent element of UG for this year. This is carried out individually for all 36 EUC/Product combinations for every UG category. Finally, these UG estimates are converted into factors by dividing by the GWh UG estimates for the forecast year by the aggregate AQ for each EUC/Product combination, as per *equation 3.3* in Section 3.3.5.

As given in *equation 3.2* (Section 3.3.1), the Consumption Method can be stated in its simplest form as:

$$\textit{Total UG} = \textit{NDM Allocation} - \textit{Metered NDM Consumption}$$

This calculation involves correcting the allocations to take account of meter errors (LDZ offtake and DM) and calculating the metered consumption using meter reads, metered volumes or an EUC average consumption for sites where no reliable metered data is available.

The Total UG calculated as above includes both Permanent and Temporary Unidentified Gas. Therefore, Temporary UG (calculated from the individual component parts of UG) has to be subtracted from the initial UG total, and it is this amended figure that then goes forward into the remainder of the calculations.

6.1 Correcting the NDM Allocation

The NDM allocation is calculated as

$$Alloc_{NDM} = \textit{Aggregate LDZ Load} - \textit{DM Load} - \textit{Shrinkage}$$

Any subsequently detected significant errors in these three components will constitute Temporary UG which has since been reconciled. Therefore, the allocations are corrected to remove this element.

6.1.1 Known DM and LDZ Metering Errors

Meter error adjustment data is received on an LDZ by LDZ basis split by billing month. The total value of the error is given, and this is split so that the correct proportion of each meter error can be assigned to each gas year in which the error occurred.

These errors affect the Aggregate LDZ Load and the DM Load, and have opposite effects on the allocation total, which is calculated at the gas year level of granularity. The result of applying corrections for the meter errors is as follows:

- LDZ meter under-reads *increase* the total NDM allocation
- LDZ meter over-reads *decrease* the total NDM allocation

- DM/Unique site meter under-reads *decrease* the total NDM allocation
- DM/Unique site meter over-reads *increase* the total NDM allocation

6.1.2 Shrinkage Error

Shrinkage Error is not a component of UG, and hence no attempt is made to estimate it directly. Any residual effects of shrinkage on the UG estimate (such as long-term bias in the shrinkage models), should they exist, are automatically included in the UG calculation via the Balancing Factor.

Full details of the AUGE's assessment of shrinkage can be found in Section 6.4 of the 2011 AUGS for 2012/13 [10].

6.2 NDM Consumption Calculation

The consumption algorithm relies on a large quantity of data, summarised in Section 5.2. A full description of the raw data used to calculate consumption figures for each individual meter point is described in Appendix A. This raw data is then pre-processed to validate it and to derive additional information to help speed up the consumption calculation process. After the pre-processing the main algorithm is run to calculate consumption on a meter by meter basis. This calculation will not be successful in all cases so a final step is required to scale up the consumption estimate to account for these 'failed' sites.

6.2.1 Algorithm

Figure 5 shows a flow chart of the process involved to calculate the consumption for a single meter and gas year with references to numbered steps, which are described in detail below.

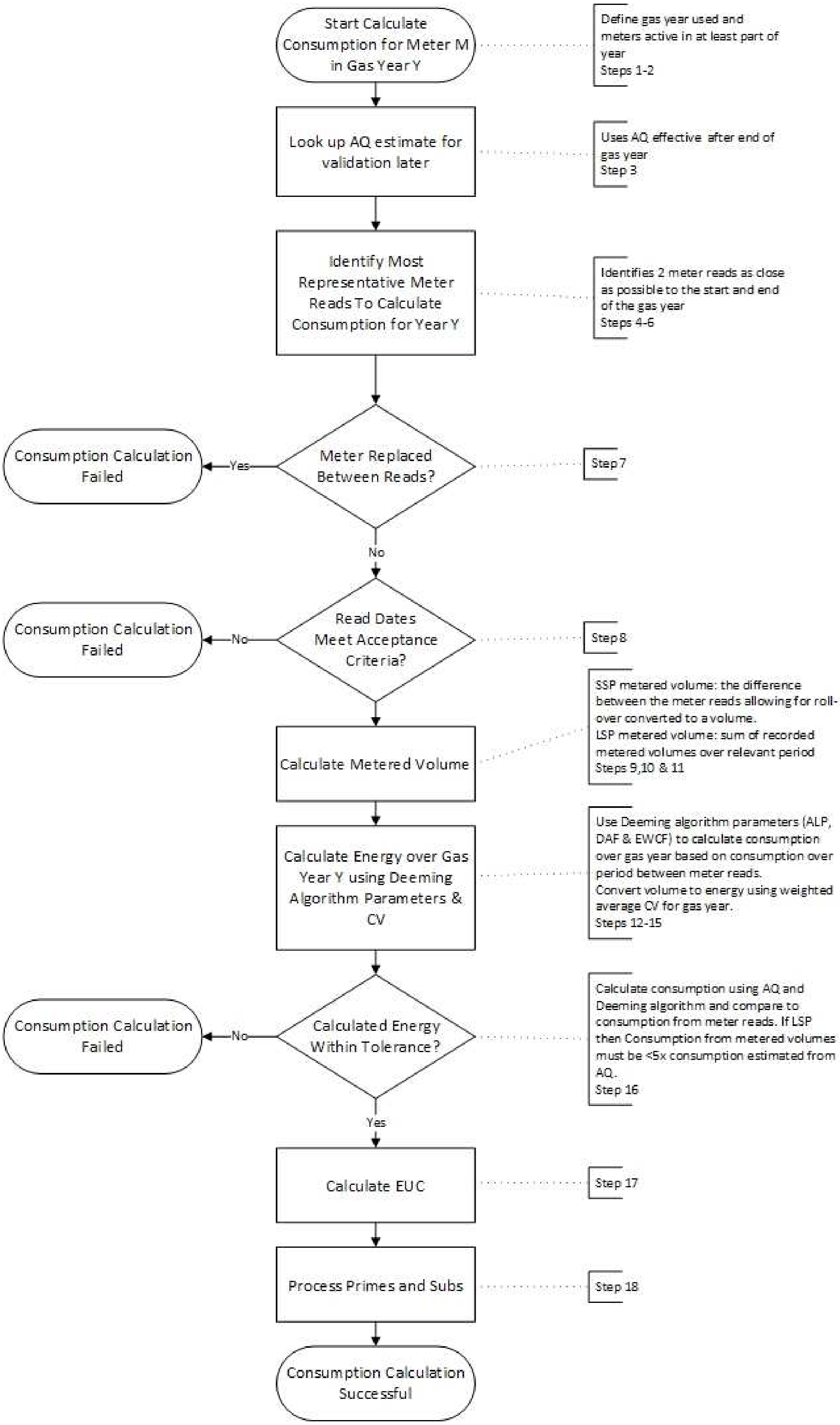

Figure 5: Consumption Algorithm Flow Chart

1. Given a gas year Y, define the start and end dates as 01 Oct Y and 30 Sep Y+1
2. Find all meter points that were active and NDM in a least part of year Y.
3. Look up the first AQ estimate effective after the end of the gas year. If none exists after the end of the gas year use the latest value. From this record store
    i. The AQ value
    ii. The EUC provided by Xoserve
    iii. The pre-calculated consumption band derived by the AUGE from the AQ value.
    iv. Market sector (SSP/LSP) based on the EUC from Xoserve
4. For each meter point find the meter reading date and value for:
    - LB1 (Lower Bound 1) – the latest meter reading prior to the start of the gas year
    - LB2 (Lower Bound 2) – the earliest meter reading within the gas year
    - UB1 (Upper Bound 1) – the latest meter reading within the gas year
    - UB2 (Upper Bound 2) – the earliest meter reading after the end of the gas year

    For SSPs those readings which have been flagged as bad by the pre-processing are excluded.

    Where a meter point has changed between NDM and DM or vice versa try to select meter reads from the period when it was NDM.

    Note that for any given meter point, only a subset of this full set of reads may be available. At least one lower bound and one different upper bound meter read are needed. Possible scenarios are shown in Figure 6 below:

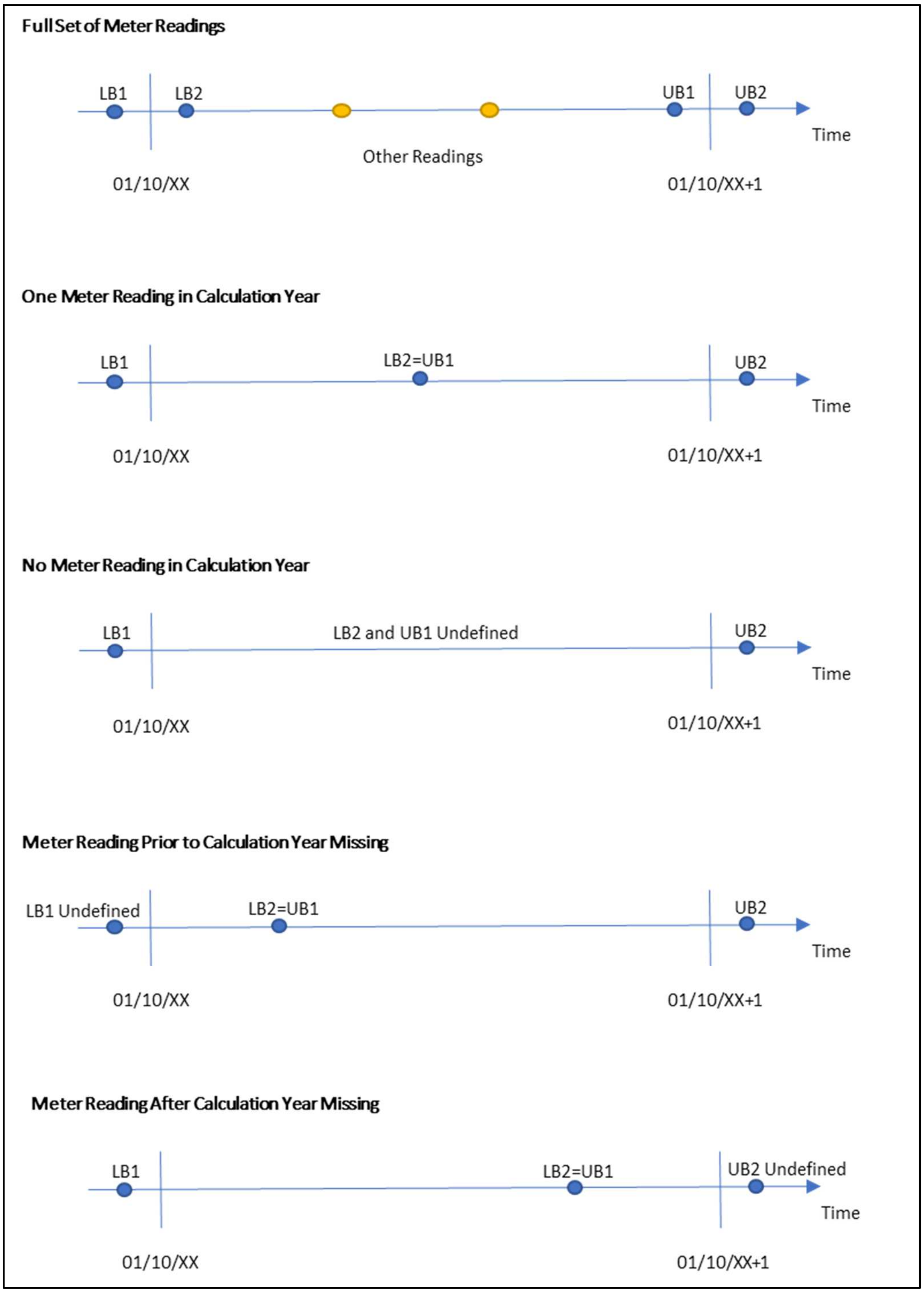

Figure 6: Meter Read Availability Scenarios

5. Set the start meter read date to LB1 unless

   A. the date of LB1 is more than 540 days from the start of the gas year, or

   B. the meter was replaced on or after LB1 and before LB2

   In which case set it equal to LB2.

6. Set the end meter read date to UB2 unless

A. the date of UB2 is more than 540 days from the end of the gas year, or

B. the meter was replaced after UB1 and on or before UB2

In which case set it equal to UB1.

7. If the meter was replaced between LB2 and UB1 inclusive, then reject the meter point.

8. Check that:

   A. The distance between the two chosen meter readings is at least 120 days

   B. The overlap between the metering period and the gas year is at least 60 days

   If this is true then proceed to calculating the metered volume, otherwise reject the meter point.

9. Apply either Rule A or Rule B according to the market sector of the meter point:

   A. If the site is SSP then calculate the volume consumed between the two chosen meter readings (mr_1, mr_2). If this gives a negative volume, then check if the meter index has rolled over (see subsection below).

   B. Otherwise sum the metered volumes (mv_i) and volume corrections between the two chosen meter readings. If there are any negative volumes in the range, set the sum to -1.

   If this step produces a positive volume then proceed to the next step, otherwise reject the meter point.

10. Calculate the fraction of the year that the meter point was active and NDM weighted by the WAALPs.

11. Calculate the volume taken over the gas year (or fraction of year calculated in the previous step) by multiplying the volume from Step 9 by

$$\frac{\sum_{\substack{\text{Formula Year} \\ \text{or Part Thereof}}} WAALP^{v}}{\sum_{\substack{\text{Metered} \\ \text{Period}}} WAALP^{v}}$$

   where $WAALP^{v}$ is the WAALP divided by the relevant CV value (i.e. a 'volume' WAALP rather than the usual energy WAALP).

12. Look up, in the meter asset information, whether the meter is/was metric or imperial and then apply either Rule A or Rule B to match the rule chosen in step 9.

   A. If the meter point is SSP look up the read units (*U*).

      - First choice is the units inferred from the meter read records.
      - If this could not be calculated, then use the units provided by Xoserve.
      - In the case where the read units from Xoserve are obviously wrong (i.e. are 0 or not a power of 10) use 1 for metric and 100 for imperial meters.

      Combine this value with the default correction factor (*CF*) 1.022640 and relevant metric/imperial conversion factor to get a combined conversion factor.

   B. Otherwise, if LSP look up the appropriate metric/imperial factor.

If no meter asset information can be found, reject the meter point.

13. Calculate the weighted average CV for the gas year, calculated as

$$\frac{\sum_{\substack{Formula\,Year\\or\,Part\,Thereof}} WAALP}{\sum_{\substack{Formula\,Year\\or\,Part\,Thereof}} WAALP^{V}}$$

14. Convert the gas year volume to energy in kWh by multiplying the output of Steps 11, 12 and 13 together. In summary, depending on the market sector of the meter point, this will be

$$Con = (mr_2 - mr_1) * U * CF * CV / 3.6 \; (* 0.0283168466 \; if \; imperial) \text{ for SSP}$$

$$Con = \sum mv_i * CV / 3.6 \; (* 0.0283168466 \; if \; imperial) \text{ for LSP}$$

15. Calculate an AQ from this consumption using the appropriate Cumulative Weather Adjusted Annual Load Profile (CWAALP)

$$AQ = Con * 365 / CWAALP$$

16. If a new AQ value has been calculated from the meter readings which is more than five times larger than the old AQ and the new AQ puts the site in the LSP market, then reject the meter point. If the old AQ is 1 then use five times the largest recorded AQ as the check instead.

17. If the consumption calculation was successful, calculate an EUC band based on the new AQ.

18. Carry out post-processing to avoid double counting of subs and deduct consumption. See subsection below for details.

Meter Index Rollover Check

Given two reads mr_1 and mr_2 where $(mr_2 - mr_1) < 0$ the following process is used:

1. Estimate the number of dials from mr_1

$$num\_dials = max(ceil(log_{10}(mr_1)), 4)$$

2. Determine the maximum possible meter read

$$max\_read = 10^{num\_dials}$$

3. Calculate the period between the two meter reads in years

$$num\_years = \sum_{mr_1(date)+1}^{mr_2(date)} ALP / 365$$

4. Assume meter index roll-over and re-calculate the volume

$$tmp_1 = max\_read - mr_1 + mr_2$$

5. Calculate the new volume as a fraction of the max read per year

$$tmp_2 = (tmp_1 / max\_read) / num\_years$$

6. If $tmp_2 < 0.25$ then assume the meter index has rolled over and use tmp_1. Otherwise leave the calculated volume as negative and reject the meter point.

Prime and Sub Meter Post Processing

As the prime meter consumption is the difference between the total consumption (based on the prime meter reads) minus the sum of the sub-meter consumptions, issues can arise in cases where a full valid set of consumptions for all meters within a sub-prime configuration are unavailable. Note that the consumption methodology will not calculate consumption for a DM meter. There are four cases to consider:

1. If the prime meter is DM, no action is necessary as the methodology won't have calculated consumption for the prime meter (consumption not required for DM meters). Sub-meters will be calculated correctly based on available data.
2. If the prime meter is NDM and contains one or more DM sub-meters, then the prime meter consumption calculation is flagged as having failed so that an EUC average consumption is used (see 6.2.2).
3. If the consumption calculation fails for any of the sub-meters, then the prime meter calculation is flagged as having failed. An EUC average consumption is therefore used for the prime meter.
4. If the consumption calculation succeeds for the prime meter and all of its sub-meters, then the prime meter consumption is calculated by subtracting the sub-meter consumptions from the total prime meter consumption.

Prime and sub meter arrangements may be disaggregated so data was requested from Xoserve to track the reconfirmation of these meters. Using this information, the necessary correction is made only for the relevant period.

6.2.2 Aggregation and Scaling-Up

When applied to each meter point in any given LDZ, the algorithm outputs a set of consumptions that can be aggregated to EUC level. The aggregated data for each EUC is also naturally split into the following categories by the algorithm:

- Meters for which a consumption could be calculated
- Meters for which the algorithm failed (failed to calculate consumption or calculated consumption failed validation)
- Meters in CSEPs (for which meter reads are not available)

The sum of these three categories across all EUCs gives the total NDM population of the LDZ.

Where a consumption value was successfully calculated the EUC is based on this consumption, otherwise it is calculated by the AUGE based on the AQ.

Therefore, for each EUC band the following can be calculated:

1. The number of meter points with a successfully calculated consumption.
2. The number of meter points without a calculated consumption (i.e. calculation failed).

3. The average consumption for those meter points with a calculated consumption greater than zero.

The values for 3) are then used to estimate the consumption for meter points in 2). This involves a number of subtleties:

- In 3) attention is restricted to consuming meters only, in order to account for potential differences in the proportion of non-consuming meters within and outside the sample.
- Meter points where the consumption calculation fails are classified as consuming/non-consuming based on AQ, as this is the only reliable data available for such meters. It is recognised that due to changing circumstances for each meter, those with an AQ of 1 for Year X are not necessarily non-consuming during Year X. Likewise, those with an AQ greater than 1 for Year X are not necessarily consuming in Year X. Therefore, two figures have been calculated using available information (i.e. meters within the sample):
  - o the proportion of meters with AQ = 1 for Year X that are consuming in Year X = A
  - o the proportion of meters with AQ > 1 for Year X that are consuming in Year X = B
- The consumption for the non-calculated meter points is then calculated as

  Consumption = A x (meters with AQ = 1) x "AQ=1" average consumption

  + B x (meters with AQ > 1) x EUC average consumption

  Where:

  - *"AQ=1" average consumption* is the average consumption of meter points where the AQ=1, but our consumption estimate is greater than zero. This can arise when an AQ review produces AQ=1 yet the period of consumption being validated is actually non-zero.
  - *EUC average consumption* is the average consumption for successfully calculated meters in the corresponding EUC Band. The 01B EUC average excludes meters where AQ=1.
- CSEPs are treated differently to failed meters. This is because meter points are assigned to EUC band based on their maximum potential AQ which may not be the same as their current AQ. It is not appropriate to estimate their consumption using the number of meter points in each EUC band multiplied by the EUC band average consumption. The approach used is described in detail in Section 6.3.3.1.
- Where the sample size for a particular EUC for a given LDZ and gas year is less than 30 the national average is used in place of the LDZ average.
- Failed meter points which were only active for part of the year are assigned an average demand scaled based on the sum of WAALPs for that part of the year.

Figure 7 below summarises the process for obtaining a consumption value for each type of meter point.

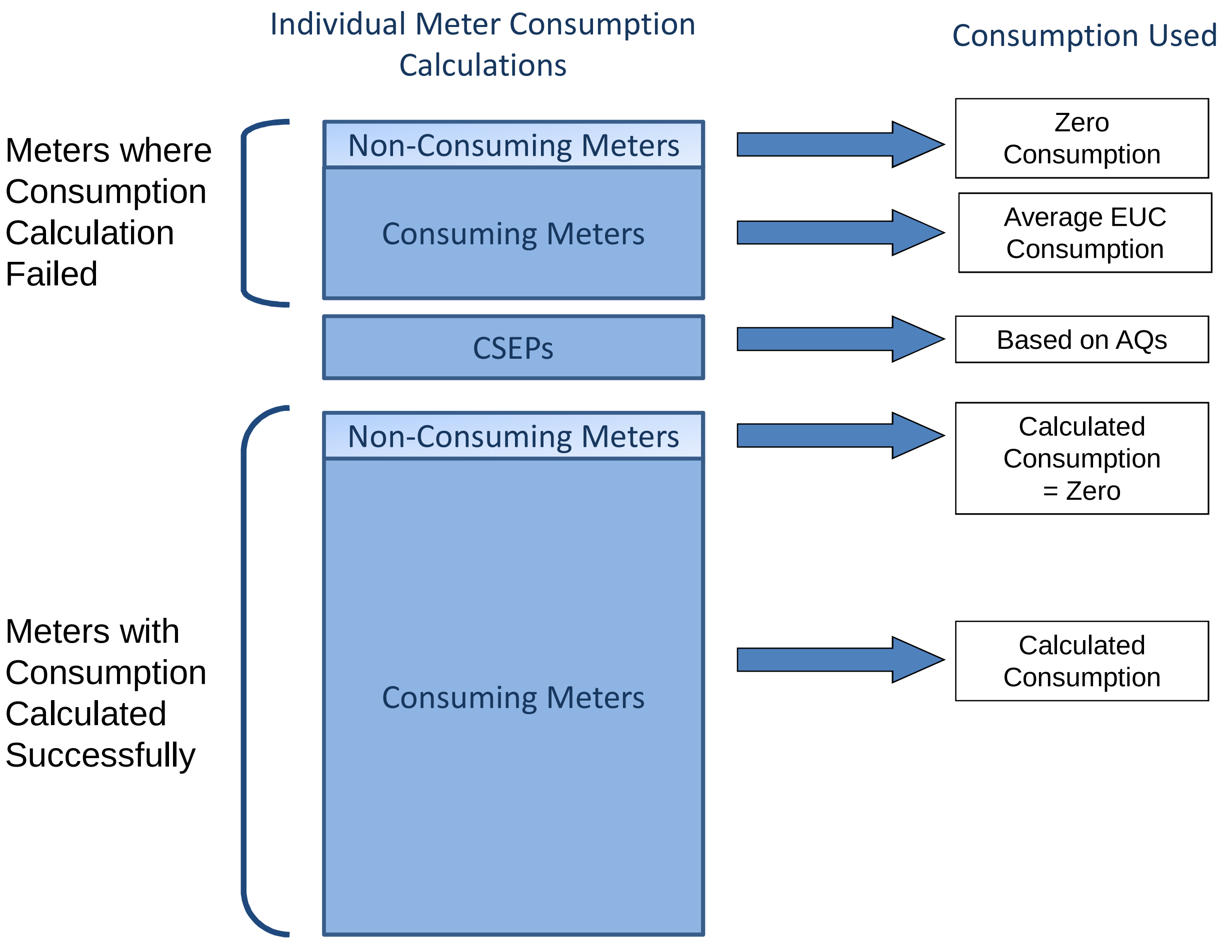

Figure 7: Consumption Method used for each type of Meter Point

UG for the LDZ for the gas year in question is then calculated by summing the metered NDM consumptions across all EUCs and subtracting these from the total combined allocations for the same period.

It is important to note that at this stage these figures still include Temporary UG. Therefore, whilst giving an indication of the order of magnitude of the Permanent UG total for that historic year, this is simply a step in the calculation process and not an estimate of the final value. The method for calculating the remaining Temporary elements is defined in detail in the relevant subsections below.

6.2.2.1 CSEP Consumption Calculation

The following steps are used in the calculation of CSEP consumption for gas year Y. The steps are carried out separately for each LDZ and EUC for each gas year. All references to AQ mean the CSEP AQ for the corresponding LDZ and EUC unless stated otherwise.

In most cases, the snapshots of CSEP AQ and supply point count are provided at the start of each gas year (1 Oct). However, the 2013 and 2014 snapshots provided are for February and it is not possible to obtain historical snapshots aligned to the gas year.

1. If the number of meter points in the CSEP is less than 100 in year Y then the CSEP consumption estimate for year Y is the aggregate AQ for year Y

$$C_Y = AQ_Y$$

Otherwise,

2. Calculate the average AQ for new meters

   For EUC01B before gas year 2012,

$$NMAQ = AQ_{2007} / N_{2007}$$

   For EUC01B for gas years 2012 and 2013,

$$NMAQ = AQ_{2012} / N_{2012}$$

   For all other EUCs and EUC01B from gas year 2014 onwards,

$$NMAQ = AQ_{Y+1} / N_{Y+1}$$

   Prior to 2012, the CSEP NExA table had not been updated since 2007. A new table was calculated for 2012 and this is now updated annually following iGT 053 which was implemented from 1 October 2014 [13]. This removes the additional bias which previously existed for 01B meters as a result of using default AQ values.

3. Calculate the average AQ for lost meters

$$LMAQ = AQ_Y / N_Y$$

4. Estimate the aggregate AQ for year Y by adjusting Y+1 for meter changes

$$AQ'_Y = AQ_{Y+1} - Max(0, (N_{Y+1} - N_Y) * NMAQ) - Min(0, (N_{Y+1} - N_Y) * LMAQ)$$

5. Adjust the aggregate AQ to allow for the recalculation success rate

$$AQ''_Y = AQ_Y + (AQ'_Y - AQ_Y) / RR$$

   where

   AQ_Y is aggregate AQ in year Y. Note that for 2009, AQ_Y is adjusted to the new SNCWV definition.

   AQ'_Y is the aggregate AQ in year Y+1 adjusted to allow for the different number of meters to year Y (as in step 4 above)

   RR is the recalculation success rate expressed as a fraction

6. Estimate consumption for year Y by adding effect of new/lost meters

$$C_Y = AQ''_Y + Max(0, (N_{Y+1} - N_Y) * MAQ_{Y+1}) * YFrac + Min(0, (N_{Y+1} - N_Y) * MAQ_Y) * (1-YFrac)$$

   where

   C_Y is the final estimate of aggregate CSEP consumption for year Y

   AQ''_Y is the estimate of aggregate AQ for year Y calculated from year Y+1 and adjusted for the recalculation success rate

   N_Y is the number of meters in year Y

   MAQ_Y is the average AQ per meter in year Y and is calculated as AQ_Y / N_Y

   YFrac is an estimate of the proportion of a year's consumption which new meters contribute. It is assumed that new and lost meters will be consuming on average for half of the year so a default factor of 0.5 is used. However, as not all snapshots are based on 1 October, a further adjustment is applied to allow for snapshots which aren't exactly one year apart. This only affects gas years 2012 and 2014. For example, the 2014 snapshot was provided for February 2014 whilst the 2015 snapshot was for October 2015. This is a period of 20 months rather than 12. In this instance the default factor of 0.5 will be adjusted to be 0.5*12/20.

If the consumption estimate is negative, then use the AQ as the best estimate of consumption i.e. $C_Y = AQ_Y$.

6.3 Unregistered and Shipperless Sites

The magnitude of every Unregistered and Shipperless category of Unidentified Gas is affected by a number of Mods introduced between 2013 and 2014 to address and reduce these specific areas of UG. The Mods in question are as follows:

- Mod 0410A [9] applies to Shipper Activity, Orphaned and Unregistered <12 Months, and any site created on or after 01/09/2013 is subject to the terms of this Mod.
- Mod 0424 [7] applies to Shipperless PTS, and any site with an isolation date on or after 01/04/2013 is subject to the terms of this Mod. This results in all UG from post-Mod sites being Temporary rather than Permanent.
- Mod 0425 [8] applies to Shipperless PTS, and any site with an isolation date on or after 01/04/2014 is subject to the terms of this Mod. In theory, this should have resulted in all UG from post-Mod sites being temporary rather than Permanent but the process required to implement this is not available in the pre-Nexus system. Therefore, all UG from post-Mod sites will only become Temporary after the implementation of project Nexus (i.e. for the forecast year but not the training years).

Note that Mods 0424 and 0425 apply to the PTS and SSrP elements of the "Awaiting GSR Visit" category in addition to their main categories.

A full description of the calculation method for all Unregistered and Shipperless UG categories is given below. Raw data for all of these except "Awaiting GSR Visit" is contained in snapshot files supplied by Xoserve every month. These are described in Section 5.4 above.

The following files also contain data that is used in the calculation process and are supplied on an annual basis.

- **Connection Details for Orphaned Sites**
  This dataset includes asset and Shipper meter reads and information on whether the confirming Shipper is the same as the asset Shipper. This data is used to determine the proportion of sites that have been flowing gas prior to becoming registered and the proportion of these that can be back-billed. Backbilling can only occur if the confirming Shipper is the same as the Shipper that carried out site works. The Connection Details dataset is split into two categories (pre-Mod 0410A sites and post-Mod 0410A sites) and different flow proportions and backbilling proportions are calculated for each. This is necessary because the terms of Mod 0410A affect how Unregistered sites are processed, and this leads to different conditions for pre-Mod and post-Mod sites.
- **Gas Safety Regulations Visit Details**
  The gas safety visit data is used to estimate the number and AQ of sites that have been recorded as isolated for less than 12 months and hence have not yet had their GSR visit and do not yet appear in the snapshots as Shipperless PTS or Shipperless SSrP, but are nevertheless still consuming Shipperless gas.

- **Shipperless Sites Supporting Data**
  This dataset contains the confirmation date of each Shipperless site that has appeared in any snapshot but has subsequently been (re)confirmed. It is used to ascertain the final outcome for each of the sites, i.e. whether it was (re)confirmed or whether it was disconnected. This is used to determine the proportion of Shipperless sites that have a meter and are *capable* of flowing gas that actually *are* flowing gas.

Further details of these data files are also given in Section 5.4 above.

The step by step calculation process for Shipperless and Unregistered UG is as follows:

1. Each MPRN in the snapshot files is assessed and flagged for further investigation by Xoserve if any of the conditions specified below are satisfied.

   - If a graph of AQs sorted by descending magnitude contains a “shoulder” point (i.e. a distinct change in gradient), any points to the left of the shoulder are flagged.
   - Any site with an AQ more than 100 times the average AQ for EUCs 02B-09B is flagged.
   - Any site with an AQ greater than 58.6 GWh is flagged.

   The resultant list of flagged sites is sent to Xoserve.

2. Xoserve respond with details where any of the flagged sites have been confirmed on their system, and the confirmed AQ of each such site is provided. Any differences between the queried AQs and the confirmed AQs are applied to the snapshot files. Sites where Xoserve have no further information are left as is.

3. All sites with a listed AQ above the VLDMC threshold (1.465 TWh) have their AQs replaced with the average EUC 02B-09B AQ. VLDMCs cannot be Unregistered or Shipperless due to the greater scrutiny the network code requires on such sites, and hence any AQ above this threshold in the Unregistered or Shipperless lists must be erroneous (e.g. MPRN or phone number accidentally entered in AQ field).

4. Before the analysis is run, the following coefficients are also calculated using the latest available data:

   - Fraction of opening meter reads with gas flow for Unregistered sites (for the Permanent/Temporary split for Unregistered UG categories, with different fractions for pre-01/09/2013 and post-01/09/2013 sites).
   - Fraction of Unregistered UG not backbilled (for the Permanent/Temporary split for Unregistered UG categories, with different fractions for pre-01/09/2013 and post-01/09/2013 sites).
   - Proportion of Shipperless sites being disconnected rather than re-registered.

5. “Fraction of opening meter reads with gas flow” is calculated using the “Connection Details for Orphaned Sites” spreadsheet. This file contains a list of Orphaned meters and includes both their asset meter reading and their opening Shipper meter reading. The number of meters with gas flow (i.e. those where the reading has changed) is expressed as a proportion of the total number of meters in the sample. The dataset is split into two sections - pre-Mod 0410A sites and post-Mod 0410A sites – and separate factors are calculated for each in order to account for changes introduced in the Mod. The calculated proportions are applied to the AQs of each pre-Mod 0410A and post-Mod 0410A site with a meter in the snapshots, to give an estimate of the consumption from sites that are actually flowing gas in the Unregistered UG calculations.

6. “Fraction of Unregistered UG not backbilled” is also calculated using the “Connection Details for Orphaned Sites” spreadsheet. In addition to the meter readings, this file contains a flag that indicates whether the asset Shipper is the same as the confirming Shipper. This flag is used to calculate the proportion of sites with gas flow (as calculated in Step 5 above) that also have a different Shipper. This is the proportion of Unregistered sites that cannot be backbilled and hence contribute permanent UG. As for “Fraction of opening meter reads with gas flow”, separate factors are calculated for pre-Mod 0410A and post-Mod 0410A sites.
7. The proportion of Shipperless sites that are disconnected rather than reconfirmed is calculated using information from the “Shipperless Sites Supporting Data” spreadsheet. Any site that disappears from the Shipperless lists without appearing in the “Confirmed” list in the supporting data has been disconnected and this is used to calculate the proportion that are disconnected rather than being reconfirmed. This figure is used as the best estimate of the proportion of sites capable of flowing gas that actually *are* flowing gas (i.e. it is assumed that if a site is flowing gas it is reconfirmed, and if it is not it is disconnected).
8. The raw Shipperless/Unregistered UG calculations are now carried out. This is carried out in a series of spreadsheets, with a set of spreadsheets for each individual UG category. Each of these sheets contains a full history of all available snapshot data for the relevant UG category, which at present runs from September 2011 to September 2016. The availability of snapshot data over such a period of time means that trends can be identified within each UG category and extrapolated to cover training years and the forecast year as necessary.
9. Every Shipperless and Unregistered category is affected by at least one Mod, and the implementation of each of these Mods therefore affects the magnitude and trend of the UG category it refers to. In addition, once the Mod has been implemented this creates a division of each category into pre-Mod and post-Mod sites: only post-Mod sites are affected by the Mod, and hence pre- and post- sites will now behave in different ways and exhibit different trends over time. Hence they must be analysed separately. In addition, the rules for UG being temporary or permanent can be different before and after the Mod and this must also be taken account of. This creates a set of four sub-categories of UG for each main UG category as follows:

   - Pre-Mod permanent
   - Pre-Mod temporary
   - Post-Mod permanent
   - Post-Mod temporary

   The trends for each of these must be assessed individually. For each one, the standard 36-way split also exists (9 EUCs and 4 Product Classes), and it can also be seen from preliminary analysis of the data that there is an LDZ-by-LDZ effect where different LDZs can show different patterns in UG consumption. This creates a total of 1872 individual sub-categories for every main UG category (pre- or post-Mod/permanent or temporary/LDZ/EUC/Product).

   The trend for each of these must be individually assessed in order to allow accurate calculation of UG for any time period covered by the snapshots, and accurate extrapolation to any required years that fall outside this range (e.g. the forecast year).

   Finally, the introduction of each Mod and the reaction of the industry to it necessarily affects these trends, which will therefore not remain constant over the entire time period covered by the snapshots. Therefore, for each main UG category, the snapshot period is split into a small number of separate sub-periods where the trend is consistent: these differ for each UG category due to the timing and nature of each Mod. Individual trends are therefore calculated for each sub-period and apply to specific time periods only.

10. The UG estimate for each year of the training period and for the forecast period is calculated as follows:

    - Where the training year lies within the snapshot period, the fitted trend for that year (calculated using the appropriate sub-period) is used.
    - For the forecast year and where the training year lies outside the snapshot period, the appropriate fitted trend is extrapolated to cover the year in question. These extrapolated values are used for the calculation.
    - Each point in the trend is the expected AQ of UG from that source at that particular point in time. Therefore, the best estimate of the UG consumed in Year Y is the average of the monthly AQ figures across the whole of the year.

    Figure 8 below shows an example of the piecewise fit approach for one UG sub-category (permanent Pre-Mod Orphaned sites, Product 4, EUC 01B, EA LDZ).

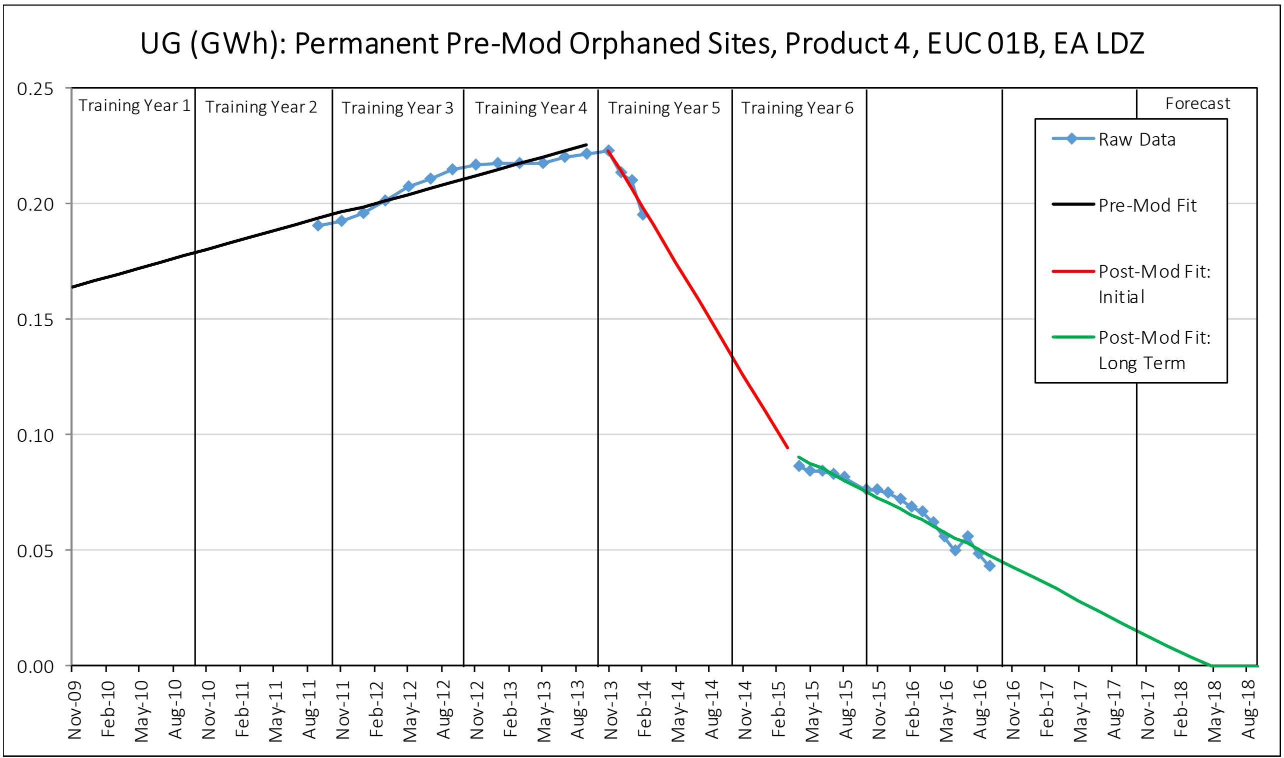

Figure 8: Piecewise Trend for Unregistered UG, Training and Forecast

11. Unregistered sites may or may not have a meter fitted. Where no meter is present, it is assumed that consumption will be zero. For meters in the Shipper Activity and Orphaned categories, the snapshot files contain data split into meter points with and without a meter present. Consumption for these categories is therefore calculated as described above only for meter points where a meter is actually known to be present. For the Unregistered <12 Months category, it is not recorded whether a meter is present or not. For these sites, it is therefore assumed that the fraction of meter points where a meter is present is the same as that found across the other two Unregistered categories.

12. The UG estimate for each type of Unregistered site is adjusted to account for the proportion of such sites with meters that actually flow gas whilst Unregistered, as described in Step 5 above. This adjustment is applied to the annual UG values calculated from the piecewise trends described in Step 10.

13. For Shipperless sites, the snapshots contain all sites found to be *capable* of flowing gas at the GSR visit. From these, the number *actually* flowing gas must be estimated. This is carried out using data in the "Shipperless Sites Supporting Data" file supplied by Xoserve. This contains the confirmation details of all sites that have appeared in the Shipperless report but have subsequently been confirmed and is used to determine the proportion of sites that were reconfirmed rather than being disconnected. The following assumptions are then made:

    - If the site was disconnected it was not flowing gas
    - If the site was reconfirmed it was flowing gas

    The reconfirmation percentage is therefore applied to the Shipperless UG totals (calculated as described in Step 10) to give the best estimate of the amount of Shipperless UG actually consumed.

14. For each Unregistered category, factors are used to convert from Requested AQ to Confirmed AQ and then from Confirmed AQ to AQ Following Review, as follows:

    Requested AQ → Factor 1 → Confirmed AQ → Factor 2 → AQ Following Review

    The "AQ Following Review" figure is regarded as a reliable indicator of the annual consumption at the site.

15. The UG estimates produced for each Shipperless/Unregistered category are multiplied by the appropriate combination of these factors. This is carried out as follows:

    - Shipperless sites (PTS, SSrP): no adjustment required for AQ bias
    - Unregistered (Orphaned, Shipper Activity and Unregistered <12 Months): adjust using composite *Factor1(n) x Factor2*, where *n* represents the UG category in question.

16. The above process allows UG estimates for all Unregistered and Shipperless UG categories apart from "Awaiting GSR Visit" to be calculated. At the time of calculation these are split by:

    - UG Category
    - Permanent and temporary
    - Pre-Mod and Post-Mod
    - Year
    - EUC
    - Product Class

    For use in further UG calculations, the estimates have to be split by permanent/temporary, Year, EUC and Product Class and so figures are aggregated across categories and pre- or post-Mod status. Tables of figures split this way feed into the final UG factor calculations.

17. "Awaiting GSR Visit" UG is calculated using Gas Safety Regulations visit data supplied by Xoserve. This file contains the details of each Shipperless site that has crossed the 12-month threshold during a period of a year and has subsequently been visited and found to be capable of flowing gas. The actual sites listed in this file by definition appear in the summarised data in the snapshot files because they have been Shipperless for more than 12 months. If it is assumed that sites become

Shipperless at a steady rate, however, it can be assumed that the number and AQ of sites crossing the 12-month threshold in Year Y is a good approximation of the number and AQ that will cross in Year Y+1. At the end of Year Y these sites will have been (recorded as) Isolated for less than 12 months and hence make up the "Awaiting GSR Visit" UG category for this year.

Therefore, in order to estimate the UG from this category, the AQs for each site from the GSR visit data are analysed and split by:

- Permanent and temporary
- Year
- EUC
- Product Class

The transient nature of this UG category means that there is no requirement to define sites as pre-Mod or post-Mod in this case. Whilst all sites in this category will go on to become either Shipperless PTS or Shipperless SSrP sites and hence are affected by Mods 0424 and 0425 (subject to the delay described above), all sites move on to their destination categories in a year and hence no legacy pre-Mod sites remain.

The permanent/temporary split for each year is defined by the implementation date of the relevant Mod, as follows:

- For the PTS element, all UG from this source is permanent up to the 2011/12 gas year, and all temporary from 2014/15 onwards. If a steady influx of sites is assumed for the remaining years, this results in 75% of UG being permanent for 2012/13 and 25% permanent for 2013/14.

- For the SSrP element, all UG from the pre-Nexus period is permanent due to the delay in implementation of back-billing. Following project Nexus go-live, any site without a record of the installation date of the new meter will still contribute permanent UG until its GSR visit regardless of the isolation date. It is assumed that new meters are installed at a steady rate for these sites and as such the average period of the year for which a meter was present and capable of flowing gas is 6 months (i.e. 50% of the year). The following calculation steps are applied:

    - Multiply the Shipperless SSrP UG element by the "% of Year with Meter" factor. This gives the total (permanent plus Temporary) UG for the Shipperless SSrP element of "Awaiting GSR Visit".

    - Multiply this total by the "% of Meters without Install Date" factor. This gives the Permanent element of the UG total from this source. The remainder of the UG for the Shipperless SSrP element of "Awaiting GSR Visit" is Temporary.

Finally, the reconfirmation percentage (as described in Step 13 above) is applied to convert from the AQ of sites *capable* of flowing gas to the AQ of sites *actually* flowing gas. This gives the final total UG estimate for this category, split by permanent/temporary, Year, EUC and Product Class.

The UG from this category is now taken through into the final UG factor calculations.

6.4 IGT CSEPs

Connected System Exit Points (CSEPs) are typically small networks owned by Independent Gas Transporters (iGTs) that connect to the GTs' systems. They are often new housing estates, where the gas network for the estate has been built and is owned by an iGT. CSEPs can potentially contribute to Unidentified Gas where either sites within them or entire iGT networks are not recognised by the Xoserve system and are thus consuming gas in an unrecorded manner.

6.4.1 Overview

UG from CSEPs arises from two sources: Unknown Projects and Unregistered sites on known CSEPs.

Unknown Projects are CSEPs that are known to exist but for various reasons are not on Xoserve's systems. Regular meetings are held between the iGTs and Xoserve in order to resolve these issues and reduce the number of Unknown Projects.

Unregistered sites on known CSEPs lie in CSEPs that are on Xoserve systems, and Xoserve are notified of such Unregistered sites on them.

For both these sources of UG from CSEPs, in the pre-Nexus market the UG from LSP sites is backbilled and is hence temporary, whilst UG from SSP sites on CSEPs is not backbilled and is hence permanent. Under project Nexus, this translates to UG from EUC 01B being permanent, whilst that from other EUCs is temporary.

It is necessary to calculate both the permanent and temporary elements of iGT CSEPs UG for the training period, whilst only permanent is required for the forecast year. This allows temporary UG to be removed from the raw UG total (permanent plus temporary) calculated using the Consumption Method for the training period, leaving the final total as permanent UG only. Any permanent UG can then be extrapolated to the forecast year to facilitate the calculation of the UG factors.

6.4.2 Data

Unknown Projects data is supplied by Xoserve in monthly snapshot files. These contain data for all Unknown Projects, split by LDZ and by the year in which the CSEP first came to the attention of Xoserve. For each LDZ, the total number of projects, the total number of supply points within them, and the sum of their AQ is given. Note that no split between market sectors is given.

Unregistered sites on known CSEPs data is supplied in a file provided on an annual basis. This file contains data for all known CSEPs, summarised to the LDZ and EUC level. For each EUC, the count of supply points within CSEPs and their aggregate AQ is given. This is provided in separate tables for registered sites and Unregistered sites.

Data for registered sites is used to calculate the average CSEP throughput percentages by EUC for each LDZ, and this is used to split the Unknown Projects data by market sector.

Data for Unregistered sites is used to directly calculate the UG from this source for each LDZ.

It should be noted that the supply point count data for Unregistered sites is actually the number of times Xoserve have been notified that the supply point is Unregistered rather than the number of sites that are actually Unregistered. Xoserve are often notified about the same site on multiple occasions, and this artificially inflates the supply point count figures in this dataset. Therefore, further analysis is carried out on this data in order to estimate the actual number of Unregistered supply points. This is described in more detail below.

6.4.3 Process

Processing is carried out in spreadsheets, which are supplied to the industry to allow auditing of the AUGE's calculations to take place. The following process steps are performed:

1. Data for *registered sites on known CSEPs* and *Unregistered sites on known CSEPs* is imported into the calculation spreadsheets. The average AQ per site for each LDZ/EUC combination for registered sites is calculated. As noted above, for the Unregistered data the number of notifications is recorded rather than the number of sites, and hence the actual number of sites must be estimated.
2. The average AQ per site derived from the registered sites is used to estimate the number of Unregistered sites in each EUC using the aggregate AQ for each EUC in the Unregistered dataset. This gives an estimated number of Unregistered sites in each EUC under the assumption that each site has the average AQ for that EUC.
    - If this calculated figure is lower than the number of notifications, it is used as the best estimate of the number of Unregistered sites in that EUC.
    - If the number of notifications is lower, this is used as the best estimate of the number of Unregistered sites in that EUC.
3. The total site count and aggregate AQ by EUC and by LDZ is calculated for registered sites. These figures are then used to calculate the percentage split of CSEP site count by EUC and the percentage split of CSEP AQ by EUC. This split is used in the calculations for Unknown Projects, described below.
4. The total site count and AQ by EUC and by LDZ is calculated for Unregistered sites. The AQ figures produced are split by Product Class using the standard rules defined in Section 3.3.3 and are used directly in the UG figures: these represent the estimated annual contribution to UG from Unregistered sites in known CSEPs based on current conditions.
5. When each new monthly snapshot file becomes available, data for Unknown Projects is updated. The snapshot tables are in the format shown in Table 5 below. In these tables, the "Year" field refers to the year in which the CSEP came to the attention of Xoserve. For each LDZ the total number of Unknown Projects, their aggregate AQ and the total number of supply points within them is given. Each snapshot represents the situation at the point in time when it was produced.

YEAR	LDZ	Count of Unknown Projects	Sum Of AQ	Count of Supply Points
2016	EA	39	3,483,428	242
2016	EM	34	3,310,074	283
2016	LC	2	656,051	71
2016	NE	9	713,548	38
2016	NO	7	449,652	27
2016	NT	28	2,808,802	136
2016	NW	23	2,579,977	110
2016	SC	71	82,397,218	1,450
2016	SE	40	19,677,626	316
2016	SO	47	11,738,973	651
2016	SW	33	2,548,838	213
2016	WM	23	2,948,638	201
2016	WN	4	292,555	11
2016	WS	12	810,594	94
		372	**134,415,974**	**3843**

Table 5: Unknown Projects Snapshot

6. The total number and composition of Unknown Projects by LDZ is calculated by summing across all years. The total Unknown Projects supply point count and AQ for each LDZ is split by EUC using the percentages calculated from known CSEPs, described in Step 3 above.
7. In some cases there may be additional Unknown Projects where the LDZ is unknown. These are assumed to have average composition by EUC (in terms of supply point count and AQ), with this composition again calculated from registered sites on known CSEPs.
8. The total AQ by EUC across all LDZs plus Unknown LDZ is calculated. These figures are split by Product Class using the standard rules and represent the best estimate of annual consumption in Unknown Projects at the time the snapshot was produced.
9. The total iGT CSEPs UG is calculated for each LDZ as the sum of Unknown Projects UG for the LDZ (from Step 8 above) and the Unregistered Sites on Known CSEPs UG for the LDZ (from Step 4 above). Any Unknown Projects UG from Unknown LDZ is smeared across all LDZs.
10. The above process gives, for each point in time, an estimate of what annual UG from iGT CSEPs would be if conditions for the full year remained as they were in the snapshot. The estimates from successive snapshots show any trend that exists, which then requires extrapolation to the year for which UG is being forecast. An example of this trend across a number of snapshots is shown in Figure 9 below.

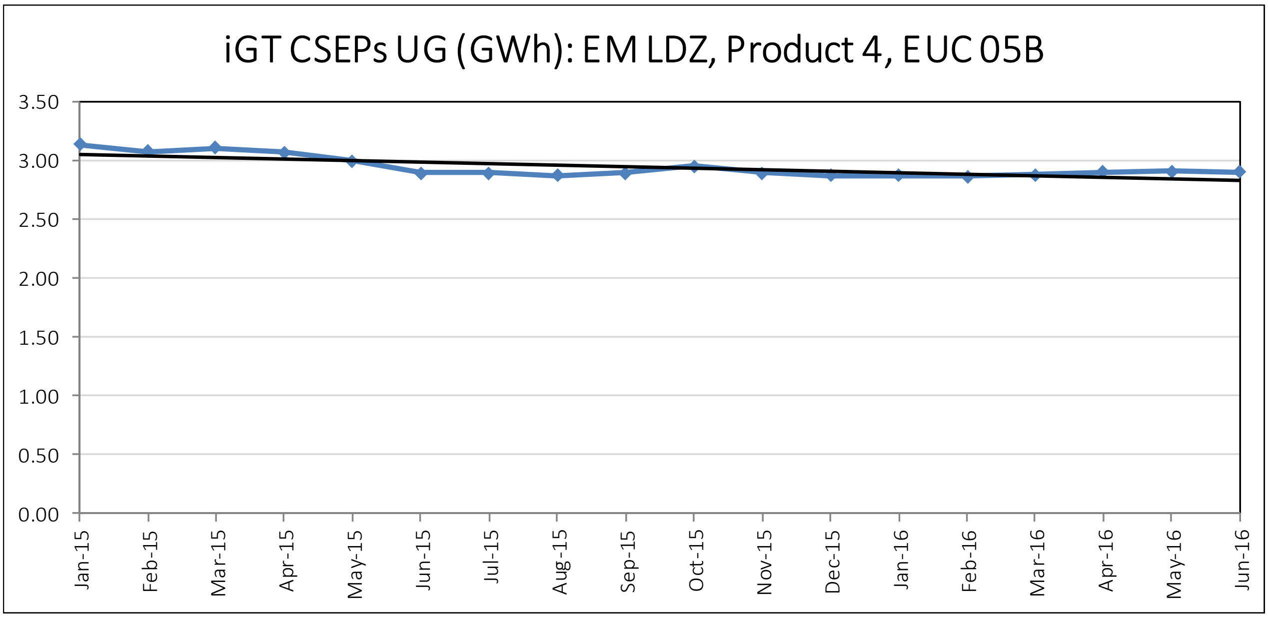

Figure 9: iGT CSEPs UG by Snapshot

11. The above process leads to the creation of a total of 468 individual trend lines for UG from iGT CSEPs. The identified snapshot-to-snapshot trend for each LDZ/Product Class/EUC combination is used to extrapolate either forwards or backwards to each time period of interest. The UG for each year used in the analysis is calculated using the fitted values for each snapshot date that falls within it. The time periods in question cover the UG forecast year and the historic UG training years, with values for each calculated using the fitted trend lines for each LDZ. The forecast year table is used directly in the final UG factor calculations, whilst those for historic years are used in the calculation of total UG and the Balancing Factor, which are based on data from the training years (currently 2009/10 to 2014/15).

12. For the pre-Nexus period, the UG calculated in this way from LSP sites is temporary. The UG calculated in this way from SSP sites is permanent. In the post-Nexus world, Xoserve have confirmed that all UG from this source will be reconcilable once the issue for the CSEP in question has been resolved. Therefore, for the forecast period all iGT CSEPs UG is temporary and does not form part of the permanent UG calculations.

6.5 Consumer Metering Errors

The effects of LDZ metering errors and known DM/Unique Site supply point errors are discussed in Section 6.1.1 above. In addition, undetected errors in all consumer supply point meters can cause gas to be burnt in an unrecorded or inaccurately recorded manner and hence have the potential to contribute to Unidentified Gas. An assessment of this area of metering error has therefore been carried out by the DNV GL Metering Team, and the conclusions drawn are presented here:

- Very little work has been done in the field of accurately assessing meter drift over time. Information is available about calibration curves taken at a particular point in time for certain meters, but there has never been any dedicated work looking at how these change over time. Therefore, conclusions drawn in this area are largely based on anecdotal evidence and/or extrapolation.

- Smaller sites (e.g. EUCs 01B and 02B) typically have diaphragm meters. The rubber diaphragm is known to warp over time, which causes drift in meter readings. Available evidence suggests that drift is equally likely to be up or down, which would result in a net bias of zero across each population. In the absence of any evidence to the contrary, this is therefore the assumption made throughout the UG calculations.
- In order for a more detailed analysis of such meter drift to be carried out, a large amount of data would have to be collected via a national meter survey. To carry out such a survey would be a significant undertaking as it would require a random sample of a sufficient size to cover many classes of meter (e.g. age of meter, type, model, level of consumption, capacity etc.), as well as co-operation of the customers and the physical testing of the meter itself with properly calibrated equipment. If such a survey was commissioned and carried out, the results could be used in future analyses of meter error. In the meantime, however, the evidence available leads to the assumption of a net zero drift over the population being used.
- Larger sites and offtakes generally have rotary/turbine meters that are constructed of metal and are unlikely to warp over time. These drift less than diaphragm meters, and again are equally likely to drift up or down, resulting in a net bias of zero across the population.
- Where large errors requiring an ad-hoc adjustment are found, these affect the UG calculations directly as described in Section 6.1.1. Data regarding such adjustments is supplied to the AUGE by Xoserve on a regular basis and is used to adjust the initial UG estimates.
- Calibration curves for both diaphragm and rotary/turbine meters follow a similar pattern. Such a curve for a NDM LSP Rotary Positive Displacement (RPD) meter is shown in Figure 10 below.

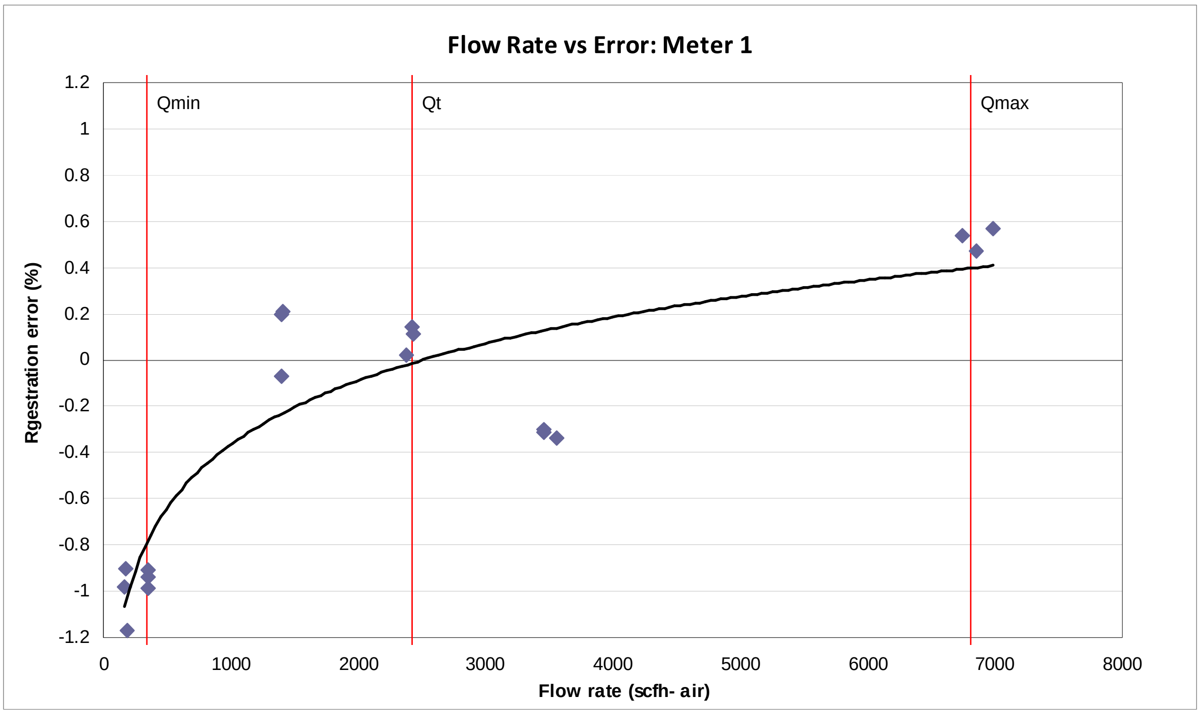

Figure 10: Typical Calibration Curve for an RPD Meter

Data for this graph was provided by the DNV GL metering team and comes from laboratory testing of a typical RPD meter. All identifying information has been removed for confidentiality purposes.

- The prominent features of this calibration curve are a consistent under-read of 1%-1.5% when operating at or below Q_{min}, unbiased readings around Q_t, and a consistent over-read at or close to Q_{max}.
- Meters are designed to operate at or around Q_t, ensuring that unbiased readings are obtained. This is not always the case, however, and circumstances may arise that cause some meters to operate close to Q_{min} or Q_{max}:
  - Loads at a particular site can drop over time, either due to changes in gas usage or because of economic conditions. This can lead meters to operate consistently close to Q_{min}.
  - Where businesses expand their operations without informing their gas supplier, the meter may no longer be appropriate for the load, causing it to run at or above Q_{max}.

Based on the above conclusions, an assessment of likely meter operating zones was carried out. Available data is limited to the meter capacity and AQ of each LSP site (EUCs 02B and above in the post-Nexus world), and this requires the AQ to be used to estimate average hourly load, which can then be compared to meter capacity. This translation from annual load to hourly load necessarily introduces uncertainty into the analysis, but the comparison of average hourly load and meter capacity allows those meters that are likely to be operating at their extremes to be identified.

As with all of the directly-estimated UG categories, available data is split according to current market sector definitions, and this must be mapped to post-Nexus Product Classes using the rules defined in Section 3.3.3 above. The EUC of each site can be derived from its AQ and so the full 36-way split by EUC/Product Class can therefore be achieved.

- Sites with an average hourly flow of less than 1% of meter capacity are considered to be likely to be operating at or around Q_{min} when gas is flowing. These are assumed to be operating with an average under-read of 1.5%.
- Sites with an average hourly flow of more than 95% of meter capacity are considered to be likely to be operating at or around Q_{max} when gas is flowing. These are assumed to be operating with an average over-read of 0.5%.

The effects of under-reads and over-reads work in different directions, and the difference between them represents the net over- or under-read in the population.

- A net under-read results in Permanent Unidentified Gas equal to the value of the under-read.
- A net over-read results in the raw estimate of Unidentified Gas being over-stated, and it is therefore adjusted down by the value of the over-read.

Only a single instance of the Meter Capacity data file is available and hence for this UG category no trends can be calculated over time. Therefore, in this case the fixed calculated UG energy values are applied to all of the training years and the forecast year.

6.6 Detected Theft

Detected theft which occurs within the window allowing back-billing (3-4 years) is a temporary source of UG and it is therefore quantified and subtracted from the total UG for each part of the training period based on year of occurrence. Data regarding theft details is provided by Xoserve. These theft values are used directly in the UG calculation for the training period and are split into the relevant year of occurrence to ensure the theft subtracted relates to the correct gas year.

The detected theft analysis is carried out in Excel, where for each theft the proportion of it that falls into each training year it is estimated to have been active is first calculated. These figures are used to calculate total detected theft by gas year for the training period as follows:

1. For each theft record and for each training year:
    a. Calculate the number of days in each year that the theft was active. There are four scenarios:
        i. The theft starts and ends within the gas year: the full duration of the theft occurs in a single year and values for all other years are zero for this theft.
        ii. The period of theft spans the gas year in question: duration of the theft in this year is all days in the year.
        iii. The theft is estimated to start in the gas year in question and end in a subsequent gas year: in this case the difference between the end of the gas year and theft start date is used.
        iv. The theft is estimated to end in the gas year in question and had started in a previous gas year: in this case the difference between the start of the gas year and theft end date is used.

    For all years for which the theft is not active, the value is zero.

    b. Calculate the amount of theft estimated to have occurred in the year in question by splitting the total estimated energy value of the theft according to the number of days it was active in each year.
2. Aggregate all thefts by gas year for the training period. Detected theft figures are used to amend the total UG calculated by the Consumption Method for each of these years and hence no split by EUC or Product Class is required.
3. The annual totals calculated in this way are then amended to account for the number of thefts for each training year that have not yet been detected but will be detected in the future up to the point where they can no longer be back-billed (i.e. those that are detected within the settlement period and are therefore temporary). This is up to year 5 prior to 2014 and year 4 afterwards following implementation of Mod 0398 [14] in April 2014. Thefts can often run for years before they are detected, and so in many cases it can be several years before a theft active in Year Y is detected. Analysis of thefts and their time to detection has been carried out using the data supplied by Xoserve. Figure 11 below shows the percentage of thefts detected (i.e. as a percentage of the total thefts that will eventually be detected up to year 8) by year based on all years in the Xoserve data.

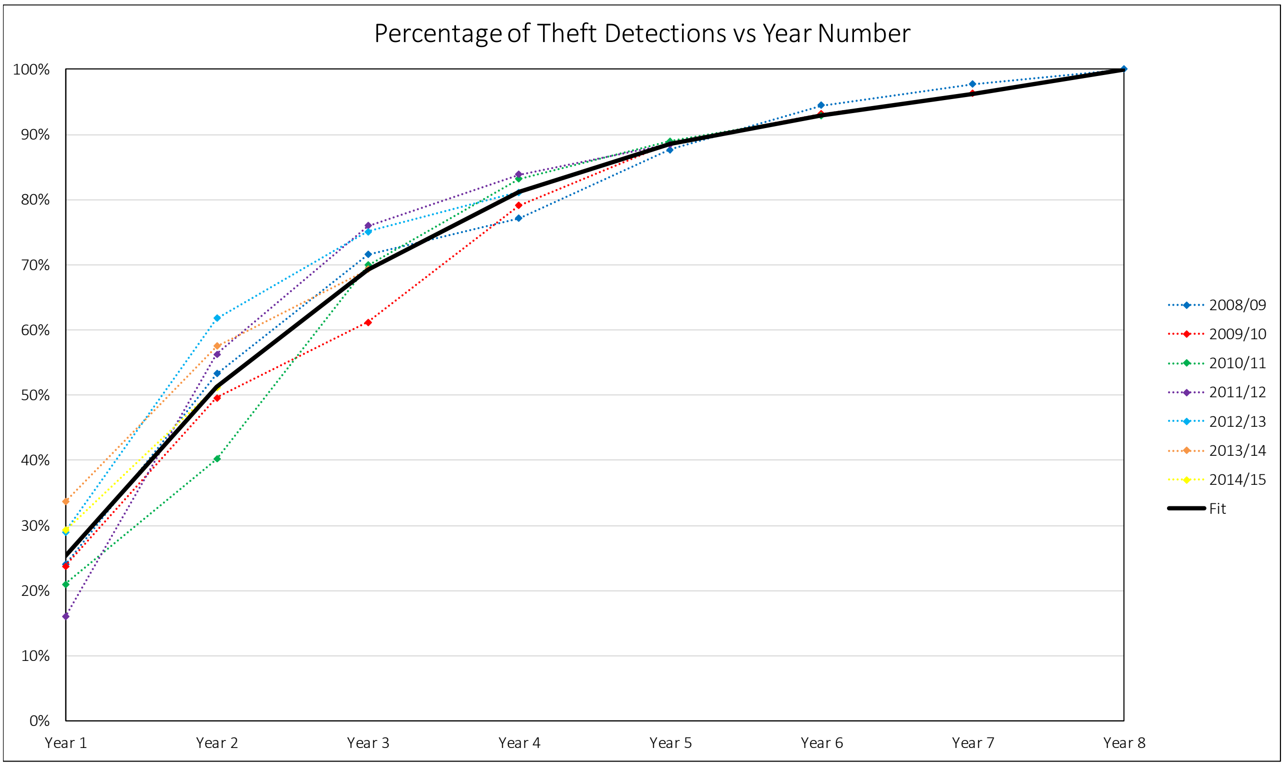

Figure 11: Percentage of Theft Detections by Year Number

The dotted lines show figures for thefts active in individual years, whilst the black line shows the overall fit. This shows that only around 25% of thefts that are going to be detected are detected in the year they are active, and that it takes around 8 years for most detections to take place.

Given that the full 8 year cycle has not completed for the majority of training years, the detected theft figures (which can now be regarded as representing thefts that have been detected so far) must be amended to incorporate an additional estimate of further thefts that will be detected. This is done using the values from the above graph, where detected thefts for active years less than 8 years ago are scaled up based on the estimated percentage to the level of theft which would be expected in total. Thefts detected up to and including year 4 contribute temporary UG, whilst the remainder are permanent.

4. The estimated annual temporary theft totals for the training period are then applied as corrections to the raw UG estimates from the Consumption Method. The permanent element becomes part of the Balancing Factor.

6.7 Balancing Factor

All of the analysis described above allows the total permanent UG to be calculated for each year of the training period. The permanent elements of the directly calculated UG categories (iGT CSEPs, Shipperless/Unregistered and consumer meter errors) can be subtracted from this to give the Balancing Factor for each year.

At present there are 6 years in the training period, which allows the pattern in the Balancing Factor to be assessed and the appropriate method selected to extrapolate it to the forecast year. This is discussed further in Section 6.8 below. In addition to extrapolating the Balancing Factor as accurately as possible, it must also be split by EUC and product class like all categories of UG. In order to do this, rules must be applied.

It is known that the Balancing Factor is composed mainly of undetected theft, and this provides the basis for how it is split. The split itself is a two-stage process, which is based on the following principles:

1. Create an initial split by EUC and product class according to the rules specified in Section 3.3.3 above. This gives a split of theft by EUC and product class on the basis of throughput (AQ). It therefore assumes that all types of sites and meters experience similar rates of theft (i.e. they are equally easy to steal from) at this point.

2. Adjust the above EUC/Product split to recognise the fact that not all meters are equally easy to steal from and not all types of site are likely to steal gas.

In November 2016 the AUGE approached the industry for information regarding the relative difficulty of stealing from different types of meter (traditional, AMR, Smart) and whether the additional information received from AMR and Smart Meters allowed theft to be more readily detected should it occur on these meters. A number of replies were received, and these have fed into the following additional rules (over and above those given in Section 3.3.3) for splitting undetected theft between EUCs and product classes. Note that Electralink, who run the TRAS service, were also approached but they were unable to supply us with any useful information regarding theft. The Balancing Factor split logic is as follows:

1. Theft is still possible and still takes place from all types of meter. If a meter is bypassed, for example, it does not matter what type of meter it is – an AMR or Smart Meter will not prevent this theft.

2. In theory, Smart Meters provide information that could be used to detect theft more readily e.g. tamper alerts. It is, however, very early in the Smart Meter rollout period and so little evidence of this phenomenon in practice has yet been observed. All shippers who responded to the AUG Expert's request for information agreed that the more detailed data that Smart Meters supply would allow thefts to be detected more quickly, but they reported that the issue of whether a greater proportion of thefts could actually be detected was less clear. Once again, this is due to it being very early in the Smart Meter rollout period, which means there is little data available regarding this issue.

3. Certain common types of theft are impossible on Smart Meters (e.g. tampering with the mechanical index) and hence the level of theft from Smart Meters as compared to traditional meters will be reduced due to this effect. Based on shipper responses to the AUG Expert, it is estimated that mechanical index tampering accounts for around 30% of thefts from traditional meters. It is acknowledged that in some cases a customer wishing to steal will choose an alternative method of doing so if they have a Smart Meter, but in others the unavailability of this very common theft method will prevent the theft taking place.

4. Out of over 15,000 detected theft records covering an 8-year period, none were from sites in EUCs 08B or 09B/DM. It is concluded that the greater scrutiny on sites of this magnitude prevents theft occurring in these cases. Thefts from all other EUCs have been observed, and hence it is concluded that undetected thefts from these sites are possible.

Based on the above, when EUCs 08B and 09B have been removed from the calculations, upper and lower limits for the true split of undetected theft can be defined. These are both based on a split of population into EUC/Product categories by throughput (defined as the aggregate AQ for each). The true split of undetected theft (and hence the Balancing Factor) must lie between these limits, and the rules for defining them are as follows:

- Upper Limit (i.e. highest possible Smart Meter theft)
  Smart Meters and AMR meters are just as easy to steal from as traditional meters and data from them does not allow a greater proportion of thefts to be detected. Undetected theft is therefore split across EUCs 01B-07B by throughput with no reference to meter type.
- Lower Limit (i.e. lowest possible Smart Meter theft)
  Smart Meters and AMR meters are either impossible to steal from, or if theft did take place the data from them guarantees detection. Undetected theft is therefore split across EUCs 01B-07B by throughput with Smart Meters and AMR removed (zero undetected theft from these sources).

The actual split will lie between these two limits, but due to the limited data available it is currently impossible to carry out a rigorous analysis to place this precisely. As stated above, however, the following information is available:

1. Mechanical index tampering, which accounts for 30% of theft from traditional meters, cannot occur on Smart Meters.
2. In theory, the more detailed data available from Smart Meters and AMR should assist with theft detection.

Therefore, at this stage of the analysis it is reasonable to place the split at the mid-point of the two limits, reflecting a situation where the undetected theft rate from Smart Meters and AMR (in terms of undetected thefts per 1000 sites, for example) is half of that of a traditional meter. Applying this logic gives the final split by EUC and product class for the Balancing Factor shown in Table 6 below. These percentages are applied to the Balancing Factor total, and the resultant figures form a part of the calculation of the final factors (which are given in Section 7).

	01B	02B	03B	04B	05B	06B	07B	08B	09B
Product 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Product 2	0.72%	0.00%	0.00%	0.28%	0.23%	0.48%	0.64%	0.00%	0.00%
Product 3	1.08%	0.00%	0.00%	0.41%	0.29%	0.24%	0.19%	0.00%	0.00%
Product 4	75.72%	7.87%	6.16%	2.07%	1.45%	1.21%	0.95%	0.00%	0.00%

Table 6: Balancing Factor Split

6.8 Extrapolation to Forecast Period

The training period for the unidentified gas calculations consists of a maximum of 6 years' data, running from 2009/10 to 2014/15. Data for the consumption method for calculating total UG is available for this length of time. Training data for individual directly-calculated elements of UG is limited by the time period for which snapshots are available: for these, the snapshot files typically do not start as early as 2009/10, but run beyond 2014/15, with snapshots available until mid or late 2016.

The analysis of unidentified gas is carried out on an LDZ by LDZ basis, due to the fact that it is dependent on identifying and extrapolating trends in each UG component and these trends differ across LDZs. The final UG factors are based on the combined national total unidentified gas, however, and so figures are aggregated across all LDZs once they have been calculated to achieve this.

The total UG is first calculated for the training period using the consumption method, which is described in detail in Section 6.2, and the permanent UG total for each year is obtained by subtracting temporary UG from it. For the forecast year, the total permanent UG is obtained by extrapolating permanent UG from each category (both the Balancing Factor and the directly calculated elements) forward to the relevant year and summing the resultant values. These UG energy values are then converted into factors using the method described in Section 6.9 below. There is no requirement for an additional independent estimation of the permanent UG total for the forecast year.

The method of extrapolation differs depending on the UG category. This section contains a brief description of the process for each category to clarify how permanent UG is calculated for the forecast year.

Unregistered and Shipperless

The principles of extrapolating this element of UG are based around creating piecewise trends for each Unregistered/Shipperless category and LDZ/EUC/Product Class combination and using these to make estimates for the training years and the forecast year. Piecewise fits are required because of the effects of Mods 0410A, 0424 and 0425, all of which affect Unregistered or Shipperless UG. The implementation of these Mods during the training period results in the UG pattern changing at specific points (e.g. the implementation dates). As many individual time segments as necessary are used to accurately model the UG pattern for each combination. Many segments may be required for an individual sub-category, as described and illustrated in Section 6.3.

The fit for the most recent snapshots is used to extrapolate forward to the forecast year in each case with the maximum degree of accuracy. In order to capture all Unregistered/Shipperless categories, LDZs, EUCs and product classes, a total of 1872 piecewise trends are required and hence it is not possible to present them in this document. Excel files containing all of this information are available to code parties on request.

The only exception to the above method is for the "Awaiting GSR Visit" category, which uses different input data. For this category, it is assumed that for the forecast year sites will continue to become Shipperless at the present rate. Within this context, the effects of Mods 0424 and 0425 are then modelled as follows:

- For the PTS element of "Awaiting GSR Visit" UG, all UG from this source is temporary from 2014/15 onwards.
- For the SSrP element of "Awaiting GSR Visit" UG, following project Nexus go-live, any site without a record of the installation date of the new meter will contribute permanent UG until its GSR visit regardless of its isolation date. It is assumed that new meters are installed at a steady rate for these sites and as such the average period of the year for which a meter was present and capable of flowing gas is 6 months (i.e. 50% of the year). The following calculation steps are applied:
    - Multiply the Shipperless SSrP UG element by the "% of Year with Meter" factor. This gives the total (permanent plus temporary) UG for the Shipperless SSrP element of "Awaiting GSR Visit".
    - Multiply this total by the "% of Meters without Install Date" factor. This gives the Permanent element of the UG total from this source. The remainder of the UG for the Shipperless SSrP element of "Awaiting GSR Visit" is temporary.

iGT CSEPs

The principle of defining trends for the training period and extrapolating to the forecast period using these, as described above for Unregistered/Shipperless sites, is also used for iGT CSEPs. In this case, 468 individual trends are required, which are extrapolated to the forecast year. Note that for this UG category, only UG arising from EUC 01B is permanent, and therefore only this element of the UG from iGT CSEPs is used in the forecast year permanent UG calculations. it is not possible to present all of the trends in this document, but Excel files containing this information are available on request.

Consumer Metering Errors

This category of UG is typically small. An assumption is made that the process is steady, and therefore single estimates of the figures for each LDZ/EUC/Product Class combination are applied to each historic year and taken forward to the forecast year.

Detected Theft

Detected theft is mostly temporary in nature and hence is used only in the calculations for the training period. Any permanent UG arising from theft is taken forward to the forecast year via the balancing factor.

Balancing Factor

The Balancing Factor is calculated individually for each gas year of the training period by subtracting temporary UG plus all directly estimated permanent UG from the total UG derived using the consumption method. However, it should be noted that the partitioning into gas years is arbitrary and relies on the allocation algorithm to assign consumption to individual gas years. It is therefore important to use multiple gas years in the calculation of the balancing factor to allow for any misallocation of consumption between gas years.

The 6 years of the training period allow any trend over time in the Balancing Factor to be identified. The year by year values are shown in Figure 12 below.

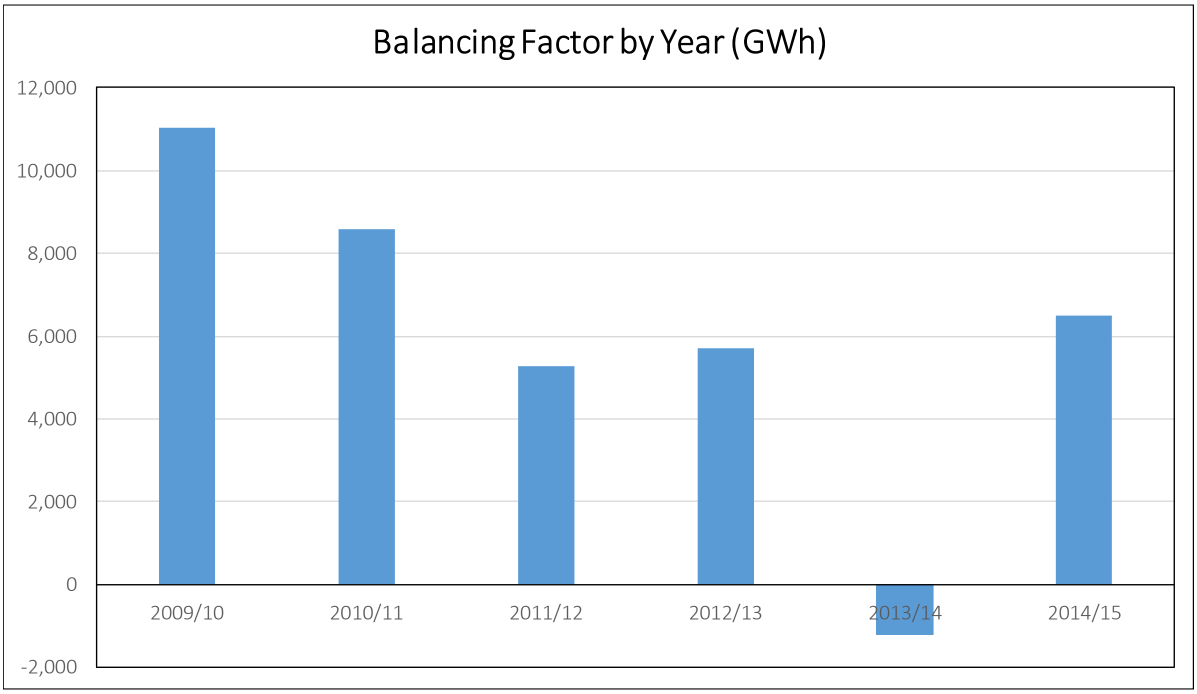

Figure 12: Balancing Factor by Year

The negative value for the Balancing Factor in 2013/14 has been investigated and no underlying data or calculation issues have been identified. We believe that this is due to the misallocation of consumption between gas years resulting from using the allocation algorithm. Xoserve have reported that most months of 2013/14 were ranked in the Top 10 warmest of the last 50 years, and that the allocation algorithms do not appear to perform as well in unusually warm conditions, especially during the summer months. This affects the UG estimates both in terms of correction to seasonal normal conditions and the allocation of UG to the correct gas year. The total UG over time will still be correct, but the difficulties in placing the gas in the correct year have, in this case, resulted in one year showing negative UG whilst those around it have been overstated. In reality, the UG from 2013/14 will have been positive, with that from the adjacent years being smaller than shown to account for this difference.

This issue aside, it can be seen in this diagram that a clear reduction in the value of the Balancing Factor has occurred from its starting value for the 2009/10 gas year. This difference is even clearer when it is considered that the UG total from 2011/12 to 2014/15 is correct but the allocation to years is not, meaning that the value for 2013/14 should be positive and the figures for the adjacent years lower.

In order to project the Balancing Factor to the forecast year 2017/18 it is necessary to use only those years where the value is varying around its new lower level. Therefore, the average from 2011/12 to 2014/15 has been used as the value to take forward to the forecast year.

Total Permanent Unidentified Gas

The total permanent UG for the forecast year, split by EUC/Product Class, is the sum of the Balancing Factor and each directly calculated category of UG. Each of these has been estimated for the forecast year as described above.

6.9 UG Factor Calculation

The final step in the calculation process is the production of the UG factors. These are a fundamental link between the population of the EUC/Product Class combination and the UG from it.

They are therefore calculated using the detailed estimates of the value of UG (for the year in which the factors will be in force) described in Section 6.8 above. Once the UG for each EUC/Product combination for the forecast year has been estimated, this is converted into a factor by dividing it by the aggregate AQ for that EUC/Product (i.e. the best estimate of the AQ for that EUC/Product combination for the forecast year). This AQ data has been supplied to the AUGE by Xoserve. Therefore, each factor is calculated as follows:

$$UG\ Factor_{PRODUCT,EUC} = UG\ (GWh)_{PRODUCT,EUC} / Aggregate\ AQ\ (TWh)_{PRODUCT,EUC}$$

7 UNIDENTIFIED GAS FACTORS

The Unidentified Gas factors, calculated as described in the document, are as follows for the 2017/18 gas year.

Supply Meter Point Classification	Product 1	Product 2	Product 3	Product 4
EUC Band 1	0.00	5.10	5.10	11.12
EUC Band 2	0.00	5.19	5.18	12.64
EUC Band 3	0.00	5.42	5.42	12.52
EUC Band 4	0.00	5.60	5.61	5.45
EUC Band 5	0.00	5.54	5.57	5.93
EUC Band 6	0.00	5.07	5.10	5.42
EUC Band 7	0.00	3.99	4.03	3.93
EUC Band 8	0.00	2.13	2.15	1.82
EUC Band 9	0.00	0.00	0.00	0.00

Table 7: Draft Unidentified Gas Weighting Factors

8 CONSULTATION QUESTIONS AND ANSWERS

This section will capture a history of the questions raised by industry bodies during consultation periods and the AUG Expert's responses.

9 CONTACT DETAILS

Questions can be raised with the AUGE at AUGE.software@dnvgl.com

10 REFERENCES

[1] Framework for the Appointment of an Allocation of Unidentified Gas Expert V6.5, 21st January 2016

[2] Uniform Network Code – Transportation Principal Document Version 4.90, 01 October 2016

[3] Mod 0432: Project Nexus – Gas Demand Estimation, Allocation, Settlement and Reconciliation reform, 17 January 2014

[4] Mod 0473/0473A: Project Nexus – Allocation of Unidentified Gas, 20 November 2014

[5] Standard Conditions of Gas Supply Licence (Gas Act 1986)

[6] CMA Energy market investigation, Final report, 24 June 2016

[7] Mod 0424: Re-establishment of Supply Meter Points – prospective measures to address Shipperless sites, 20 December 2012

[8] Mod 0425V: Re-establishment of Supply Meter Points – Shipperless sites, 7 January 2014

[9] Mod 0410/0410A: Responsibility for gas off-taken at Unregistered Sites following New Network Connections, 12 July 2013

[10] 2011 Allocation of Unidentified Gas Statement for 2012/13

[11] Mod 0594R: Meter Reading Submission for Advanced & Smart Metering, 15 September 2016

[12] Mod 0572: Amendment to the definition of AUG Year within UNC TPD Section E

[13] iGT 053: Introduction of annual updates to the AQ values within the CSEP NExA table, 1 October 2014

[14] Mod 0398: Limitation on Retrospective Invoicing and Invoice Correction (3 to 4 year solution), 1 April 2014

[15] Project Nexus Workgroup Volumetric Assumptions, Xoserve presentation, 24 July 2015

GLOSSARY

AGI	Above Ground Installation
ALP	Annual Load Profile (deeming algorithm parameter)
AMR	Automated Meter Reading
AQ	Annual Quantity. An estimate of annual consumption under seasonal normal conditions
AUG	Allocation of Unidentified Gas
AUGE	Allocation of Unidentified Gas Expert
AUGS	Allocation of Unidentified Gas Statement
Balancing Factor	An aggregate of the combined unidentified gas of various items calculated by subtraction. This includes theft, errors in the shrinkage estimate, open bypass valves, meters "Passing Unregistered Gas", unknown sites, and additional common cause variation.
CMA	Competition & Markets Authority
Consumption Method	Unidentified Gas methodology using meter reads and metered volumes
CSEP	Connected System Exit Point
CV	Calorific Value
CWAALP	Cumulative Weather Adjusted Annual Load Profile
CWV	Composite Weather Variable
DAF	Daily Adjustment Factor (deeming algorithm parameter)
DM	Daily Metered
DME	Daily Metered Elective. A site below the DM mandatory threshold of 58,600,000 kWh which the shipper has elected to be DM. The meter read equipment is provided by the shipper.
DMM	Daily Metered Mandatory. A site with an AQ above the DM mandatory threshold of 58,600,000 kWh.
DMV	Daily Metered Voluntary. A site below the DM mandatory threshold of 58,600,000 kWh which is voluntarily DM. The meter read equipment is provided by the transporter.
ECV	Emergency Control Valve
EUC	End User Category
EWCF	Estimated Weather Correction Factor (deeming algorithm output - alternative to WCF based on CWV rather than demand)
Found Meter	A meter being supplied by a Shipper but for which Xoserve have no record
GFD	Gas Flow Day

GSR	Gas Safety Regulations
IGT	Independent Gas Transporter
Isolated Meter	A meter that has been disabled (through capping or clamping) and hence is no longer capable of flowing gas, and this information has been conveyed to Xoserve and recorded on their system.
LDZ	Local Distribution Zone
LSP	Larger Supply Point
MAM	Meter Asset Manager
Model Error	The statistical error associated with any modelling or estimation process. It an inherent part of any statistical model and does not imply that the model itself is inadequate or incorrect.
MPRN	Meter Point Reference Number
NDM	Non-Daily Metered
ODR	OFGEM Data Request
OUG	Own Use Gas
PSND	Pseudo Seasonal Normal Demand, calculated using AQ values rather than being based on historic metered demands
PTS	Passed To Shipper
RbD	Reconciliation by Difference
RPD Meter	Rotary Positive Displacement meter
SAP	System Average Price
SF	Scaling Factor (deeming algorithm output)
SNCWV	Seasonal Normal Composite Weather Variable
SND	Seasonal Normal Demand
SPC	Supply Point Component
SSP	Smaller Supply Point
SSrP	Shipper Specific rePort
TPD	Transportation Principal Document (of UNC)
UIP	Utility Infrastructure Provider
UNC	Uniform Network Code
UG	Unidentified Gas
WAALP	Weather Adjusted Annual Load Profile
WCF	Weather Correction Factor (deeming algorithm output)

WSENS	Weather Sensitivity (deeming algorithm parameter used in EWCF definition, reflecting the sensitivity of an EUC to difference in CWV from seasonal normal)

APPENDIX A
Data

This appendix describes the raw data provided by Xoserve for the consumption method.

ALLOCATIONS

This data contains all allocations including CSEPs from 01/10/2008 onwards.

Name	**Description**
GAS_DAY	Date - Gas day for which allocation applies
LDZ	Char[2] - LDZ identifier e.g. EA
EUC	Char[11] - Full EUC Code e.g. WM:E0708W02
ALLOCATED_ENERGY	Number - Final allocated energy value (kWh). Includes CSEPs

ANNUAL_QUANTITY

This data includes all meter points active at any point from 01/10/2008 onwards, not just those currently live. It includes all within gas year updates, appeals etc.

Name	**Description**
MPR_ID	Number – Unique dummy ID for meter point which is used consistently throughout the data
AQ_EFFECTIVE_DATE	Date - Date on which AQ becomes effective
EUC	Char[11] - Full EUC Code e.g. WM:E0708W02
AQ	Number - Annual Quantity to apply from effective date (kWh)
SITE_TYPE_FLAG	Char[1] - Indicator ="N" for NDM meter point, "D" for DM meter point or "U" for Unique site

CSEPS

This data contains information for gas year 2008 onwards.

Name	**Description**
GAS_YEAR	Date - Gas year for which CSEP AQ/Numbers apply
EUC*	Char[11] - Full EUC Code e.g. WM:E0708W02
TOTAL_AQ	Number - Aggregate CSEP AQ at start of gas year
COUNT_OF_SUPPLY_POINTS	Number - Count of supply points at start of gas year

* Note that the EUC classification for CSEPs is based on a nominal maximum AQ

Xoserve also provide the success rate for the AQ calculation process. This is used in the process to adjust CSEP consumption for AQ bias.

FACTORS

This data is provided from 01/10/2008

Name	Description
LDZ	Char[2] - LDZ identifier e.g. EA
EUC	Char[11] - Full EUC Code e.g. WM:E0708W02
GAS_DAY	Date - Gas day for which factors applies
ALP	Number - Annual Load Profile (6 d.p.)
DAF	Number - Daily Adjustment Factor (6 d.p.)
EWCF	Number - Estimated Weather Correction Factor (8 d.p.)
CV	Number - Calorific Value (1 d.p.)

METER_ERRORS

All meter error adjustments from 01/04/2008 onwards. In addition to these resolved meter errors, any open errors will be taken from the JoT website. Where appropriate, the AUGE will clarify these with Xoserve.

Name	Description
BILLING MONTH	Month and year where billing correction was applied for the given meter error
LDZ	Char[2] - LDZ identifier e.g. EA
AGGREGATE ENERGY	Total correction for period of error in kWh
REASON	Reason for adjustment
ADJUSTMENT	Value of adjustment in kWh over billing period. Positive value represents an over-read

METER_READS

This data includes all meter reads from 01/10/2008 onwards. Multiple records for a meter point with the same date are filtered by Xoserve using the following methodology.

Where there is an A (Actual) Read Type and an E (Estimate) Read Type Xoserve remove the E and retain the A Read. Where there are Read Types of R (Replacement) Xoserve retain this read and remove the original read type that it replaced. Where there are multiple R Reads they are ranked by number e.g. R01 and R02 and the highest number is the latest replacement read that is retained.

Name	Description
MPR_ID	Number - Unique dummy ID for meter point which is used consistently throughout the data
START_READ_DATE	Date – Start date of metered period
METER_READ_DATE	Date - Date of meter read
IMP_IND	Char[1] - Indicator ="Y" for imperial meter read, else "N"
METER_READ_VAL	Number - Value of meter read
METERED_VOL	Number - volume of gas since previous meter read in units appropriate for meter (imperial or metric)
ROUND_THE_CLOCK_IND	Number – Number of times the meter index has passed zero since the last read.
AQ	Number – Prevailing Annual Quantity at time of meter read (kWh)
METER_READ_FREQ	Char[1] - Indicator for frequency of meter reads (A-Annual, 6-6 monthly, M-monthly)
SSP_LSP	Char[3] - "SSP" or "LSP"
EUC	Char[11] - Full EUC Code e.g. WM:E0708W02
READ_TYPE_CODE	Char[4] - Code for type of meter read

METER_INFO

This data includes all available meter asset data.

Name	Description
MPR_ID	Number - Unique ID for meter used across ALL data
LDZ	Char[2] - LDZ identifier e.g. EA
NUM_DIALS	Number - Number of meter dials
IMP_IND	Char[1] - Indicator ="Y" for imperial meter read, else "N"
METER_FITTED_DATE	Date - Date meter was fitted
UNITS	Number - Multiplier for meter read units (1, 10, 100 etc)
CORRECTION_FACTOR	Number – Volume correction factor
STATUS_UPDATE_DATE	Date – Date of record

METER_STATUS	Char[27] – e.g. Live, Removed
METER_CAPACITY	Number
READ_FACTOR	Number
METER_MECHANISM	Char[30]

MMSPS

This data includes details of all MMSPs active at any time since 01/10/2008.

Name	**Description**
MPR_ID	Number - Unique ID for meter used across ALL data
SUPPLY_POINT_ID	Number - Unique dummy ID for supply point
LDZ	Char[2] - LDZ identifier e.g. EA
CONF_EFFECTIVE_DATE	Date
CONF_END_DATE	Date

NEW_LOST_SITES

This data contains all meter points with a first confirmation date or an end date from 01/10/2008 onwards.

Name	**Description**
MPR_ID	Number - Unique dummy ID for meter point which is used consistently throughout the data
START_DATE	Date - First confirmation date for meter point
END_DATE	Date - Date meter point was excluded from allocations process

PRIMES

This data includes details of all prime meter points active at any time since 01/10/2008.

Name	**Description**
MPR_ID	Number - Unique dummy ID for meter point which is used consistently throughout the data

LDZ	Char[2] - LDZ identifier e.g. EA

SUBS

This data includes details of all sub-prime meter points active at any time since 01/10/2008.

Name	Description
MPR_ID	Number - Unique dummy ID for meter point which is used consistently throughout the data
PRIME_MPR_ID	Number – Dummy ID for the prime meter

A list of re-confirmation dates has also been provided for meter points which were previously in a prime/sub configuration but are no longer.

About DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil & gas and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our professionals are dedicated to helping our customers make the world safer, smarter and greener.