Attachment 7.3

Unaccounted for Gas Forecast

2016/17 to 2020/21 Access Arrangement Information

Australian Gas Networks

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SOUTH AUSTRALIA
ACCESS ARRANGEMENT INFORMATION
Attachment 7.3

UNACCOUNTED for GAS FORECAST

March 2015

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Glossary

AEMO	Australian Energy Market Operator
CI	Cast Iron mains
MAT	Moving Annual Total
Network	The AGN South Australian distribution network
Unaccounted for Gas (UAFG)	The difference between the quantity of gas metered into a pipeline system and metered out of the Network.
UAFG%	UAFG expressed as a percentage of system throughput
UPS	Unprotected steel mains - mains without coating or cathodic protection

1. Executive Summary

This document discusses the UAFG performance of AGN's South Australian Network, and provides a UAFG forecast for the 2016 to 2021 Access Arrangement period.

There are many elements of UAFG which make it difficult to forecast UAFG with any level of precision. Notwithstanding, modelling can be used to provide an estimate of the breakdown of UAFG, and if it is assumed that many elements will not vary significantly over a forecast period, it is possible to estimate how UAFG might change over time if certain parameters are changed.

In summary, this report concludes that:

(1) There has been a significant reduction in UAFG which has been largely attributed to the high level of CI and UPS mains replacement, with a small contribution arising from a reduction in operating pressure in part of the Network. The level of UAFG in the current (2011-12 to 2015-16) Access Arrangement period has consequently out-performed the UAFG regulatory target.

(2) Based on the planned level of mains replacement and analysis by an independent expert, UAFG has been forecast annually going forward, and is forecast to be 1035 TJ by the end of 2020/21. At the time of preparation of the AGN submission, AGN submits that these are best estimates prepared on a reasonable basis.

2. UAFG Target – Current Regulatory Period

In the period leading up to the current Access Arrangement period, there was concern over the increasing level of UAFG in the Network. This is because a significant component of UAFG at the time was acknowledged as being leakage from aged mains, and such leakage poses a safety risk to consumers and the public.

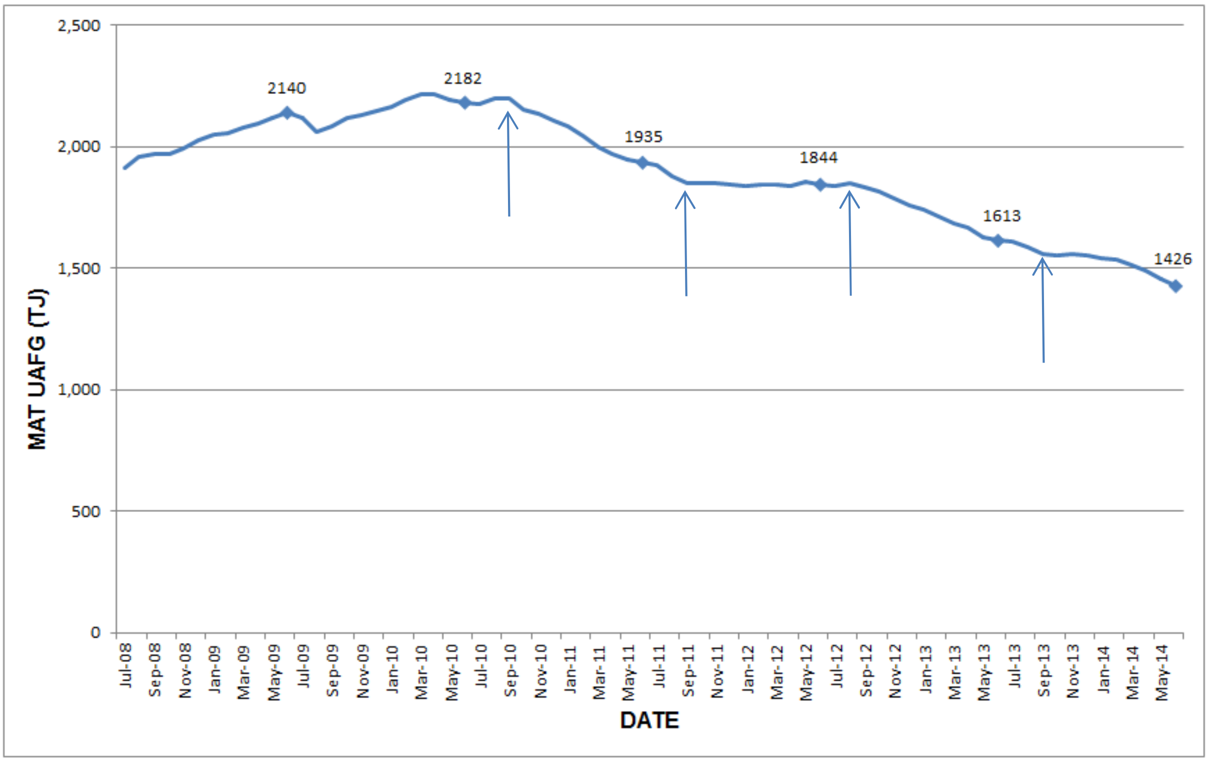
UAFG had been increasing progressively over the 6-year period to April 2010, at which time the MAT UAFG reached a peak of 2217 TJ. In recognition of the role that mains replacement provides in eliminating leakage from old mains, AGN has been undertaking a mains replacement programme for many years (albeit stifled for a period during the Global Financial Crisis), and continued this program during the current Access Arrangement period. This programme has involved the replacement of over 1000 km of CI and UPS mains.

Estimates at that point in time (early 2010, when UAFG was near its peak), indicated that the replacement of aged mains could result in a reduction of UAFG to around 1626 TJ by the end of 2015/16, and consequent reporting has been against this benchmark.

3. UAFG Performance

Since June 2010 the MAT UAFG has decreased by 756 TJ to 1426 TJ as at June 2014 (note that this result is subject to review and amendment for up to 425 days), which is significantly ahead of the 1626 TJ target for 2015/16. This is also the lowest recorded level of UAFG during the last decade.

The level of MAT UAFG since July 2008 is shown in the following graph.



Graph 1: Historical UAFG TJ

Two major improvement periods are evident. UAFG reduced by around 350 TJ in the period from September 2010 to September 2011, followed by a further 290 TJ reduction between August 2012 and September 2013.

It is noted that in December 2011, the operating pressure in about 2000 km of high pressure mains[1] was reduced from 350 kPa to 250 kPa. It is estimated that this operational change contributed to an approximate 70 TJ reduction in the MAT UAFG, as reduced gas pressure reduces the rate of leakage.

For this particular period of time, there appears to be a relationship between UAFG and mains replacement, which can be seen from the following graph, noting that there is a lag between the replacement of mains, and the effect of that replacement on decreased leakage showing up through subsequent metering and UAFG measurements.

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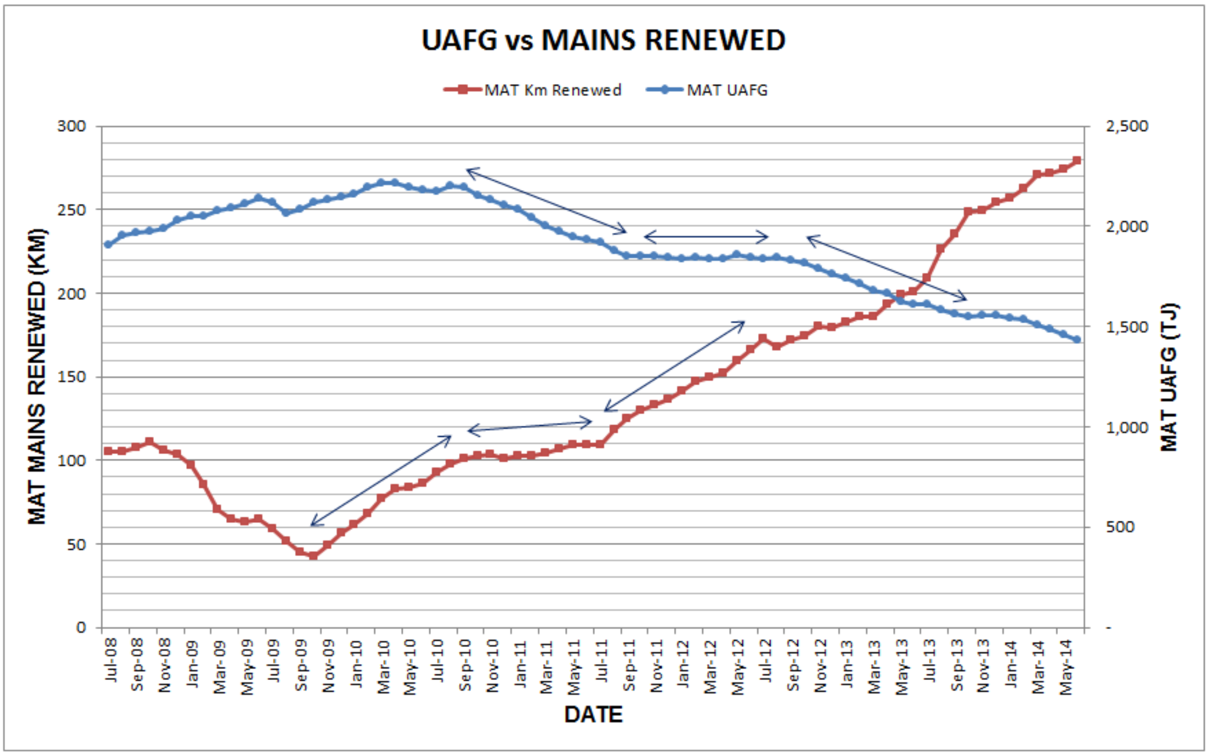
[1] It is noted that leakage occurs in all parts of the Network, i.e. in aged mains operating at low pressure and also in newer mains operating at higher pressure. Leaks in the latter portion of the Network are not as frequent, due to the higher quality materials, however when they do occur, the higher pressure means that the volume of gas leakage can be higher than that attributed to a leak in an old low pressure main.



Graph 2: Historical UAFG and Mains Replacement

It can be seen that periods of increased mains replacement have been followed by matching periods of a decline in UAFG, indicating that the majority of the UAFG reduction to-date has been attributable to the mains replacement program, which has been targeting those old mains (CI & UPS) that contribute the most to leakage. Accordingly, over time, as the "leakiest" mains are replaced, it is expected that the reductions in UAFG will not be as high, particularly as the stock of aged mains will be diminishing as the CI and UPS replacement program nears its conclusion.

4. UAFG Management

As mentioned in Section 2, leakage has been a material component of UAFG in the Network. However, UAFG is comprised of a number of factors. AGN has a multi-pronged approach to managing UAFG, in order to ensure that the level of UAFG from all sources is minimised. This section provides an overview of the processes used by AGN (and its operator, APA Group) to continually monitor and minimise UAFG.

As a national gas distributor, AGN places a significant emphasis on the analysis and mitigation of UAFG across each of its networks. UAFG is reviewed by AGN at both senior management and Board levels in recognition of the safety, cost and environmental impact this item has on AGN's business.

AGN has gas distribution networks in every State apart from Western Australia. It therefore has a national perspective when considering UAFG and is able to leverage a 'best practice' approach that incorporates outcomes across all of its networks. That is, the extensive number of networks owned by AGN across Australia means that the experience gained in addressing UAFG in one network can be leveraged to address a similar issue in another network elsewhere in Australia. Previous investigations conducted by AGN into UAFG have investigated the following UAFG elements:

- linepack factor (increasing volume of linepack from network expansions);
- pressure correction factors;
- differences between actual and billed gas pressures;
- difference between actual and standard billing temperature;
- domestic metering bias;
- errors in network injection measurements;
- differences in transmission and distribution measured heating values;
- inconsistent treatment of heating values;
- potential differences in AGN's Works Management and Metering/Billing Systems; and
- potential of missing meters in metering/billing systems.

The above factors are not dis-similar to factors that comprise UAFG in gas distribution networks nationally and internationally.

On a monthly basis, UAFG data is prepared for all of AGN's networks. This data compares the rolling moving annual total UAFG against targets. Quarterly reporting of data provides management with key information, including:

- a high level summary, that reports current MAT UAFG and variances;
- tabulated volume and percentage statistics for the various zones in the networks; and
- graphs of three-year history, to highlight monthly and MAT UAFG data, to identify and highlight trends.

The UAFG data is analysed in granularity by APA staff on an on-going basis, with network zones sometimes further divided into smaller sub-networks, to provide greater scope to analyse the data and undertake corrective investigations and activities.

Nationally, APA's UAFG review team includes the following positions:

- Manager Projects and Revenue Assurance (overall UAFG responsibility);
- 3 Asset Planning / Integrity Managers;
- Supervisor Interval Metering & 3 interval metering analysts;
- 2 revenue analysts and a revenue assurance analyst

with additional assistance / input from:

- 3 asset / project engineers;
- Planning and integrity manager
- Planning analyst
- Supervisor systems monitoring;
- Supervisor asset protection; and
- Supervisor metering.

The monthly data is reviewed by senior AGN management in conjunction with senior APA management, with particular attention paid to sub-networks where trends indicate anomalies, or the possibility of erroneous inputs, potential pipeline faults, theft, or other unusual factors. The results of this analysis and review are used to optimise execution of AGN's UAFG management strategy, and ultimately to ensure that the level of UAFG is minimised.

The above activities (in addition to the key field activity of mains replacement) all assist in driving actions to minimise UAFG. The following lists some key actions that demonstrate that AGN undertakes activities in this area that are consistent with those of a prudent and efficient distributor:

(a) Theft Mitigation

Theft of gas contributes to UAFG. To combat theft, customer sites reported as "inlet only" sites are included in the list of sites visited and checked by meter readers on a bi-monthly basis, to ensure that gas is not being illegally or unintentionally being used at such sites.

These are sites where the following activities may have occurred:

- a gas connection requested, and the inlet/service riser installed, but the computerised works management system has yet to record details of the gas meter being installed;
- the customer has requested removal of the meter for renovations or other reasons; or
- the meter has been removed at the request of a retailer for credit risk concerns.

The quarterly visit by a meter reader identifies instances where a customer has been using gas illegally, via a stolen meter, or via a bypass function, as well as providing a check for the internal administration of meter connection services.

(b) Pressure Correction Factor Reviews

The pressure correction factor used for billing a consumer is important in determining the volume of gas used by that customer. It is incorrect, it will contribute to UAFG.

AGN undertakes reconciliations of pressure correction factors recorded in AGN's asset management system and metering/billing system to ensure there have been no administrative errors in billing consumption details. This provides an additional cross-check on the UAFG monitoring process that ensures accurate delivery point billing details, thereby distilling further confidence in AGN's UAFG calculations.

AGN also undertakes reviews of customer pressures by suburb to identify potential billing discrepancies.

(c) Meters that Under-record Consumption

AGN undertakes periodic reviews of sites that indicate zero or low annual consumption, to identify potential issues with meters malfunctioning, or under-recording consumption. These details are reviewed against historic consumption for each site, and where there are unexplained changes in consumption patterns, a site visit is arranged to investigate. This often results in inaccurate meters being replaced.

(d) Ongoing Review of Large Consumers

Due to the size and potential impact on UAFG, interval-metered data (i.e. for large consumers) is analysed on an individual meter basis to identify changes in consumption patterns that could result in UAFG.

These reviews have resulted in a number of instances of on-market and off-market adjustments to increase recorded customer consumption (and therefore reduce UAFG).

(e) Gate Station Meter Tolerance Reviews

AGN regularly attends gate stations to witness the testing of these facilities by the asset owners, to ensure the test processes and results do not identify issues requiring corrective actions and/or revisions to injection data.

(f) Leakage Management

AGN has a comprehensive leak survey and leakage response/repair strategy that ensures all detected and reported leaks are attended to in a timely manner. Timely repair of leaks assists in minimising UAFG.

(g) Meter Management

AGN has a meter management policy that ensures all meters are removed from the field and tested for accuracy on a regular basis. This not only provides confidence to the consumer in respect of billing accuracy, but minimises the metering error component of UAFG.

5. Independent UAFG Analysis and Forecast

5.1 UAFG Analysis

Due to the various factors that comprise UAFG and the inherent difficult in quantifying contributing factors to UAFG, the focus of gas distributors is not in forecasting UAFG but in analysing trends and underlying factors as described in Section 4. Attempts at analysing and forecasting UAFG have been undertaken in the past, but the inherent problem is that UAFG is, by definition, comprised of 'unaccounted for' factors. This means that each factor that comprises UAFG has an associated 'bandwidth error' which, when combined, usually results in a wide tolerance band on any forecast that is generated.

In the past, a simplified forecasting approach has sometimes been used (where networks demonstrate a correlation between mains replacement and UAFG) which essentially involves:

(a) establishing a base/current level of UAFG for the network;
(b) attempting to quantify the amount of leakage attributable to each kilometre of old pipe replaced; and then
(c) reducing the level of UAFG in accordance with the level of planned pipe replacement.

The main drawback with this methodology is that, without consideration of compositional factors, there can be a disconnect between the real level of UAFG and that implied going forward. For example, if the estimate of leakage rate (part (b) above) was extremely over-estimated, this could result in a negative UAFG forecast.

In order to provide the best forecast on a reasonable basis, AGN engaged a consultancy with experience in modelling UAFG on a bottom-up basis, Asset Integrity Australasia Pty Ltd (AIA), to undertake an independent analysis of the Network's UAFG and to prepare a UAFG forecast for the 2016 to 2021 Access Arrangement period. A copy of AIA's report is attached (Attachment 1)[2].

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2 It should be noted that the AIA report refers to "AGN's SA Networks", which pre-dates the name change to AGN.

AIA previously undertook UAFG analysis for Victorian gas distributors, which analysis was provided to the Essential Services Commission of Victoria to assist in the determination of UAFG forecasts for the current regulatory period applicable in that jurisdiction. AIA analysis involves the allocation of emissions factors and uncertainty/confidence levels to various elements of a distribution network and to components of UAFG, which are then apportioned to the actual level of UAFG. The outcome is a quantified estimate for each component of UAFG, together with an estimate of the associated tolerance band for each element.

AIA quantified the following elements of UAFG, which are described below:

(1) Timing 'mismatch' – if data inputs do not relate to the same periods of time, network injections and deliveries will be mis-matched, resulting in either a positive or negative contribution to UAFG. The impact of this component is minimised by using longer (annual) time periods and ensuring appropriate data is used.

(2) Tolerance on gate station meters (injection meters) – all meters, including those at gate stations, have inherent margins of accuracy.

(3) Pressure compensation – the pressure of gas at most delivery points is not measured but regulated by a device at the meter, to be within certain limits. The difference between actual pressure and billing pressure results in a positive contribution to UAFG, as billing factors are designed to ensure that consumers are not disadvantaged.

(4) Temperature compensation – the temperature of gas at most delivery points is not measured but assumed to be at a certain temperature. The difference between actual and assumed temperature results in a positive contribution to UAFG, as billing factors are designed to ensure that consumers are not disadvantaged.

(5) Heating value differences – the heating value of gas consumed is not measured, with an average figure used in accordance with established methodologies. This leads to a difference between actual energy consumed and that billed to the customer.

(6) Metering accuracy at delivery points – all meters have an inherent tolerance, and can measure slightly above or below the actual volume of gas delivered. The tolerance on meters generally favours the consumer.

(7) Change in linepack – as networks grow, gas is required to fill the new pipes, giving rise to relatively small increases in UAFG over time.

(8) Company own use – gas can be used to purge new mains and services, and to drive compressors, water bath heaters or other equipment. Such gas is not measured, for practical reasons.

(9) Theft

(10) Line losses/leakage (mains, services, meters, regulators) – leakage from pipe joints and fittings represents a material amount of loss in all distribution networks, due to the technical practicalities associated with materials and construction.

(11) Third party damage – gas pipes are often damaged by other parties, resulting in gas lost to atmosphere.

AIA analysed each of the above components (and in some cases sub-components, e.g. leakage attributable separately to mains and services) in order to estimate their quantitative contribution to UAFG in the Network (see Figure 5.1). In some cases, the confidence level associated with the calculated quantity is relatively high, while in other cases the confidence level is relatively low, and this is indicated in the uncertainty bands shown for each UAFG component.

The AIA methodology also involves an allocation of unknown UAFG (that portion of UAFG that cannot be attributed to any one element) to each UAFG element in proportion to the likely uncertainty of each component ("unknown distributed"). This results in the UAFG composition as shown in Figure 5.1.

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The above indicates that approximately 15% of Network UAFG (215 TJ) is attributable to leakage from the low pressure part of the distribution system. When the "unknown" component of UAFG is distributed, the estimate increases to 20% or 280 TJ. Therefore, in theory, if the low pressure network is eliminated, UAFG should reduce by around 280 TJ (but offset to some degree by high pressure leakage when low pressure assets are replaced with high pressure assets).

AGN's UAFG strategy focuses on those aspects of UAFG that are controllable, or able to be influenced, this being predominantly low pressure mains. While the stock of low pressure mains is now rapidly declining, in the interim, continual deterioration of the remaining stock of these mains is countering a portion of the benefits gained from those mains that are replaced.

The AIA analysis estimates that temperature factors represent anywhere from 0.2% to 5% of UAFG. Temperature factors have not been economic to address to-date except for those customers that consume large volumes of gas and who have meter sets capable of measuring and correcting for gas temperature and pressure. Nevertheless, this area remains one of continual assessment in relation to developing technologies and optimisation of metering and billing systems.

Leakage losses from the high pressure parts of the Network are inherent in the operation of any distribution network, and AGN has a comprehensive leak detection and response strategy to deal with these as they arise. The leak response strategy is part of AGN's overall asset management strategy, which has been approved by the Office of the Technical Regulator.

A large proportion of all leak calls received by AGN are as a result of a leak at a meter installation. In recent years, AGN conducted a detailed investigation into the causes of such leaks and means of minimising such leakage, with various changes in processes introduced across AGN's networks. AGN regularly analyses leak data to ensure that areas for follow-up are identified and actioned.

5.2 UAFG Forecast

AIA used AGN's planned annual replacement levels over the 2016 to 2021 Access Arrangement period to estimate the annual level of UAFG. This was done by:

(a) establishing the base level components of UAFG, as explained in section 5.1; and

(b) leaving all other UAFG factors constant, replacing the length of low pressure mains in the AIA model with an equivalent length of high pressure mains, in accordance with the mains replacement program. The resultant forecast UAFG is shown below.

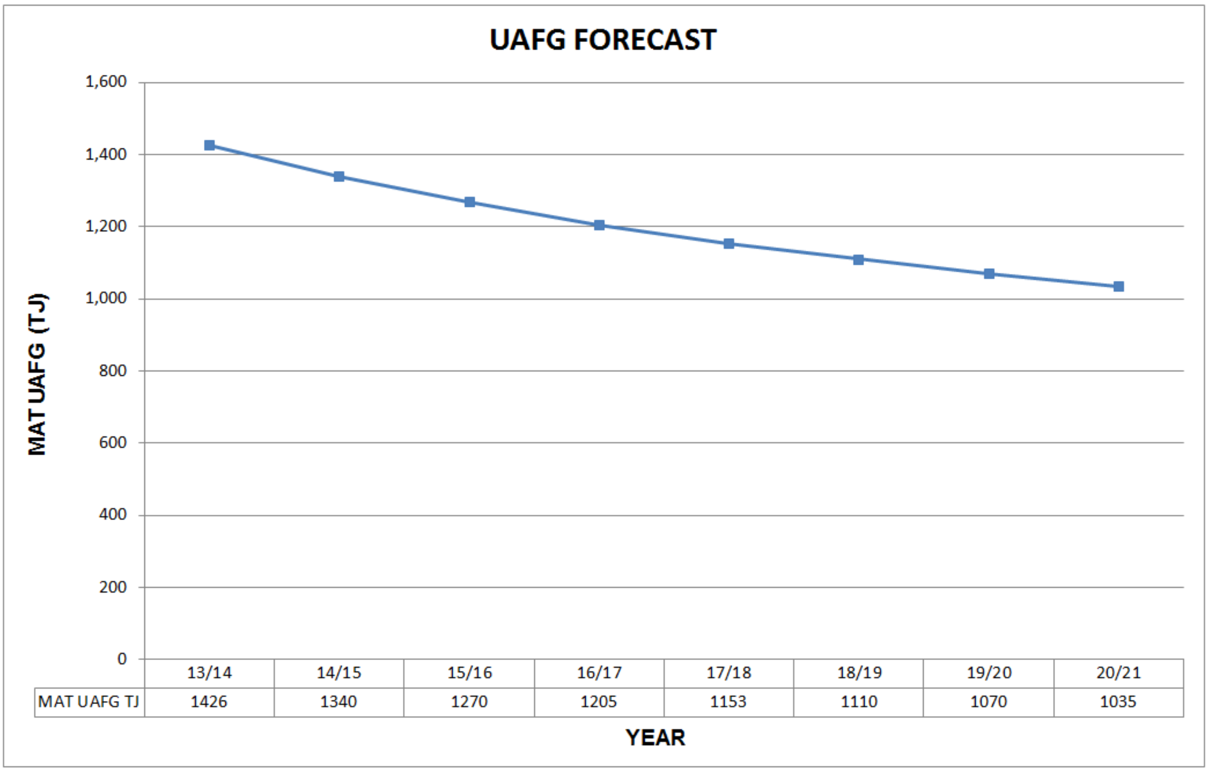

Figure 5.2: UAFG Forecast

It is noted that the stock of low pressure mains will diminish over the 2016 to 2021 Access Arrangement period, such that further benefits to UAFG will also reduce over time (it is anticipated that all of the low pressure CI and UPS mains will be replaced by the end of 2020/21). This results in the level of UAFG plateauing towards 2021.

AGN acknowledges that the above modelling is based on UAFG data as at 30 June 2014, noting that UAFG data is subject to change by AEMO up to a period of 425 days following each gas market day. It is AGN's intention to update the above modelling and forecast in the second half of 2015.

ATTACHMENT 1: AIA REPORT

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