Zincara

From strategy to action

Review of Unaccounted for Gas Benchmarks – Methodology

Prepared for

Essential Services Commission

July 2017

Zincara P/L

11 Alexandra Street

St Kilda East 3183

Telephone 03 9527 4921

DISCLAIMER

Zincara endeavours to provide accurate and reliable reports based on supplied data and information. Zincara and its staff will not be liable for any claim by any party acting on or using the information supplied in this review.

Report prepared by: E Teoh, B Fitzgerald
Reviewed by: S Jones

TABLE of CONTENTS

List of Tables

List of Figures

1. EXECUTIVE SUMMARY

The Essential Services Commission proposes to set the Unaccounted for Gas (UAFG) benchmarks for the period 1 January 2018 to 31 December 2022. The Commission is undertaking the review of the UAFG benchmarks in 2 stages. The first stage of the review will involve consultation on the methodology to calculate UAFG. The second stage will involve setting the UAFG benchmarks.

As part of the first stage process, the Commission engaged Zincara P/L to prepare a report for the development of the methodology to calculate the UAFG benchmarks. The report considers the advantages and disadvantages of each option including the incentives for the distributors to minimise UAFG.

Zincara's approach is to divide the project into 3 key areas:

- Part 1 is to consider what components have contributed to the aggregate UAFG for each distribution area and what is an appropriate approach in forecasting the UAFG. Zincara will also investigate the practices adopted by other Australian jurisdictions and overseas and their applicability to the Victorian regime.
- Part 2 is to consider what data should be used for the calculation of UAFG benchmarks and what period should be used.
- Part 3 of this project is to comment on the appropriateness of dividing UAFG into Class A and Class B.

The results of Zincara's analysis are detailed below.

UAFG is defined as the difference between the total gross gas purchased and the gas sales to all consumers. Zincara has concluded the following.

There are approximately 17 components that contribute to UAFG. This makes the task of analysing the components of UAFG considerably complex. The components can be consolidated into 5 categories:

- Fugitive emissions
- Metering errors
- Heating value
- Data quality
- Theft.

The level of uncertainty from all of the above categories makes it difficult to estimate any one component accurately. For example, gas leaks from the distribution network are recognised as one of the components of UAFG. However, it is not possible to measure with any level of accuracy the amount of leakage in the distribution system and therefore its contribution to UAFG. Based on Zincara's experience, such leaks could contribute to anything between 15-40%

depending on the age and condition of the network. In addition, the US Environmental Protection Authority[1] has rejected the idea that UAFG can be used as a surrogate for methane emission due to the difficulty of estimating the extent that gas leaks contribute to UAFG.

In summary, Zincara does not believe that UAFG can be calculated accurately using a bottom up approach.

Zincara considered the impact of gas mains replacement and any under delivery by the distributors on the impact of UAFG. From the discussion above, Zincara does not believe that it is possible to single out leaks and quantify its contribution to any level of accuracy. It is therefore not possible to comment on any under delivery of mains replacement and its impact on UAFG.

For the current Access Arrangement period, the three gas distributors have indicated that they will be completing their mains replacement programs consistent with the allowance that the AER has approved. There is therefore not an issue in regard to the impact on UAFG from any underspending by the distributors.

In regard to the methodologies for forecasting UAFG, Zincara has considered the following three options:

- Revealed cost
- Bottom up approach
- External comparisons

Zincara has concluded that the revealed cost approach is the most appropriate methodology for calculating UAFG. The revealed cost approach is based on the circumstances that the distribution businesses are actually experiencing. The bottom up approach relies too much on value judgements by a third party to estimate the components of UAFG and the level of uncertainty in determining each component. It is also difficult to replicate the estimates every five years given the changing network due to growth and mains replacement. External comparisons are essentially a benchmarking exercise. It is difficult to determine which network is best practice given that each network has its own characteristics. The International Gas Union (IGU) has indicated[2] that a useful benchmark of 2.7% can be used and has not elaborated further on how it relates to individual businesses.

Within the revealed cost approach, Zincara has considered three options:

1. Using the most recent year's actual UAFG as the benchmark for the five year period (i.e. most recent year);

[1] Document titled "AGA Unaccounted for Gas in the Utilities System" published on the American Gas Association website.
[2] IGU Triennium Work Report Oct 2009 WOC4.

2. Using an average taken over a period and applying the average as the annual UAFG for the forecast 5 year period; and
3. Carrying out a trend analysis and extrapolating the trend for the forecast 5 year period.

Zincara considers that option 2 is the best approach. It takes into account the fact that the current UAFG process already has an incentive mechanism. It also recognises that multiple factors contribute to UAFG and takes into consideration the ongoing changes to the network.

In relation to which data should be used, Zincara concludes that the calculation of UAFG should use settled data which has been agreed by distributors and retailers. There is at least some scrutiny on the bona fide of the data. As a result, the time period of data used may vary between the businesses.

In regard to whether Class A and Class B benchmarks should be combined to a single UAFG benchmark, Zincara believes that to the extent possible, any cross subsidy between different classes of customers should be minimised. The concept of having the two classes is that there should not be a cross subsidy between the industrial market (Class A) which has more sophisticated metering compared to the mass market (Class B) which only has basic meters.

Zincara also believes that it is not possible to change the Class A UAFG benchmarks easily. The methodology for assigning UAFG to Class A and Class B customers requires that the UAFG for Class A be predetermined. To consider changing the Class A UAFG benchmarks would require a bottom up approach to determine the factors that contribute to the Class A UAFG and an estimate of each of the contributions.

2. INTRODUCTION

2.1 BACKGROUND

The Essential Services Commission proposes to set the Unaccounted for Gas (UAFG) benchmarks for the period 1 January 2018 to 31 December 2022. The Commission is undertaking the review of the UAFG benchmarks in 2 stages. The first stage of the review will involve consultation on the methodology to calculate UAFG. The second stage will involve setting the UAFG benchmarks.

As part of the first stage process, the Commission engaged Zincara P/L to prepare a report for the development of the methodology to calculate the UAFG benchmarks. The report considers the advantages and disadvantages of each option including the incentives for the distributors to minimise UAFG.

The report also considers relevant methodologies that have been used in other jurisdictions – both in Australia and overseas.

2.2 APPROACH

In Victoria, the Gas Distribution System Code (GDSC) sets the annual benchmark quantity of UAFG to apply for the five year Access Arrangement period for the gas networks connected to the Principal Transmission System (PTS) and the non-Principal Transmission System (non-PTS), as shown in the tables below.

It is worth noting that although the GDSC describes the transmission systems as PTS and non-PTS, the PTS is now known as the Declared Transmission System (DTS) and the non-PTS is known as the non-Declared Transmission System (non-DTS). For the purposes of this report, Zincara will refer to the transmission systems as DTS and non-DTS.

Table 1 UAFG benchmarks for the gas distribution networks connected to the DTS

Company	Class B Benchmarks					Class A Benchmarks 2013-2017
	2013	2014	2015	2016	2017	
AGN (Victoria)	0.037	0.037	0.037	0.037	0.037	0.003
AGN (Albury)	0.037	0.037	0.037	0.037	0.037	0.001
Multinet	0.041	0.041	0.041	0.041	0.041	0.003

AusNet Services	0.054	0.054	0.054	0.054	0.054	0.003

Source: GDSC

Note:

- Class A refers to customers with an annual consumption ≥ 250,000 GJ/pa
- Class B refers to customers with an annual consumption < 250,000 GJ/pa
- AGN was previously Envestra
- AusNet Services was previously SP AusNet

UAFG benchmarks for the gas distribution networks connected to the non-DTS are shown in the table below.

Table 2 UAFG benchmarks for the gas distribution networks connected to the non-DTS

	2013	2014	2015	2016	2017
AGN	0.020	0.020	0.020	0.020	0.020
Multinet	0.020	0.020	0.020	0.020	0.020
AusNet Services	0.058	0.056	0.053	0.051	0.049

Source: GDSC

The GDSC requires the distributors to use reasonable endeavours to ensure that the quantity of UAFG for any year is less than the benchmark shown in the tables above.

In addition, the benchmarks set the ceiling that the retailers are responsible for paying for UAFG. If the annual UAFG for a distributor exceeds the benchmark, the distributor has to pay the retailer for the amount of gas above the benchmark. Conversely, if the quantity of UAFG is less than the benchmark, the retailer has to pay the distributor for the amount of gas below the benchmark.

To determine the difference between the actual UAFG and the benchmark, the Australian Energy Market Operator (AEMO) administers a reconciliation process each year for the gas distributors and gas retailers. AEMO declares the reconciliation amount of UAFG for the distribution areas. This amount is calculated using the difference between the benchmark UAFG that has been allocated for the distributor and the actual UAFG for that year and the average cost of gas.

Before AEMO can carry out the reconciliation, the gas distributors and the retailers have to agree on the metering data for the Class A and Class B customers. After the parties have agreed on the metering data (also called settled data), AEMO then carries out the reconciliation using the settled data for both Class A and Class B customers provided by each distributor. AEMO also uses metering information from the custody transfer stations to prepare the reconciliation statements which allocate the costs to either the distribution business or the retail business.

Zincara has divided this report into three parts.

- Part 1 is to consider what components have contributed to the aggregate UAFG for each distribution area and what is an appropriate approach in forecasting UAFG. Zincara will also investigate the practices adopted by other Australian jurisdictions and overseas for their applicability to the Victorian regime.
- Part 2 is to consider what data should be used for the calculation of UAFG benchmarks and what period should be used.
- Part 3 of this project is to comment on the appropriateness of dividing UAFG into Class A and Class B.

Zincara believes that there should be some guiding principles in the development of any methodology. The principles that Zincara has adopted are:

- Continue to incentivise the industry to reduce UAFG;
- Efficient, equitable and reliable;
- Consistently applied for the period;
- Simple to understand and not too complex to administer;
- Transparent to all parties; and
- Minimise risk to individuals and to the overall market

3. FORECASTING UAFG

3.1 INTRODUCTION

UAFG is defined as the difference between the total gross gas purchased and the gas sales to all consumers. Gas is transported through transmission and distribution systems and as such UAFG exists in both transmission and distribution networks. The term distribution UAFG is used in Victoria to define the difference between the gas delivered into the distribution system and the gas measured out of the distribution system. In other words, UAFG represents the difference between the metered gas injected into the distribution area and the metered gas withdrawn by the customers over a period of time (12 months).

In Victoria and in most jurisdictions, UAFG is expressed as a percentage of the difference between the gas withdrawn and the gas injected into the distribution system.

3.2 FACTORS CONTRIBUTING TO UAFG

There are approximately 17 components that contribute to UAFG. This makes the task of analysing the components of UAFG considerably complex. These components can essentially be divided into 5 categories:

- Fugitive emissions
- Metering errors
- Heating value
- Data quality
- Theft.

3.2.1 Fugitive Emissions

Fugitive gas emission is the loss of gas from each distributor's transmission and distribution networks. The gas loss from the transmission system is mainly through its above ground valves and regulators and is considered to be very small.

For distribution networks, the source of fugitive gas is leaks. Leaks in the pipes are usually caused by defects, material failure or third party damage. In particular the unprotected steel and cast iron pipes are generally the main source of leaks in the system.

All the gas distributors have a program to progressively replace the low pressure cast iron and unprotected steel pipe. As part of this program, the low pressure system has been upgraded to high pressure.

In the 1990's, there was considerable effort by British Gas, South California Gas and the Gas Research Institute (USA) to try and quantify the level of leakage occurring within a gas distribution network. The conclusion was that distribution losses in general cannot be uniquely measured but are clearly a component of UAFG. The disparity in pipeline technologies, age, operating pressures and level of maintenance makes it difficult to estimate with any level of accuracy the contribution that fugitive emissions make to UAFG.

Nevertheless, in 2012, using information provided by AusNet Services (then SP AusNet), Zincara calculated the percentage of gas loss in 2012 to be 18% of UAFG. Zincara believes that 18% is on the low side as previous work carried out by British Gas has indicated that fugitive gas could contribute up to 40% of UAFG. Zincara does, however, acknowledge that the contribution of fugitive gas to UAFG is dependent on the quality of the gas mains in the distribution networks.

In summary, Zincara believes that actual losses as a result of leaks are difficult to measure due to operating pressures in the distribution networks, the size of each individual leak and the ground conditions where the pipes are located.

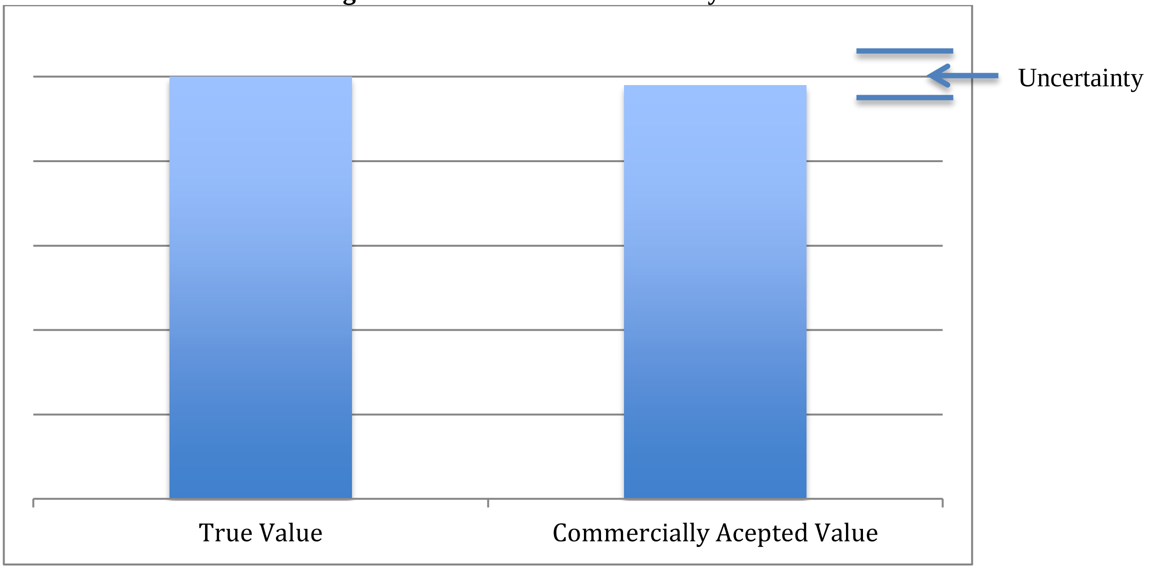
3.2.2 Metering Errors

Customer Meters

A customer is billed for its gas usage through the measurement of the volume of gas passing through the gas meter at the customer's premises. The volume of gas is then converted to energy by multiplying the volume by the heating value, and for large customers by the pressure and temperature of the gas supplied to the customer.

The measurement of the volume of gas is dependent on the uncertainty in the measurement. The uncertainty in measurement is best illustrated in the figure below.

Figure 1 Measurement Uncertainty



The true value of any measurement is never actually known, only the commercially accepted value is known. The difference between the true value and the commercially accepted value is the uncertainty in measurement or also often referred to as the accuracy of the meter.

In Victoria, the GDSC specifies the maximum allowable error limit for the meters. Part B of Schedule 1 of the GDSC states that the maximum allowable variance in quantity from the agreed true quantity for a gas meter shall be:

(a) not more that 2 percent in favour of the distributor;

(b) not more that 3 percent in favour of the customer.

In addition, there is a further allowance of ±1% for equipment for large customers to correct the large customers' volume measurement to standard conditions. The large customers' consumptions have a significant impact on the overall UAFG if the customers have not been metered accurately.

Zincara's report in 2012 quoted a report from AusNet Services that the contribution of the uncertainty of measurement to UAFG is approximately 34%.

The metering uncertainty of +2% and -3% is almost as large as total UAFG and as such any minor movement in the measurement can have a large impact on UAFG.

Custody Transfer Meters (CTM)

A custody transfer meter (CTM) is a meter that measures the volume of gas injected into the distribution system. There are a number of CTM's measuring the gas that is injected into the distribution system. These meters generally have an accuracy of at least ±1%.

In Victoria, these meters are owned by APA and there is no visibility to the maintenance performed by APA to ensure these meters are accurate. However, as these meters also have an impact on the transmission UAFG, Zincara has assumed that APA will have maintained the meters to ensure their accuracy.

Zincara's 2012 report had attributed approximately 45% of the UAFG to the CTM.

Summary

In summary, metering error or accuracy is a significant contributor to UAFG. The extent of the contribution is dependent on the throughput and gas measurement at any one time. As in fugitive gas, the extent of the contribution is difficult to quantify with any level of accuracy.

3.2.3 Heating Value

Another factor that contributes to UAFG is the heating value of the gas. The heating value is used to convert the measured volume of gas consumption to energy units for billing to customers. The heating value is derived from the quality of gas delivered to the network. In Victoria, a state wide heating value is used to calculate the energy consumption.

The majority of the gas supplied to the gas market comes from the Gippsland area, which includes the Longford gas plant and the Lang Lang gas plant. Gas to a lesser extent and declining is also supplied from the Port Campbell area, which includes the Otway and Minerva gas plants and the Casino development.

In the 2013 UAFG review, the gas distributors highlighted that the multiple gas sources have adversely affected the quality of gas received into their distribution network. Although AEMO agreed in principle with their conclusion, it also pointed that the margin of error for heating value measurement is ± 0.7%[3]. The uncertainty means that it cannot be definitive that the heating value for each distribution business was adversely affected by the multiple gas sources.

This heating value uncertainty has further contributed to the complexity of calculating UAFG.

[3] Market Issue IN031/09 and AEMO's Analysis on GMI 031/09 Zonal Heating Value.

3.2.4 Data Quality

Data quality is also referred to as accounting error in some countries. From a logistical perspective, not all meters can be read at the same time. In addition, there are different reading cycles which means that the total gas demand at any one time has an error due to meter reading lag.

The gas injected into the network is measured using CTMs, which can be read remotely. Similar technology is also used for large customer installations. Residential customers have meters that cannot be read remotely and must be manually read. As such, when UAFG is calculated by using the data from all these sources, the issue of time lag contributes to the UAFG error.

In addition, residential and small industrial and commercial customers do not have any equipment to compensate the measurement for temperature and pressure. The calculation of the gas volume deems all of these meters to have the same temperature and pressure when the gas volumes are measured.

This data quality issue is also a contributing factor in UAFG.

3.2.5 Theft

Another factor that contributes to UAFG is the theft of gas. It is difficult to quantify the extent of the theft of gas but based on Canadian and UK observations, theft of gas contributes to approximately 5-10%[4] of UAFG.

3.2.6 Mains Replacement Program

All distribution businesses have embarked on mains replacement programs to reduce the leaks in the low pressure networks and to a small extent in the medium pressure networks. The low pressure networks generally consist of the old cast iron and unprotected steel mains and the deterioration of these pipes is the main cause of leaks.

The main drivers for the replacement of the low pressure network are safety and capacity issues and not UAFG. Due to the size of the low pressure network, it is necessary to progressively replace the old pipes over a 20 to 30 year period. The Commission when it was responsible for the review of the Access Arrangement in 2002 had determined that a 20-30 year timeframe for the replacement of the low

[4] NGG LDZ Shrinkage Quantity Proposals Formula Year 2013/14 indicates that 0.02% of shrinkage is attributed to theft of gas. This equates to approximately 8-10% of shrinkage or UAFG.

pressure network would be a reasonable timeframe. As such, AGN and AusNet Services are expected to complete their program in the mid 2020s and Multinet in the mid 2030s. The different timeframe is because Multinet has more low pressure pipes in their network than the other two distribution businesses.

Notwithstanding that the key drivers of the replacement program are safety and capacity, one of the contributors to UAFG is the leaks from the distribution networks (discussed in Section 3.2.1). As such, the Commission in its 2013 decision on UAFG stated that the distribution businesses did not explain why they were unable to complete their approved mains replacement programs for the period 2008-2012 and failed to explain the impact of not carrying out their mains replacement programs on UAFG.

For the current Access Arrangement period 2013-2017, the AER approved capital expenditure for the mains replacement program for each of the distribution businesses. The AER also put in place a mechanism by which a distribution business can seek additional allowance for the low pressure mains replacement for the current Access Arrangement period if the distribution business can justify the additional expenditure and also demonstrate that it can complete the work.

All three distribution businesses sought and were approved additional capital expenditure to extend the mains replacement program. The table below shows the total length of the low pressure mains replacement program for each distribution business.

Table 3 Total Mains Replacement Program 2013-2017

	AGN	AusNet Services	Multinet
AER final decision plus pass through amount	696 km	500km	527km

Source: Distribution Businesses Access Arrangement Information

AGN said that it is on track to complete the program by the end of 2017. AusNet Services also said that it is confident of completing the program. Multinet said the same albeit in a different mains replacement profile as to what was originally proposed.

3.3 UAFG IN OTHER AUSTRALIAN JURISDICTIONS AND OVERSEAS

A summary of the UAFG processes overseas and in other Australian jurisdictions is described below. Refer to Appendix A for more information.

3.3.1 United Kingdom

In the United Kingdom, Ofgem has a major role in determining the level of UAFG. Ofgem manages an incentive scheme which monitors the gas distributors' operational activities including UAFG.

In addition, National Gas Grid is required to publish its UAFG annually and report on the activities that it has undertaken to reduce UAFG.

3.3.2 USA/Canada

The North American utilities adopt various strategies in terms of monitoring and forecasting UAFG as shown in the table below.

Table 4 UAFG Forecasting Methodologies for North American Gas Utilities

Gas Utilities	Number of Customers (millions)	UAFG Forecasting Methodologies	UAFG Forecasting Performance
American	4.3	3 years or 1 year depending on which average is a good judge of best predictor	Do not formally track the accuracy of forecast
American	2.3	5 year simple average	Do not formally track the accuracy of forecast
American	3.3	4 year average or other recent actual depending on which average is best predictor	Do not formally track the accuracy of forecast
American	0.7	5 year simple average	Negotiated amount
American	2.1	6 year simple average	Do not formally track the accuracy of forecast
Canadian	1.3	3 year weighted average	Present both forecast and actual within regulatory filing
Canadian	0.2	8 year average	Do not formally track the accuracy of forecast
Canadian	0.9	5 year simple average	Do not formally track the accuracy of forecast

Source: Enbridge Gas Distribution Unaccounted for Gas Study 2012

3.3.3 NSW

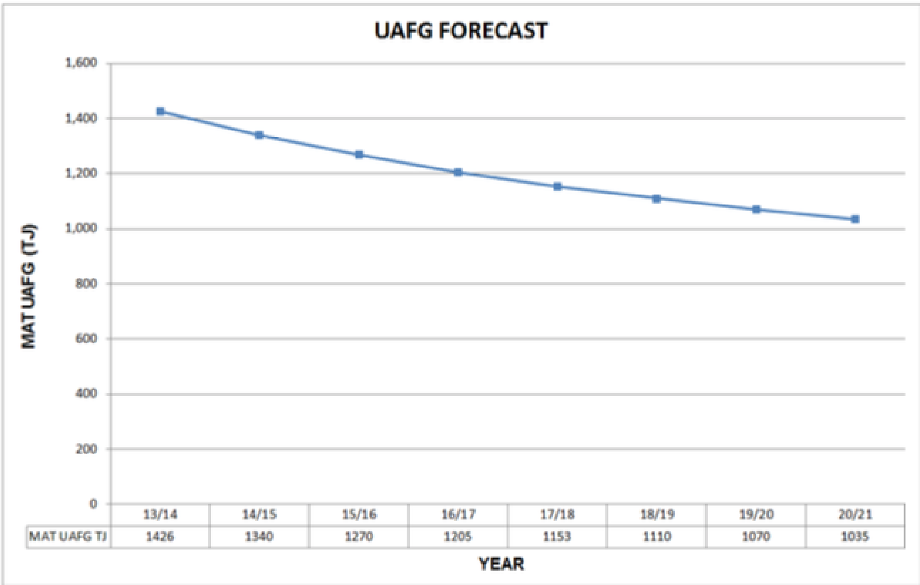
For its Access Arrangement period 2016/17 – 2021/22, Jemena proposed that UAFG should be set as the average of the 5 years actual data. In addition, it proposed that there should be two target rates; one for the daily metered sites (large customers) and one for the non-daily metered sites (mass market).

3.3.4 South Australia

In the Access Arrangement review for South Australia, AGN indicated[5] that it has lowered its actual UAFG from the benchmark figures for the period 2011/12 – 2015/16. Its UAFG for the Access Arrangement period 2016/17 – 2020/21 was forecast to be a declining trend as shown in the figure below.

[5] Australian Gas Networks Attachment 7.3 Unaccounted for Gas Forecast.

Figure 2 AGN forecast UAFG for the South Australian Network



Source: Attachment 7.3 Unaccounted for Gas Forecast

3.3.5 Western Australia

The Economic Regulation Authority (ERA) determines the forecast level of UAFG for ATCO Gas Australia (AGA). AGA revised its Access Arrangement Information to incorporate the UAFG figures. Zincara has not been able to find further information on how the ERA has determined the forecast UAFG.

3.4 APPROACHES IN FORECASTING UAFG

Zincara considers there are 3 possible options to forecast UAFG:

- Revealed cost;
- Bottom up;
- External comparisons.

Discussion on each of these options is described below. From a high level perspective, Zincara considers that these three options cover all the methods of calculating UAFG.

3.4.1 Revealed Cost Approach

The revealed cost approach uses the gas distributors' past performance as the base for forecasting UAFG. The advantage of using the revealed cost approach is that it is derived from the actual gas distributors' performance. A gas distributor must use reasonable endeavours to ensure that its UAFG is below the benchmarks otherwise it is penalised by having to pay the retailer for the amount of gas that exceeds the benchmark UAFG.

Using the revealed cost approach, there are a number of options that can be adopted in forecasting UAFG. They are:

1. Using the most recent year's actual UAFG as the benchmark for the five year period (i.e. most recent year);
2. Using an average taken over a period and applying the average as the benchmark UAFG for the forecast 5 year period; and
3. Carrying out a trend analysis using the actual UAFG and extrapolating the trend for the forecast 5 year period.

Most recent year

The most recent year is using the most current year's actual UAFG and applying the same value over the 5 year period.

Pros

- Uses the most current data.
- Recognises that the distribution businesses are already incentivised to reduce UAFG.
- It can be replicated every five years.

Cons

- Difficulty in determining what is the most current data; is it the data that is settled between the distribution business and the retailers or the data that the distribution business has estimated.
- Difficulty in deciding if the most recent year should be the same for all the three distribution businesses.
- The most recent year may have other factors influencing the UAFG which have not been taken into account (i.e. it is not a representative year).

Multi-year average

This option uses the actual UAFG data for a period to calculate the average and applies it as the annual UAFG benchmark for the 5 year period.

Pros

- The average takes into account any annual deviation due to influences of the different components of UAFG.

- Recognises that the distribution businesses are already incentivised to reduce UAFG.
- Using older data may not represent the characteristics of the network today.
- Recognises there is complexity in forecasting each component of UAFG.
- It can be replicated every five years.

Cons

- Difficulty in determining what is the most current data; is it the data that is settled between the distribution business and the retailers or data that the distribution business has estimated.
- Difficulty in deciding if the most recent year should be the same for all the three distribution businesses.
- Needs a number of data points to be able to get a representative sample.

Trend Analysis

This option takes into account annual actual UAFG and uses a mathematical modelling technique (regression analysis) to forecast UAFG. Regression analysis derives an equation which can be used to estimate the UAFG from data points.

Pros

- The model can be improved, as more data is available.
- It does not rely on any estimate of any components of UAFG and already allows for any uncertainty.
- A simple measure of the accuracy of the model can be assessed by how close the data points are to the line of best fit.
- The method can be repeated consistently every five year reset period.

Cons

- It assumes that there are no outliers in data and that there are no extraneous influences.
- There may be insufficient data points to get a meaningful line of best fit.
- Determining whether a trend will continue is difficult because of the uncertainty in the cause of the trend.
- There is an issue with the quality of the data – should it be based on data that the market has settled or can data from the distributors' estimates be included.

- The trend could be counterintuitive to what is expected given the extent of the mains renewal program.

3.4.2 Bottom Up Approach

The bottom up approach uses the engineering characteristics of the distribution system to estimate the UAFG. It requires that each component that contributes to UAFG be identified and a comprehensive quantitative analysis of its contribution be carried out. The level of uncertainty for each component needs to be determined.

Pros

- It uses an engineering approach to determine the factors that contribute to UAFG.
- The estimation methodology is based on the knowledge of experienced practitioners.
- It requires detailed data from the distribution businesses.

Cons

- The estimation is a judgement call given the uncertainty in estimating each component.
- The starting point for the UAFG is difficult to determine.
- There is an issue in determining which should be the base year of the data (a multi-year average or the most recent year).
- The assumptions are based on judgement calls that may be difficult to replicate in the next 5 year period.

3.4.3 External Comparisons

This approach is a benchmark exercise taking a top down view of what the UAFG is for various businesses. It needs to take into consideration the different characteristics of the network including network size, throughput and customer mix.

Zincara carried out a similar exercise in 2012 and the results of the benchmark exercise are shown in the table below.

Table 5 Gas Distributors' UAFG in Australia

Gas Distributor	UAFG
Allgas Queensland	4%
Envestra Queensland	0.5%[6]
Envestra SA	8.3%
Jemena Network NSW	2.7%
ActewAGL	1.8%

[6] There are no explanations for why the UAFG for Envestra Queensland is unusually low.

Envestra (Victoria)	2.87%
Multinet	4.03%
SP AusNet	3.53%

Source: Compiled from Access Arrangement Information and consultant reports
Note: The UAFG levels for each gas distributor are based on the latest information available but are not necessarily for the same year. The UAFG for Victoria is based on the 2010 level.

In addition, the IGU Working Committee October 2009 paper[7] reports on a survey that the working committee carried out on leaks through the distribution networks from its members. It said that a useful benchmark for UAFG is 2.7% after outlying data has been removed.

Pros

- The benchmark exercise can take into account the best practice distribution business approach.
- It provides the distributor with an incentive to work to be the best performing utility.
- It allows for a competition by comparison environment.

Cons

- The benchmark exercise may not take into account each distributor's environment.
- It could lead to complacency depending on where a distributor is placed in the performance spectrum.
- There is a degree of subjectivity as to what allowance is provided when taking each distributor's environment into account.
- It is difficult to repeat every five years as the characteristics of each business may change.

3.4.4 Summary

In summary, Zincara has concluded that the revealed cost approach is the most appropriate method for calculating UAFG. The revealed cost approach is based on the circumstances that the distribution businesses are actually experiencing. The bottom up approach relies too much on value judgements to estimate the components and the level of uncertainty in determining each component. It is also difficult to replicate the estimates every five years given the changing network over time. External comparisons are essentially a benchmarking exercise. It is difficult to determine which network is best practice given that each network has its own characteristics. The International Gas Union (IGU) says that a useful benchmark of 2.7% can be used and has not elaborated further on how it relates to individual businesses.

[7] IGU Triennium Work Report Oct 2009 WOC4.

Within the revealed cost approach, there are three options:

1. Using the most recent year's actual UAFG as the benchmark for the five year period (i.e. most recent year);
2. Using an average taken over a period and applying the average as the benchmark UAFG for the forecast 5 year period; and
3. Carrying out a trend analysis and extrapolating the trend for the forecast 5 year period.

In deciding which is the best approach, Zincara has taken into account a number of factors including:

1. The underlying principle of the UAFG process in Victoria is that it should incentivise the distribution businesses to use reasonable endeavours to keep UAFG levels below the benchmarks.

2. There are multiple factors contributing to UAFG. On a year-on-year basis, each factor could contribute a variable amount to aggregate UAFG. It is therefore difficult to determine what is the true value of UAFG or whether a particular year is an outlier.

3. Using the latest year's data does not necessarily represent the true UAFG as that year could be an outlier due to the extent that each of the factors contributes to UAFG.

4. For any meaningful statistical analysis, the data gathered should have a clear set of rules. This means that over the years, the data gathered for UAFG should have the same operating conditions. For example, the network size and composition should not change over time. However, the mains replacement program and the network expansion mean that UAFG data has been gathered under a changing environment. It would therefore be difficult to use the data to predict a trend.

Given the above factors, Zincara considers that the best approach is option 2, using a multi-year average and applying the result over the forecast period.

4. DATA UTILISATION

One of the key issues is what data should be used to calculate the UAFG benchmarks for the forecast period. In its UAFG final decision in 2013, the Commission decided to use the settled data for the period 2008 – 2010 to calculate the forecast UAFG for the period 2013 – 2017. At that time, Zincara recommended using settled data as there could be differences between unsettled data and settled data at the final stage of settlement.

As part of the UAFG settlement procedure, a gas distributor has to consolidate all the UAFG data and apportion it to the relevant retailers(s). This data is called the unsettled data. Upon receipt of the data, each retailer will scrutinise the data and either seek to correct the data or accept the data as accurate. If the data has to be corrected, the process could take a few iterations before both the retailer and the distributor accept the data as correct. This final set of data is called settled data.

The question that arises is whether unsettled data can be used to determine the benchmarks as often the final settled data is not materially different to the unsettled data.

There are a number of factors to be to considered when deciding which set of data to use.

1. The benchmark UAFG is the base figure for the calculation of UAFG compensation from either the distributor to retailer or vice versa. It is therefore important to ensure that the benchmark has been calculated using the data that all parties have agreed upon.
2. The principle of the distributor allocating the UAFG to each retailer and seeking the approval of the retailers is that there is a degree of scrutiny of the data from the retailers which ensures that the data is reliable.
3. The use of unsettled data is similar to having financial accounts that are not independently audited as true and correct.
4. Under the current process, there is no mechanism to ensure that all the parties settle the data in a reasonable time. If data remains unsettled for a long period of time, a dispute resolution process should be triggered.
5. It is not possible to assume that the settled data is the same as the unsettled data. In the future, there could be a situation when erroneous unsettled data is used due to complexity in determining the contribution of the multiple factors that contribute to UAFG.

Given the above discussion, Zincara recommends the use of only settled data.

5. CLASS A AND CLASS B UAFG

Class A customers are large customers whose gas demand is greater than 250,000 GJ/annum. Class B customers are small or medium size customers whose gas demand is less than 250,000 GJ/annum. The UAFG benchmarks for the two customer classes are shown in Table 1.

The concept of having two customer classes and setting separate benchmarks for the two classes is that it is more reflective of actual field conditions. Class A customers are large customers with sophisticated equipment for measuring their gas consumption. The meters for these large customers have an accuracy of ± 1 %. In addition, there is field equipment that measures the temperature and pressure of the gas volume and corrects the measured volume to the standard pressure and temperature conditions for billing purposes. The standard temperature and pressure are set so that all customers are billed under the same conditions. Although the volume of gas for Class A customers is corrected to standard conditions, there is no such correction for Class B customers. This leads to error in billing for the Class B customers and not in Class A customers.

In addition, the Class A customers are supplied from the distributors' high pressure network which does not experience the same leaks as the low pressure network where some of the Class B customers are supplied.

Therefore having benchmarks for these two categories of customers will reduce any cross subsidies between the two customer classes.

5.1 CALCULATION OF CLASS A AND CLASS B UAFG

The calculation of Class A UAFG and Class B UAFG is outlined in the steps below:

1. Calculate the total UAFG

L = M – N

L = Total UAFG for the system (GJ)
M = CTM injection into the distribution system (GJ)
N = Total gas consumption from Class A and Class B customers (GJ)

2. Calculate the Class A UAFG

Z = X * Y

X = Total gas consumption of Class A customers (GJ)
Y = Percentage of UAFG allowance as determined in the GDSC.

Z = Class A UAFG in GJ.

3. Calculate the Class B UAFG

C = L – Z

C = Class B UAFG (GJ)

Method 1
Class B UAFG in % = C/M – X

Method 2
Class B UAFG in % = C/M – (X+Z)

In its 2012 report, Zincara found that that there was inconsistency in how the percentage of UAFG was calculated. AGN used Method 1, although Multinet and AusNet Services used Method 2. Zincara recommended that the industry participants resolve this issue but is unaware of whether there has been any resolution.

The above formula was set out to show that determining the UAFG percentage for Class B requires that the GDSC specification for Class A UAFG be a constant. If Class A is not fixed, there are too many variables to calculate Class B UAFG. This means that the Class A UAFG cannot be changed easily. It would require a bottom up approach to determine the factors that contribute to the Class A UAFG and an estimate of each of the contributions.

6. CONCLUSION

UAFG is defined as the difference between the total gross gas purchased and the gas sales to all consumers. Zincara has reached the conclusions detailed below.

There are approximately 17 components that contribute to UAFG. This makes the task of analysing the components of UAFG considerably complex. The components can be consolidated into 5 categories:

- Fugitive emissions
- Metering errors
- Heating value
- Data quality
- Theft.

The level of uncertainty from all of the above categories makes it difficult to estimate any one component accurately. For example, gas leaks from the distribution network are recognised as one of the components of UAFG. However, it is not possible to measure with any level of accuracy the amount of leakage in the distribution system and therefore its contribution to UAFG. Based on Zincara's experience, such leaks could contribute to anything between 15-40% depending on the age and condition of the network. The US Environmental Protection Authority has rejected[8] the idea that UAFG can be used as a surrogate for methane emission due to the difficulty of estimating the extent that gas leaks contribute to UAFG.

In summary, Zincara does not believe that UAFG can be calculated accurately using a bottom up approach.

Zincara considered the impact of gas mains replacement and any under delivery by the distributors on the impact of UAFG. From the discussion above, Zincara does not believe that it is possible to single out leaks and quantify its contribution to any level of accuracy. It is therefore not possible to comment on any under delivery of mains replacement and its impact on UAFG.

For the current Access Arrangement period, the three gas distributors have stated that they will be completing their mains replacement programs consistent with the allowance that the AER has approved. There is therefore not an issue in regard to the impact on UAFG from any underspending by the distributors.

In regard to the methodologies for forecasting UAFG, Zincara has considered the following three options:

[8] Document titled "AGA Unaccounted for Gas in the Utilities System" published on the American Gas Association website.

- Revealed cost
- Bottom up approach
- External comparisons

Zincara has concluded that the revealed cost approach is the most appropriate method for calculating UAFG. The revealed cost approach is based on the circumstances that the distribution businesses are actually experiencing. The bottom up approach relies too much on value judgements by a third party to estimate the components and the level of uncertainty in determining each component. It is also difficult to replicate the estimates every five years given the changing network due to growth and mains replacement. External comparisons are essentially a benchmarking exercise. It is difficult to determine which network is best practice given that each network has its own characteristics. The International Gas Union (IGU) has indicated that a useful benchmark of 2.7% can be used and has not elaborated on how to apply it to individual businesses.

Within the revealed cost approach, Zincara has considered three options:

1. Using the most current year's actual UAFG as the proxy for the five year period (i.e. most recent year);
2. Using an average taken over a period and applying the average as the annual UAFG for the forecast 5 year period; and
3. Carrying out a trend analysis and extrapolating the trend for the forecast 5 year period.

Zincara considers that option 2 is the best approach. It takes into account the fact that the current UAFG process already has an incentive mechanism. It recognises that multiple factors contribute to UAFG and takes into consideration the ongoing changes to the network. This means that the data has not been gathered from a clear set of conditions.

In relation to which data should be used, Zincara concluded that the calculation of UAFG should use settled data which has been agreed to by distributors and retailers. In this way, there is at least some scrutiny on the bona fide of the data.

In regard to whether Class A and Class B benchmarks should be combined to a single UAFG benchmark, Zincara believes that to the extent possible, any cross subsidy between different classes of customers should be minimised. The concept of having the two classes is that there should not be a cross subsidy between the industrial market (Class A) which has more sophisticated metering compared to the mass market (Class B) which only has basic meters.

Zincara also believes that it is not possible to change the Class A UAFG benchmarks easily. The methodology for assigning UAFG to Class A and Class B customers requires that the UAFG for Class A be predetermined. To consider changing the Class A UAFG would require a bottom up approach to determine the factors that contribute to the Class A UAFG and an estimate of each of the contributions.

Appendix A

UAFG Overseas and in other Australian Jurisdictions

United Kingdom

In the UK, Ofgem has a major role in determining the level of UAFG. In 2012, as a result of increasing UAFG, Ofgem introduced a separate scheme to incentivise National Gas Grid (NGG), as the system operator, to identify the causes of UAFG. The incentive scheme was to apply for 3 years. The level of UAFG was set as an average of the gross UAFG for 2001 to 2008/09 (7 years). The target UAFG was the same for the 3 years as Ofgem believed that there was sufficient incentive for NGG to investigate and reduce UAFG.

In addition, NGG was also required to publish its UAFG annually and report on the activities that it had undertaken to reduce UAFG.

As part of its incentive regime, Ofgem takes an active role in various aspects of the gas industry's activities including the level of UAFG and level of leaks. Ofgem has a model which is used to monitor leakage levels and the extent of the gas distributors' mains replacement programs. In 2012, Ofgem introduced a new incentive scheme because it was concerned about UAFG.

USA/Canada

As part of its 2013 rate review, Enbridge Gas Distribution Inc[9] (Enbridge) carried out a study on UAFG[10] and in particular the steps that the distribution businesses were taking to measure, forecast and control the variability of UAFG. The report also provided the forecasting methodologies applicable to the North American gas utilities. The forecasting methodologies are provided in the table below.

Table 6 UAFG Forecasting Methodologies for North American Gas Utilities

Gas Utilities	Number of Customers (millions)	UAFG Forecasting Methodologies	UAFG Forecasting Performance
American	4.3	3 years or 1 year depending on which average is a good judge of best predictor	Do not formally track the accuracy of forecast
American	2.3	5 year simple average	Do not formally track the accuracy of forecast

[9] Enbridge Distribution Inc is a gas distribution business in Canada that services over 2 million residential, commercial and industrial customers. Its network areas are in central and eastern Ontario including the City of Toronto.
[10] Enbridge Gas Distribution Unaccounted for Gas Study 2012 EGDI-D2-6-1.

Gas Utilities	Number of Customers (millions)	UAFG Forecasting Methodologies	UAFG Forecasting Performance
American	3.3	4 year average or other recent actual depending on which average is best predictor	Do not formally track the accuracy of forecast
American	0.7	5 year simple average	Negotiated amount
American	2.1	6 year simple average	Do not formally track the accuracy of forecast
Canadian	1.3	3 year weighted average	Present both forecast and actual within regulatory filing
Canadian	0.2	8 year average	Do not formally track the accuracy of forecast
Canadian	0.9	5 year simple average	Do not formally track the accuracy of forecast

Source: Enbridge Gas Distribution Unaccounted for Gas Study 2012

In the USA, a gas distribution business is known as a Local Distribution Company (LDC). A LDC can own transmission and distribution networks, LNG facilities and underground storage facilities. There is not a consistent definition or approach to forecasting UAFG, which is known as Lost and Unaccounted For gas (LAUF).

In Massachusetts[11] for example, all 11 LDCs have to report their annual LAUF as part of their annual returns. The Department of Public Utilities uses the report to assess the accounting practice and operational efficiency of the businesses. In addition, the businesses have to report to the Pipeline and Hazardous Material Safety Administration (PHMSA) and the Energy Information Administration (EIA). These organisations use the reports to evaluate the overall efficiency of the distribution businesses.

It is therefore important to recognise that although the North American utilities use a simple forecast for their UAFG, the data is used for different purposes as compared to the application of the data in the Victorian gas market.

New South Wales

In its previous Access Arrangement period, Jemena was allocated a UAFG allowance of 2.34% annually. If the actual UAFG is below the benchmark rate, Jemena would recover the cost that it has allocated for the benchmark UAFG rate of 2.34%. The converse is also true in that if the UAFG exceeded its benchmark number, Jemena would have to pay for the additional gas.

In the five year period 2010/11 - 2015/16, Jemena experienced a higher UAFG of 2.4% than the benchmark number for the first 3 years.

[11] ICF International Report on Lost and Unaccounted for Gas 2014.

In its next Access Arrangement period 2016/17 – 2021/22, Jemena proposed that the incentive scheme should continue but the UAFG should be set at an average of the 5 years actual data. It also proposed that there should be two target rates; one for the daily metered sites (large customers) and one for the non-daily metered sites (mass market).

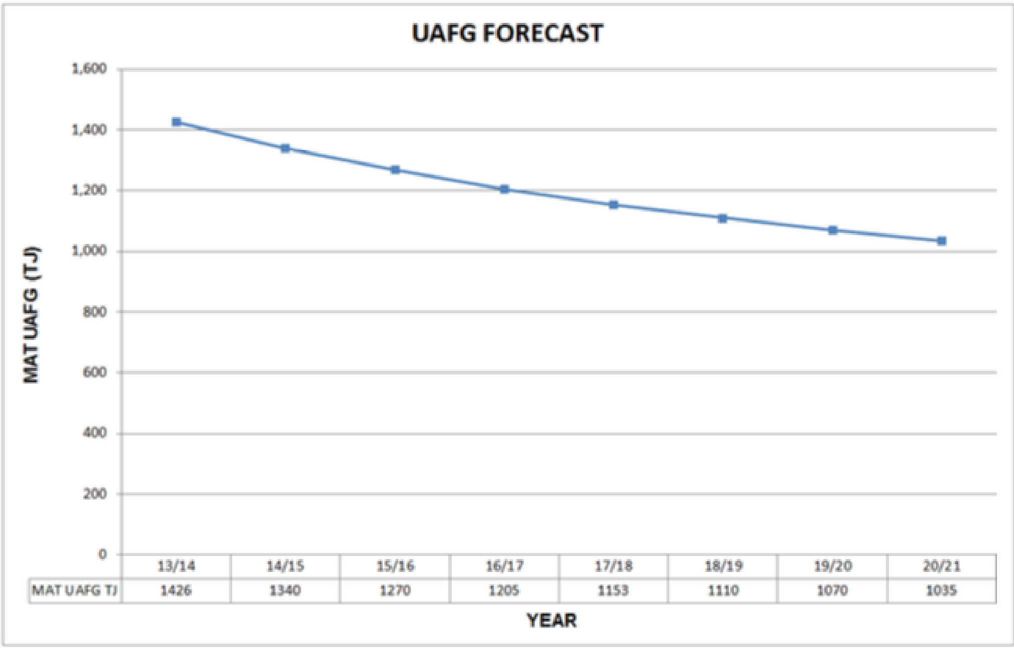
South Australia

In the Access Arrangement review for South Australia, AGN indicated[12] that it has lowered its UAFG from the benchmark figures for the period 2011/12 – 2015/16. To forecast its UAFG for the next Access Arrangement period 2016/17 – 2020/21, AGN engaged Asset Integrity Australia (AIA) to model the UAFG taking a bottom-up approach. The AIA methodology was to estimate the contribution for each component of UAFG. There was an unknown component due to the uncertainty in the estimate. This unknown component was then allocated to all the components of UAFG.

The result of AIA's analysis was that 15% of the UAFG was attributable to leaks from the low pressure system. If the unknown element was allocated out, 20% of the UAFG would be attributed to leaks in the low pressure system. Using this methodology, AGN estimated its forecast UAFG as shown in the figure below.

[12] Australian Gas Networks Attachment 7.3 Unaccounted for Gas Forecast.

Figure 3 AGN forecast UAFG for the South Australian Network



Source: Attachment 7.3 Unaccounted for Gas Forecast

Western Australia

In October 2016, the Economic Regulation Authority (ERA) decided the forecast level of UAFG for ATCO Gas Australia (AGA). AGA revised its Access Arrangement Information to incorporate the UAFG figures. The ERA has not provided any information on how the figures have been derived. The table below shows the figures accepted by the ERA.

Table 7 AGA forecast UAFG

	July to Dec 2014	**2015**	**2016**	**2017**	**2018**	**2019**
UAFG	2.52	2.63	2.62	2.62	2.60	2.58

Source: Access Arrangement Information for Mid-West and South-West Gas Distribution Systems, October 2016