Un-Accounted for Gas (UAFG) Strategy

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ISSUE/AMENDMENT STATUS

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1	December 2009	Strategy developed from a combination of sources. Structure of document build around the existing draft document "Unaccounted for Gas – Avenues for Mitigation".		
2	November 2011	Strategy updated to contain reconciled 2009 UAFG data and updated Recommends and Actions.	M. Cooper	N. Nithianandan
3	August 2017	Reviewed.	M. Horomidis	L. Burridge
4	September 2018	Strategy review and update	A. Sharma	L. Fetherston

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1 Purpose

This document sets out the strategy to reduce the liability from declared transmission system (DTS) and non-declared transmission (non-DTS) Unaccounted for Gas (UAFG) for AusNet Services natural gas distribution network.

This strategy:

1. Defines UAFG and its potential drivers;
2. Describes current and future monitoring and reporting of UAFG within AusNet Services including historic UAFG performance; and
3. Outlines actions for implementation to reduce UAFG liabilities to at least within regulatory benchmarks published by the Essential Services Commission (ESC) and pursue outperformance against these benchmarks over the period 2018 to 2022.

This strategy demonstrates AusNet Services commitment to minimise UAFG for the benefit of its customers and stakeholders and to minimise fugitive methane emissions from its distribution network.

2 References

AMS 30-01	Asset Management Strategy – Gas Networks
AMS 30-51	Network Regulator Strategy
AMS 30-52	Mains and Services Strategy
AMS 30-57	Supervisory Control And Data Acquisition (SCADA) Strategy
ESC 2017	Review of unaccounted for Gas Benchmarks: Final Decision – Calculation
TS 5201	Technical Standard – Leakage Management
GDSC	Gas Distribution System Code

3 Document Review Period

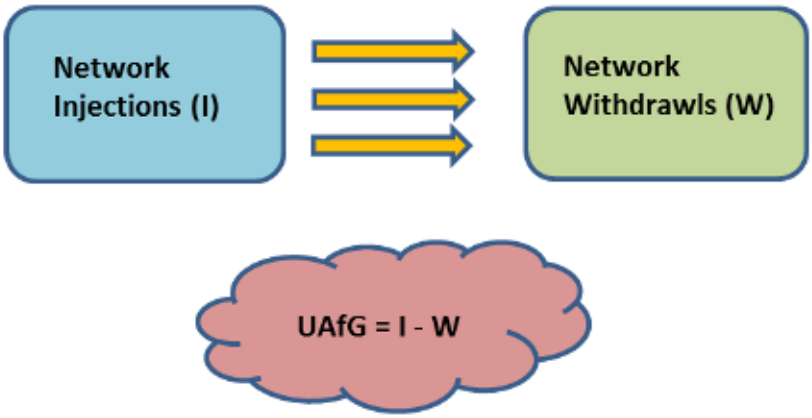
A review shall be undertaken at the end of first year from the date of approval or no later than 1 December 2019. This first review will focus on the progress is recommended to track the progress of recommendation actions, and to quantify their impact and recommend any new strategies. Thereafter, a two yearly review cycle shall apply.

4 Unaccounted for Gas (UAFG)

4.1 Overview

Un-Accounted for Gas or UAFG refers to the difference between the measured quantity of gas entering the gas distribution system from various supply points and the gas delivered to the customers. On the DTS network, the custody transfer of gas is between APA's transmission network and AusNet Service's distribution network. On the non-DTS network, the custody transfer of gas is from Gas Pipelines Victoria's (GPV's) transmission pipeline and AusNet Service's distribution network in Ararat, Horsham, Stawell and Avoca.

Figure 4-1: Un-Accounted for Gas flow diagram



In Victoria and in most jurisdictions, UAFG is managed via a benchmark process (Ref Sec 4.2). The Gas Distribution System Code (GDSC) sets out UAFG benchmarks for each Victorian gas distributor for the period 2018 to 2022. The GDSC requires gas distributors to use reasonable endeavours to ensure that UAFG is less than the ESC benchmarks.

The difference or unaccounted amount for the gas is calculated and reconciled on an annual basis from data supplied by the Australian Energy Market Operator (AEMO), consumer usage data and other data sets as required. The Distribution Tariff Agreement (DTA) requires AEMO to calculate the DTS Reconciliation Amount in accordance with the formula and methodology as defined in the Gas Distribution System Code (GDSC).

4.2 Regulation and Benchmarks

The Gas Distribution System Code (GDSC) sets out UAFG benchmarks for each Victorian gas distributor. The benchmarks express UAFG as a percentage of the aggregate quantity of gas injected into the distribution system for each Victorian gas distributor. Separate benchmarks are applied in respect of customer classes based on the volume of gas consumed annually.

There are currently two classes of UAFG benchmarks applied on the Declared Transmission System (DTS) and Non-DTS networks:

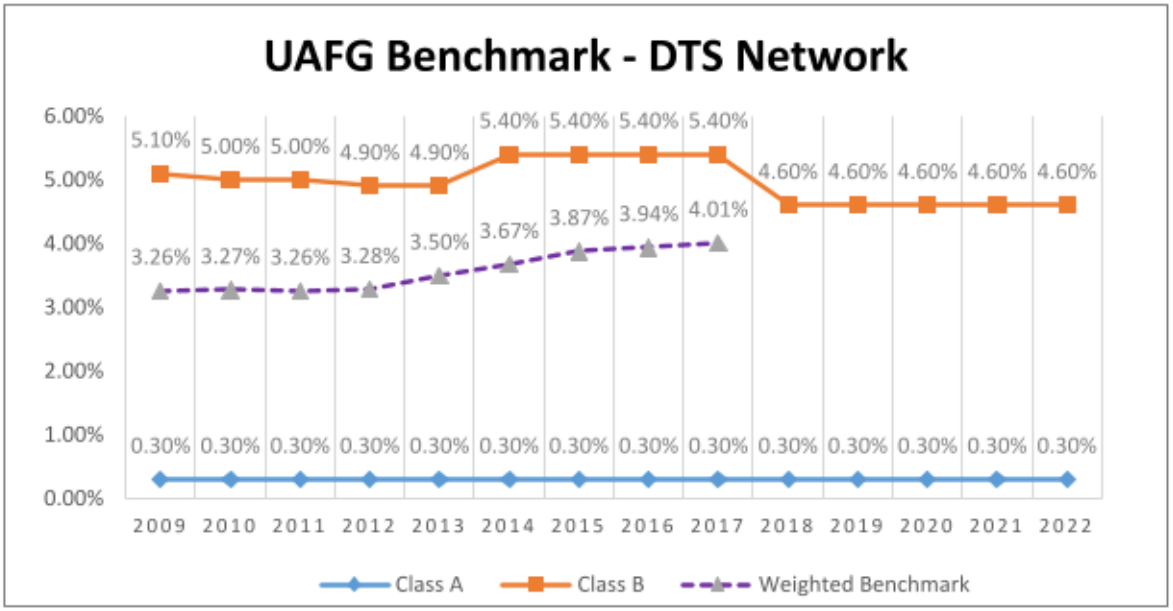
- **Class A**: Customers using more than 250 TJ's per annum and are typically serviced by the transmission / high pressure networks.
- **Class B:** Customers using less than 250 TJ's per annum and are typically serviced by High, Medium and low pressure networks

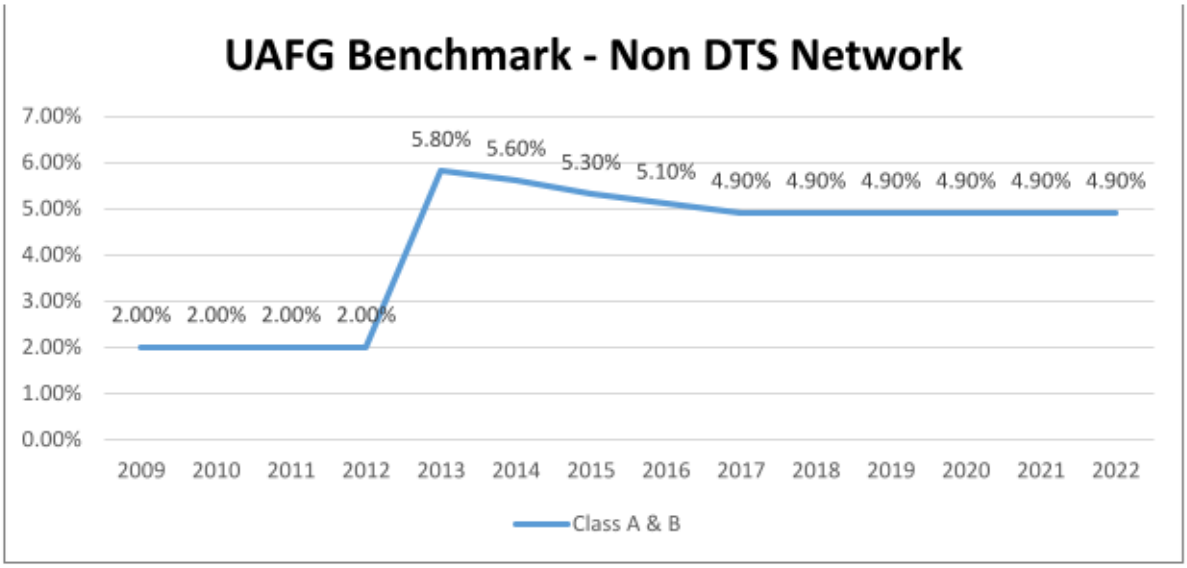
For the DTS network, AEMO specifies a separate UAFG benchmark value for Class A and B customers. However, for the purpose of UAFG reconciliation and performance monitoring a "weighted average benchmark" value is used. This is derived by multiplying the Class A and Class B benchmarks by the respective consumption for each category and dividing this by the total withdrawals from the network.

For the non- DTS network UAFG benchmark for class A and B customers is the same.

Figure 4-2 below shows the UAFG benchmarks specific to AusNet Services for the period 2009 – 2022 for both the DTS and non-DTS networks:

Figure 4-2: UAFG Benchmark – DTS & Non DTS Network





The reconciliation amount calculation between the retailers and distributors is performed annually by AEMO in accordance with the current UAFG Reconciliation Amount formula is stated in the GDSC. (Part C).

5 AusNet Services UAFG Performance

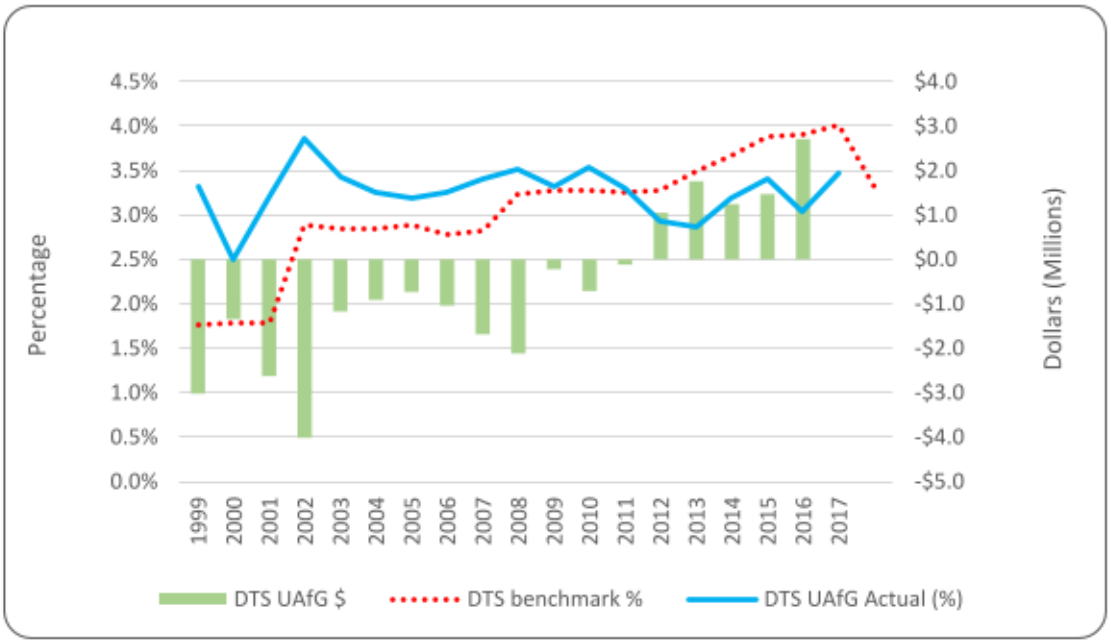
Historical UAFG performance between 2003 and-2011, AusNet Services exceeded the Essential Services Commission (ESC) weighted average benchmark on its DTS network. From 2012 onwards, the DTS UAFG benchmark was not exceeded, as demonstrated by the figures and graph below.

Table 5-1: DTS – Past UAFG Performance

	2010	2011	2012	2013	2014	2015	2016	2017*
Weighted Average Benchmark	3.27%	3.26%	3.28%	3.50%	3.67%	3.87%	3.94%	4.01%
Actual UAFG %	**3.53%**	**3.30%**	**2.92%**	**2.85%**	**3.18%**	**3.41%**	**3.04%**	**3.46%**
UAFG Above Benchmark	0.26%	0.04%	-0.36%	-0.64%	-0.49%	-0.46%	-0.89%	-0.55%
Reconciliation Amount $'000	**-713**	**-121**	**1,053**	**1,759**	**1,244**	**1,472**	**2,711**	

Note: * 2017 Forecast only

Figure 5-1: DTS – Past UAFG Performance



The increasing DTS benchmark during the 2013-2017 period was due to re-setting 2013-2017 benchmarks based on 2008-2012 performance and reductions in Tariff D consumption, most of which is deemed 'Class A' for UAFG purposes with a 0.3% UAFG benchmark. Therefore, the lower proportion of Class A consumption translated into a higher weighted average benchmark (weighted between Class A and Class B). The DTS benchmark for 2018 reduced to reflect our strong actual UAFG performance during 2013-2015.

The non-DTS UAFG performance exceeded the ESC benchmark for a number of years. From 2012 onwards there was an increasing trend in UAFG on the non DTS network reaching 18.8% in 2015 before falling as demonstrated by the figures and graph below.

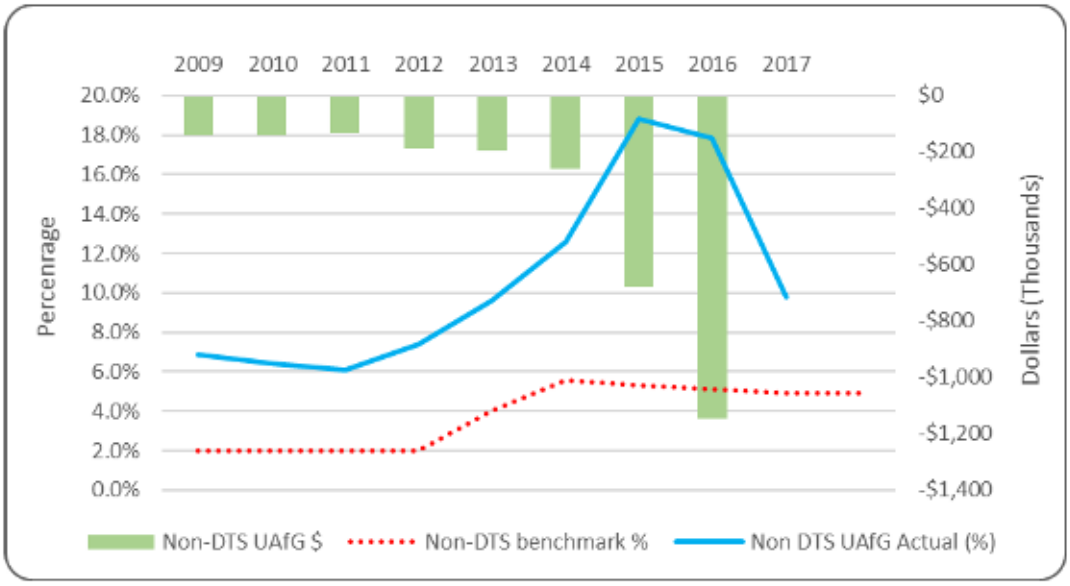
The increase in the non-DTS benchmark between 2013-2017 was a recognition from the ESC that 2.0% was unrealistic, and the ESC adopted a glide path to capture efficiencies that we would be able to implement in the non-DTS network. The ESC has adopted the 2017 benchmark for the 2018-22 period.

Table 5-2: Non DTS – Past UAFG Performance

	2010	2011	2012	2013	2014	2015	2016	2017*
Weighted Average Benchmark	2.00%	2.00%	2.00%	4.19%	5.60%	5.30%	5.10%	4.90%
Actual UAFG %	**6.40%**	**6.11%**	**7.43%**	**9.62%**	**12.57%**	**18.84%**	**17.82%**	**9.8%**
UAFG Above Benchmark	-4.40%	-4.11%	-5.43%	-5.43%	-6.97%	-13.54%	-12.72%	- 4.9%
Reconciliation Amount $'000	**-143**	**-133**	**-190**	**-198**	**-261**	**-680**	**-1,146**	

Note: * 2017 Forecast only

Figure 5-2: Non DTS – Past UAFG Performance



As a result of deterioration in the non-DTS UAFG performance since 2012, significant effort was devoted to understanding the drivers of this issue in 2017. In late 2017, an internal UAFG Taskforce was established to pursue actions to improve UAFG levels in the non-DTS network. This work led to a reduction in non-DTS UAFG levels and a focus on UAFG management to a more granular level across the entire AusNet Services network.

Table 5-3 below shows UAFG levels (on GJ basis) for each of the sub-networks over a period of five years.

Table 5-3: Gas Distribution Network – Historic UAFG Levels (2013 -2017)

Network	Region	UAFG (GJ)					% Change (2013-17)	Injection Vol (GJ)[1]	Region Ranking[2]	UAFG $ Ranking[3]
		2013	2014	2015	2016	2017				
DTS	Metro	1,547,596	1,161,839	1,263,840	1,210,516	1,489,829	-4%	39,611,481	1	1
	Geelong	402,259	397,535	456,460	720,777	515,804	28%	12,173,146	2	2
	Ballarat	5,202	-16,282	-14,541	62,846	78,839	1415%	4,655,219	3	6
	Bendigo	112,144	119,196	148,518	137,924	156,942	40%	2,672,065	4	3
	Allansford	42,776	39,713	42,293	51,724	26,774	-37%	1,858,105	5	9
	Melton	49,213	50,359	58,914	65,417	74,793	52%	1,461,411	6	7
	Sunbury	4,441	14,294	7,850	11,667	16,479	271%	884,846	8	10
	Castlemaine	877	530	-2,322	-2,857	-4,468	-609%	761,020	9	19
	Portland	7,505	3,958	4,765	-16,483	-238	-103%	720,878	10	15
	Colac	5,969	23,520	101,908	197,686	50,427	745%	709,557	11	8
	Koroit	-2,599	2,151	6,868	-22,914	7,550	-390%	651,010	12	13
	Cobden	4,139	7,720	12,495	7,144	-3,855	-193%	538,717	13	17
	Bacchus Marsh	18,720	10,916	36,072	55,661	79,862	327%	527,575	14	5
	Woodend	8,988	-8,503	-3,477	-4,300	-10,123	-213%	368,050	15	22
	Maryborough	10,165	7,025	8,890	14,883	15,503	53%	325,839	16	11
	Hamilton	13,706	9,913	14,485	16,164	9,799	-29%	242,264	17	12
	Kyneton	-210	-5,366	-3,002	-3,606	-5,782	2653%	224,686	18	20
	Daylesford	1,111	-4,499	-3,147	-2,292	-4,314	-488%	159,499	19	18
	Lancefield	-664	-2,415	-2,856	101	-3,397	411%	93,597	20	16
	Ballan	539	-1,890	-1,055	-1,512	-6,775	-1356%	61,947	21	21
	Diggers Rest	3,312	3,870	4,294	3,852	2,429	-27%	53,059	22	14
Non- DTS	Horsham/Ararat/ Stawell/Avoca	91,629	102,617	191,528	198,389	88,102	-4%	977,068	7	4

[1] Gas Injection volumes in GJ for FY 2017.

[2] Region ranking based upon injection volumes.

[3] UAFG $ Ranking based upon 2017 UAFG levels (GJ) & natural gas price @ $ 9.40 / GJ for CY 2017.

The following are key findings:

- UAFG levels in metropolitan Melbourne fell significantly (relative to 2013) from 2014 to 2015 and then increased from 1.2 PJ in 2016 to 1.5 PJ in 2017.
- There have been large increases in UAFG levels in outer Melbourne including Melton and Sunbury.
- There have been significant increases in UAFG in regional areas including Geelong, Ballarat, Bendigo, Bacchus Marsh, Maryborough and Colac.
- A significant deterioration in UAFG levels in the non-DTS network from 2013 approaching 200TJ in 2016 with an improvement in 2017 to below 90TJ.

Table 5-4 below provides visibility on UAFG (%) within the gas distribution network between 2013 - 2017.

Table 5-4: Gas Distribution Network UAFG Performance

Region	2013	2014	2015	2016	2017
Allansford	2.40%	2.20%	2.20%	2.90%	1.40%
Bacchus Marsh	5.00%	2.80%	7.90%	11.90%	15.10%
Ballan	0.90%	-3.20%	-1.60%	-2.40%	-10.90%
Ballarat	0.10%	-0.40%	-0.30%	1.40%	1.70%
Bendigo	4.70%	5.20%	5.90%	5.30%	5.90%
Carisbrook (Non-DTS)	10.50%	11.70%	18.70%	19.00%	9.00%
Castlemaine	0.10%	0.10%	-0.30%	-0.40%	-0.60%
Cobden	1.00%	1.50%	2.30%	1.40%	-0.70%
Colac	1.60%	6.10%	18.70%	27.50%	7.10%
Daylesford	0.70%	-3.00%	-2.00%	-1.40%	-2.70%
Diggers Rest	9.20%	10.80%	9.90%	8.40%	4.60%
Geelong	2.80%	3.00%	3.70%	5.90%	4.20%
Hamilton	5.90%	4.50%	6.00%	6.70%	4.00%
Koroit	-0.30%	0.20%	0.80%	-2.80%	1.20%
Kyneton	-0.10%	-2.80%	-1.40%	-1.60%	-2.60%
Lancefield	-0.90%	-3.20%	-3.40%	0.10%	-3.60%
Maryborough	3.90%	2.60%	2.90%	4.70%	4.80%
Melton	4.10%	4.20%	4.30%	4.80%	5.10%
Metro	3.90%	3.20%	3.20%	3.10%	3.80%
Portland	1.00%	0.50%	0.60%	-2.20%	0.00%
Sunbury	0.60%	1.80%	0.90%	1.40%	1.90%
Woodend	3.20%	-2.90%	-1.00%	-1.20%	-2.80%

UAFG above benchmark UAFG below benchmark

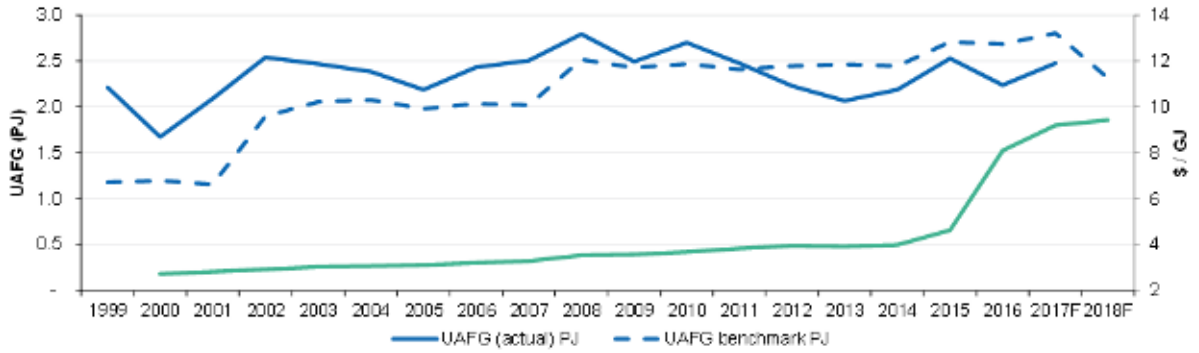
Note: Based upon weighted average UAFG benchmark percentage for DTS and non DTS network.

Annex B provides further visibility on the network Injection and withdrawals values since 2003 for the key regions. This strategy reflects a targeted set of actions that have been informed by analysis of the level of UAFG across our gas distribution network.

5.1 Natural Gas spot price exposure

Annual reconciliation of UAFG between distributors and retailers (including financial payments) is calculated using average volume weighted market price of the gas which takes into account the wholesale spot price of the gas. Figure 5-3 below shows the combined DTS and non-DTS UAFG performance and combined DTS and non-DTS benchmark for AusNet Services in PJs and the natural gas spot price used to settle UAFG payments from 2000. This chart highlights the dramatic increase in gas prices that has occurred since 2013 and the total amount of UAFG for AusNet Services has varied between 1.7 PJ and 2.7PJ.

Figure 5-3: Historic Natural Gas Spot price and performance



The management of UAFG liabilities for the current benchmark period 2018 to 2022 is more critical than in previous periods due to the more than doubling in the wholesale price of gas from $3-4/GJ to over $9/GJ (Ref Figure 5-3). This increase has been driven by major shifts in the supply and demand of gas within Eastern Australia and the impact of the Queensland LNG export projects, which have increased demand for Victorian gas and linked east coast domestic gas prices to global markets.

In this market environment, and with tougher regulatory benchmarks UAFG management must now be treated on the basis that "every molecule counts."

6 Customer Definitions

This section provides an overview on different types of customer connections within AusNet Services customer base.

6.1 Based upon the meter regulator type

Based upon meter regulator, customers can be classified as:

Industrial & Commercial customers (I&C)	Customers that have an industrial and commercial meter regulator setup. For CY 2017 approximately 50% of the gas usage volume is though I&C customers which account for 2.5% of the total gas customers. There are approximately 17K I&C customer connections.
Domestic customers	Customers with a domestic meter regulator. AusNet Services currently has approximately 680,000 domestic customer connections.

6.2 Based upon the meter type

Based upon meter type, customers can be classified as:

Interval or Daily metered	Sites where meter consumption data is recorded daily through the use of data loggers or flow computers. Meter reading of these sites is managed by AEMO through a third party provider, VIPAC. This category comprises of AusNet Services I&C customers. Maintenance of these gas meters and data logging devices is undertaken by Downer and VIPAC respectively.

Basic	Sites where consumption of data is to be recorded monthly or bi-monthly. Reading of these sites are managed by Downer on behalf of AusNet Services. This category comprises of majority of the domestic customers in AusNet Services network.

6.3 Based upon Tariff Class

Based upon tariff, customers can be classified as:

Tariff D customers	Customers whose consumption is greater than 10 TJ p.a. and whose tariffs are based predominantly on demand. This predominantly includes AusNet Service's I&C customers.
Tariff V customers	Customer whose consumption is less than 1 TJ p.a. and whose tariffs are based predominantly on volume. This represents all AusNet Service's domestic customers.

7 Sources of UAFG

In general, sources of UAFG can be classified into two categories, related to:

1. Measurement; and
2. Fugitive Emissions.

Measurement sources of UAFG are due to the errors in the way the gas is measured and / or calculated whereas fugitive emissions are considered physical losses of gas.

Table 7.1 below provides a summary of further sub-categories that contribute to UAFG through Measurement and Fugitive emissions.

Table 7- 1: Sources of UAFG

Classification	UAFG Source	Description
Measurement	**Timing Mismatch**	Caused by the difference in period of measurement between input and output collected meter data over a defined UAFG period.
	Custody Transfer Meter (CTM) and Check Meter Accuracy (Injections)	UAFG is the difference between injections and withdrawals. Injections are defined as the sum of the measurement through CTMs (on the DTS network) and can be based on the measurement through Town meters on the non-DTS network. CTM and Town meter inaccuracies can therefore be strong drivers of UAFG.
	Pressure & Temp Compensation	The gas delivered to customer is at a different condition to what its purchased (i.e. purchased at atmospheric pressure at sea level & 15°C). AEMO specifies the PCF value to compensate for the change and gas distributors have limited ability to alter these values however inaccuracies in PCF application can materially affect UAFG.
	Higher Heating Value (HHV Compensation)	Difference between the average HHV applied to the customer and the HHV at the CTM's. There can be different treatment of heating value compensation of injections and withdrawals. Inconsistencies

		between the application of HHV to injections and withdrawals can therefore contribute to UAFG.
	Meter Accuracy (Withdrawals)	Metering accuracy associated with industrial, commercial and domestic customers due to various factors including age, regulator setting, calibration issues associated with the meters.
	Linepack Volume	Volume of gas required to charge / pressurize a newly installed pipework within existing / new estates during a UAFG measurement period.
	Meter Bypass & Theft	Unauthorised changes to meter configuration leading to no / low consumption recorded through meter.
	Company Own Use	AusNet Services Service's own gas consumption from the network that is either not metered or not metered accurately or not declared as sales. i.e. gas usage to fuel water bath heaters which heat gas before its pressure is regulated at City gate facilities.
	Administrative / Process / System errors	Internal process related errors resulting in inaccurate gas usage data i.e. incorrect PCF, customers not registered for a period of time in relevant systems.
Fugitive Emissions	**Transmission / Distribution Losses**	Loss of gas within the transmission and distribution network due to leaks or inadequate joints and commissioning or decommissioning of parts of the network.
	Equipment Losses	Leaks from meters and associated equipment (i.e. regulator, valves, fittings etc.).
	Third Party Damages	Gas lost from leaks resulting from third party damages, eg. accidental asset strikes.
	Mains Commissioning and Decommissioning	Gas lost during the process of commissioning and decommissioning of Transmission, mains and services pipework.
	Theft	Non-technical losses of gas from customers leading to lower recorded gas consumption than used.

In addition to the sources of UAFG listed in the table above, other factors such as the methodology for calculating UAFG, regulatory changes and the benchmark setting process can have a significant impact on UAFG liabilities. It is prudent to also consider these factors in the management of UAFG.

8 Gas Systems and UAFG

The Gas business systems are shown in Figure 8-1 and in more detail in Annex C. The effective interaction of data and processes across these systems is crucial for the effective monitoring and management of UAFG.

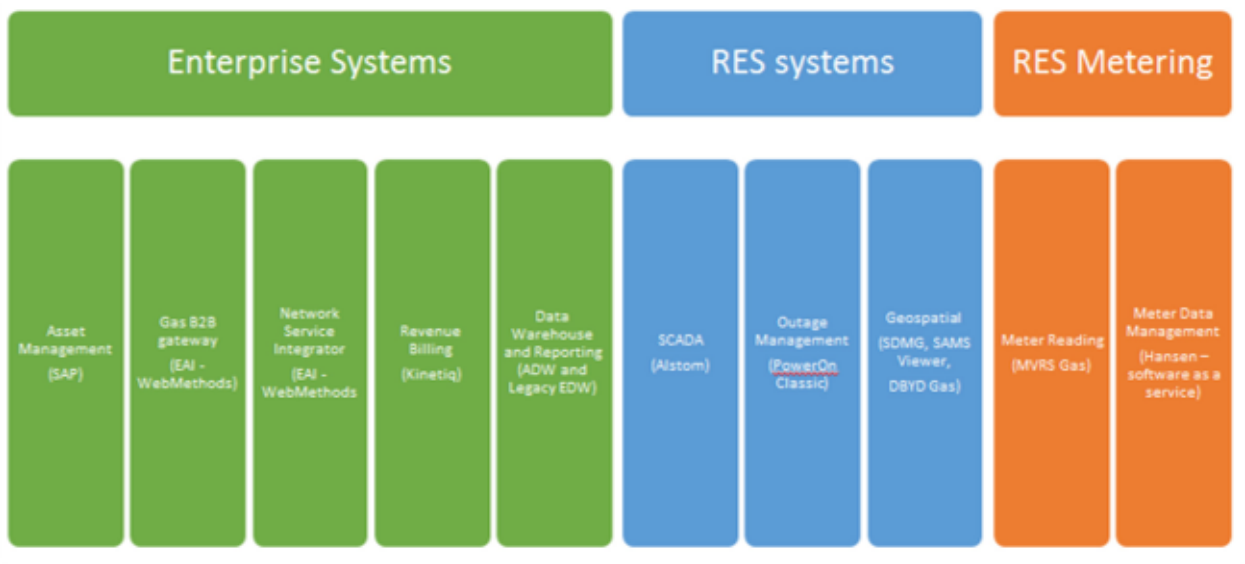
A brief description of the Gas business systems is provided in Table 8-1 and a basic comment on the role they play in the effective monitoring and management of UAFG.

Table 8-1: Gas Business Systems

System	Basic description	Relevance for UAFG management
SAP	Asset management solution	Contains asset data for all gas systems
Kinetique	Billing database	Managing billing & back billing issues

Hansen Hub	Metering information database	Accuracy of meter data including pressures, PCF values.
PowerOn Gas	Database for Service orders, outages and customer information	Review / reporting of outages and service orders.

Figure 8-1: Gas IT systems categories



9 UAFG Mitigation Strategies

9.1 Monitoring, reporting and key performance indicators (KPIs)

As outlined earlier in this document, AusNet Services must use reasonable endeavours to maintain UAFG to within the ESC benchmarks. Since 2018, AusNet Services is monitoring UAFG performance against the ESC benchmarks in monthly management reports.

Recommendations:

1. Injection, withdrawal and % UAFG performance levels to be published within the Gas Business monthly report by each sub-network.

2. Corporate UAFG targets to be set each year for the DTS and non-DTS UAFG networks and for FY19, these are to be set to the volume-weighted ESC benchmark levels.

3. A review of UAFG performance to be produced by the Gas Business and tabled annually with the Asset Management Committee of AusNet Services.

4. An internal UAFG Taskforce will meet monthly to monitor and review UAFG performance and pursue improvement initiatives outlined in this strategy and other improvement initiatives as they arise.

9.2 Custody Transfer Meter (CTM) Accuracy

A CTM measures the volume of high pressure gas injected into AusNet Services DTS gas distribution network through a city gate or a compressor station. The accuracy of the injection volume is vital for calculation and reconciliation of UAFG. A small metering inaccuracy can have a significant impact on UAFG. All injection points within the DTS network have a Custody Transfer Meter (CTM) installed on site.

CTM meter accuracy and limits are specified in AEMO's Wholesale Market Metering Procedures, and this applies to DTS network metering and not to the metering of energy entering the non-DTS distribution network.

As at 2018, there are 38 City gates within the DTS network. CTM within the DTS network are owned, maintained and calibrated by APA, under an arrangement with AusNet Services.

Within the non-DTS network, AusNet Services currently supplies natural gas to four townships – Ararat, Stawell, Horsham and Avoca, fed from a transmission pipe-line known as the Carisbrook to Horsham Gas Transmission Pipeline owned which is owned and operated by Gas Pipelines Victoria Pty Ltd (GPV).

There are three town gate meters (Elster Instromet) at Horsham, Stawell and Ararat that meet the accuracy requirements in the Gas Distribution System Code and the Retail Market Procedures (Victoria). Avoca currently does not have a town meter; however, plans are in place to install a meter at the site. These meters measure the transfer of gas from the GPV transmission pipeline to AusNet Service's non-DTS distribution network.

CTM maintenance and calibration is maintained by APA and provided to AusNet Services on request only. The contract between AusNet Services and APA provides for a formal process to review CTM performance and to engage APA with regards to CTM lifecycle management strategies (i.e. Proposed replacement / upgrade plans). The opportunity to review non-DTS CTM meter accuracy has not been pursued recently.

Recommendations:

1. Identify priority CTMs based upon the age profile and accuracy issues for review and replacement by APA.

2. Install a town gate meter at Avoca with the same characteristics as those in Ararat, Horsham and Stawell.

9.3 Conversion Errors (Pressure and Temperature) compensation for meters

Gas sold as a unit of energy is measured in Gigajoules (GJ). This is based upon the gas being measured at atmospheric pressure at sea level (i.e. 101.325kPa) and at 15°C.

Changes in metering pressure and atmospheric pressure affect the volume of gas that is metered. These changes are more profound at lower metering pressures (i.e. 1.1kPa). To compensate for the change in atmospheric pressure based on ground elevation, the following calculation could be performed to correct the values for UAFG volume:

$$UAFG_{atm} = V_m\left[\frac{(P_a - P)}{1013.25} - 1\right]$$

UAFG atm	= UAFG due to variation in atmospheric pressure at elevation
Vm	= volume of gas metered
Pa	= atmospheric pressure at sea level (mB)
P	= pressure correction at elevation (mB)

Temperature compensation is required since the temperature of the gas supplied will vary depending on the soil temperature. It is assumed that the gas temperature is the same as the soil temperature at the pipe depth. For UAFG due to the temperature variation between Longford and the meter:

$$UAFG_{temp} = V_m \left[\frac{288.15}{(T_m + 273.15)} - 1 \right]$$

$UAFG_{temp}$ = UAFG due to temperature variation of gas

V_m = volume of gas metered

T_m = temperature of gas metered (degrees Celsius)

Accuracy of gas usage data can be further enhanced by the use of dynamic pressure and temperature monitoring unit (i.e. Flow correctors) at the consumer meter end. However, considering very low gas consumption by the domestic customers and low overall UAFG contribution, the investment to upgrade meters with flow correctors is not warranted.

For the purpose of UAFG contribution this section takes into account the PCF impact on Interval I&C customers only due to very high volume usage as compared to domestic customers.

Interval I&C Customers (Tariff D only)

As at August 2018, AusNet Services currently has 382 Tariff D I&C customers. Depending upon the meter setup, the site can be classified as:

a. Data logger sites– Basic meters equipped with data logger which records the uncorrected gas usage at a set pressure. A set PCF is then applied to the usage to convert into corrected usage volume. It shall be noted that the PCF are determined and set by AEMO

b. Flow Corrector sites – These meters provide corrected gas usage volume based upon real time measurement of pressure only or pressure & temperature both at the meter end. No fixed PCF is applicable to the metered volume.

The table 9-1 below provides a breakdown of Tariff D I&C customers based upon the meter setup:

Table 9-1 – Tariff D Customers based upon meter setup

Site Type	Number of Customers
Data Logger Sites	255
Flow Corrector Sites	127
Total	382

PCF for data logger sites is based upon the pressure requirement set at the time of meter connection and does not take into account any variation in pressure due to change in customer requirements / usage behaviour. Due to high usage volume by I&C customers, any inaccuracies in PCF could result in significant UAFG. For example, the PCF applicable at12 Kpa is 1.1188 as compared to PCF at 15 Kpa which is 1.1484.

AEMO stated PCF's are can be referenced using the following link: https://www.aemo.com.au/-/media/Files/Gas/Retail_Markets_and_Metering/Market-Procedures/VIC/2017/AEMO-Pressure-Correction-Factors--August-2015.pdf

Recommendations:

1. Define and document criteria / requirement for data logger or a flow corrector configuration for I&C customers.

9.4 Higher Heating Value (HHV) Compensation

Higher Heating value is the amount of heat produced by a complete combustion of a specified quantity / volume of gas in GJ. This value is based on the volume of gas metered at CTM's and the HHV for the source gas that is injected at each location. This calculation is performed at each CTM, resulting in the GJ of gas that is supplied into the network at that CTM location.

However, HHV values used in customer billing are calculated using the average HHV for all CTMs across the entire network. With all other factors constant, a variation exists between the total amount of gas metered at CTMs, and the total customer consumption (in GJ). Due to changes in the east-coast gas market conditions, AEMO has recently updated the way HHV are applied to injections.

Based on analysis from 2008 and data from all CTMs located in the AusNet Services network, the average of the Zonal Heating Value (HV) was 38.34 . This was lower than the average of Statewide HV, which was 38.55. AusNet Services currently adopts the use of the Statewide Heating Values. The lower the heating value, the less consumption that will be billed. This analysis concluded that if AusNet Services moved to a Zonal Heating Value, it would lead to an increase in UAFG and lower Revenue. With regards to Statewide versus Zonal, based on current CTM heating values, it has been beneficial financially for SP AusNet Services to remain with a Statewide HV and this needs to be revisited based on the latest available data.

In early 2018, AEMO changed how the Heating Value (HV) is allocated to CTMs on the Victorian Declared Transmission System (DTS). AEMO's existing model to do this was developed in 2003 and since then the Victorian DTS has undergone significant change through a number of expansion projects. Following the 2013 - 2015 expansion of the DTS in northern Victoria, and addition of the Winchelsea compressor in south-west Victoria, market driven transmission system flows can adjust more frequently within a gas day and between gas days. The new heating value allocation model is better suited to these changes and is designed to handle future DTS augmentations, such as the completion of the Western Outer Ring Main.

The previous heating value allocation tool required AEMO to manually determine which gas supply source(s) should be assigned to a heating value zone and the time delays for the time taken for the gas to move through the transmission system (with these times being impacted by changes in gas demand). The new Heating Value Allocation Model (HVA model) uses a topographical representation of the DTS to hydraulically model gas flow and composition to determine the HV and gas composition at every metering installation. The new model will handle changes of gas source to metering installations for each hourly metering period.

Further investigation is needed in order to establish if a customer CTM zonal heating value is beneficial to UAFG for AusNet Services and to understand the impact of AEMO's 2018 changes.

Recommendations:

1. Review and analyse impact of HHV changes to injections by AEMO to AusNet Services, especially CTMs most impacted by changes in overall Victorian DTS system flow changes. Recommend changes as required.

9.5 Pressure Correction Factor (PCF) Errors

9.5.1 Incorrect PCFs

For all customers with a data logger setup, a static PCF based upon the pressure setting is applied to the MIRN to ascertain total gas usage. For I&C customers with a data logger setup, a fixed PCF is registered with AEMO based upon the data provided by AusNet Services at the time of creation of MIRN. It shall be noted that PCF values are determined and defined by AEMO and the onus is on AusNet Services is to ensure PCF settings are correct and updated in systems following metering pressure upgrades or downgrades for I&C customers.

Within the current operating framework, AusNet services has limited visibility on the PCF applied by AEMO to derive the usage for I&C customers. Hence any anomaly in PCF applied by AEMO vs PCF stated within AusNet Services database could go unnoticed and can be attributed to UAFG.

For example:

An incorrect PCF was applied to Ararat Prison site since 2012. The anomaly was picked up by AusNet Services during their review of unusually high UAFG in the non-DTS network in 2017. The financial impact of this is for 2012 – 2016 is estimated to be approximately $460,000.

Recommendations:

1. Engagement with AEMO with an aim of establishing a process of receiving a periodic usage data (including PCF applied) for I&C customers on a half yearly basis.
2. Define and document the procedure for updating usage data and back-billing associated with residential and I&C customers.

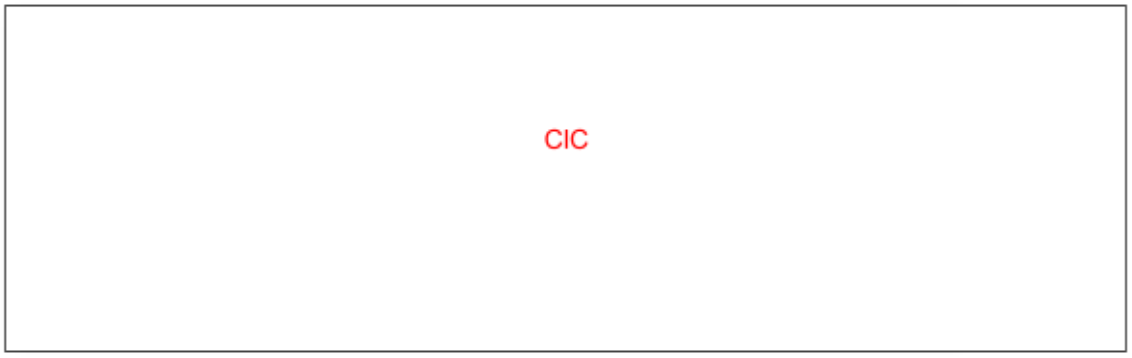
9.5.2 Equipment malfunction

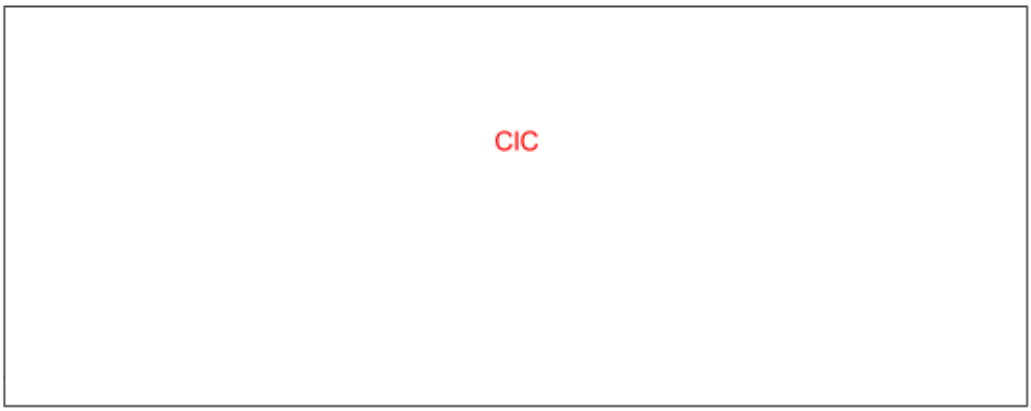
Currently there are 127 I&C meter installations with Flow corrector units. These units rely on sensors to continuously monitor the pressure and temperature which is then used to determine the actual gas usage. All flow corrector units are maintained by VIPAC on a six monthly basis under contractual arrangement for AusNet Services.

While the probability of fault / failure with this type of equipment should be quite low, however in an event of a malfunction the usage recorded could be substantially lower usage than actual usage and can go unnoticed if not detected during maintenance or routine review.

For Example:
Figure 9-1 below shows the drop in usage recorded at Geelong Hospital due to unit malfunction in May 2018.

Figure 9-1: Geelong Hospital Usage Data





Recommendations:

1. Provision for high level quarterly performance reporting from VIPAC and Downer for the units maintained within that period.
2. Updated guidelines and checks to be completed as part of regular I&C meter maintenance Downer to validate accuracy of meter data (PCF & Pressure) with the SAP / Hansen Records.
3. Time expired meter PCF checks to be undertaken to ensure correct PCF is applied and recorded in database for billing.

9.6 Company's own use

Natural gas from the transmission pipework is generally preheated prior to pressure reduction within the city gate facility. This is required to prevent icing and a significant drop in gas temperature within the distribution network. Out of the 41 city gate facilities, 38 sites have water bath heaters installed. These heaters utilise natural gas to heat water which in turn heats gas through a natural convection process. Not all city gate site gas meters have a MIRN number allocated to them. Within the current practice, the gas usage from these sites is overlooked as its considered to be of a small proportion and have a minor impact on UAFG.

Recommendations:

1. Undertake audit of all City gates to identify sites with meters but no MIRN and incorporate a schedule for maintenance and routine meter reading for all the City Gate sites.
2. Incorporate annual gas usage data associated with city gate sites for UAFG reconciliation.

9.7 Pipework Losses

The majority of AusNet Service's low pressure (LP) and medium pressure (MP) networks consist of cast iron, un-protected steel and PVC pipework. These pipes are prone to degradation over time due to corrosion and fatigue related issues and result in leakage of gas.

A component of UAFG can be attributed to leaks within the distribution system. The completion of mains renewal programs, to replace old, leak-prone cast iron pipes with high pressure-rated, polyethylene pipes will act to curb the increase in the number of gas leaks originating from pipes in the distribution system.

In 2003, AusNet Services initiated the Mains Replacement program to replace the ageing and leaking Medium Pressure (MP) pipework with new generation Polyethylene (PE) pipework. Since the introduction of this program, AusNet Services has demonstrated its commitment to completing the program by 2027 with the replacement of over 900 km of MP pipework till date. To address the similar risk within the Low Pressure (LP) network, a mains replacement program for LP pipework was initiated in 2013 with an aim of replacing highest risk LP mains by 2017, since 90 Km of LP main shave been replaced till date.

In accordance with the company's asset management strategy '30-2507-03 Asset Management: Gas Mains Replacement Strategy', renewal programs are performed in areas considered to be 'high risk and high benefit'. Strategic analysis is used to identify areas that fit these criteria, including areas with high rates of pipe breakage (High

Breakage Zones) and low pressure (LP) areas with cast iron pipes that are within close proximity to existing high pressure (HP) networks. Priority replacement areas from 2018 to 2021 include metropolitan Melbourne suburbs (such as Yarraville, Footscray, Moonee Ponds, Kensington and outer Metro areas including Geelong and country towns Bendigo & Ballarat.

Moreover, as LP networks are replaced by HP, decreasing the overall demand in the remaining LP network, the outlet pressure from the district regulators which feed the LP networks can be reduced, which in turn reduces the rate of leakage from the remaining LP cast iron pipes.

Figure 9-2: Mains Replacement Program

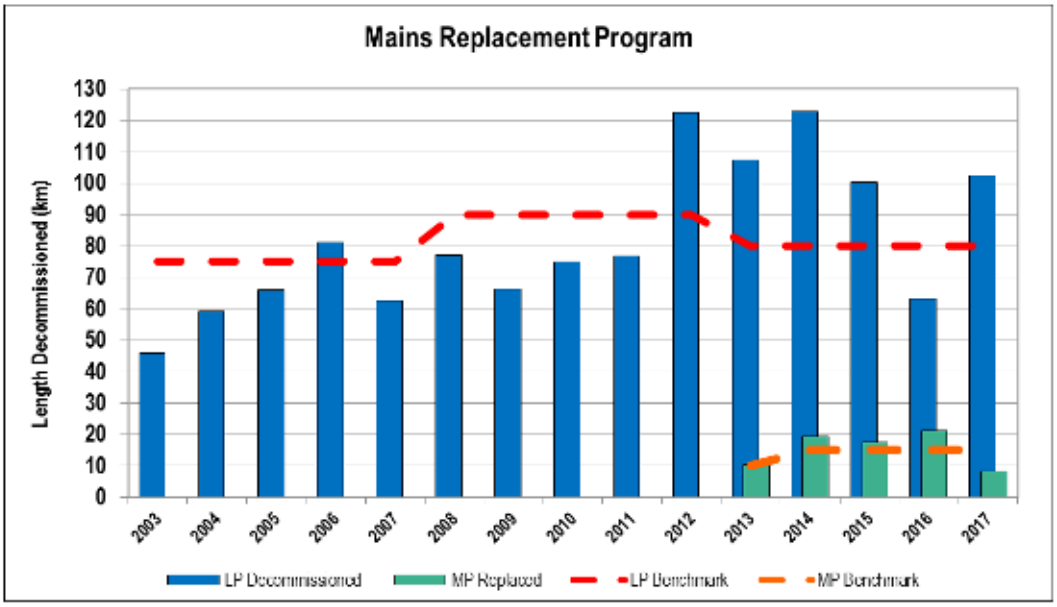
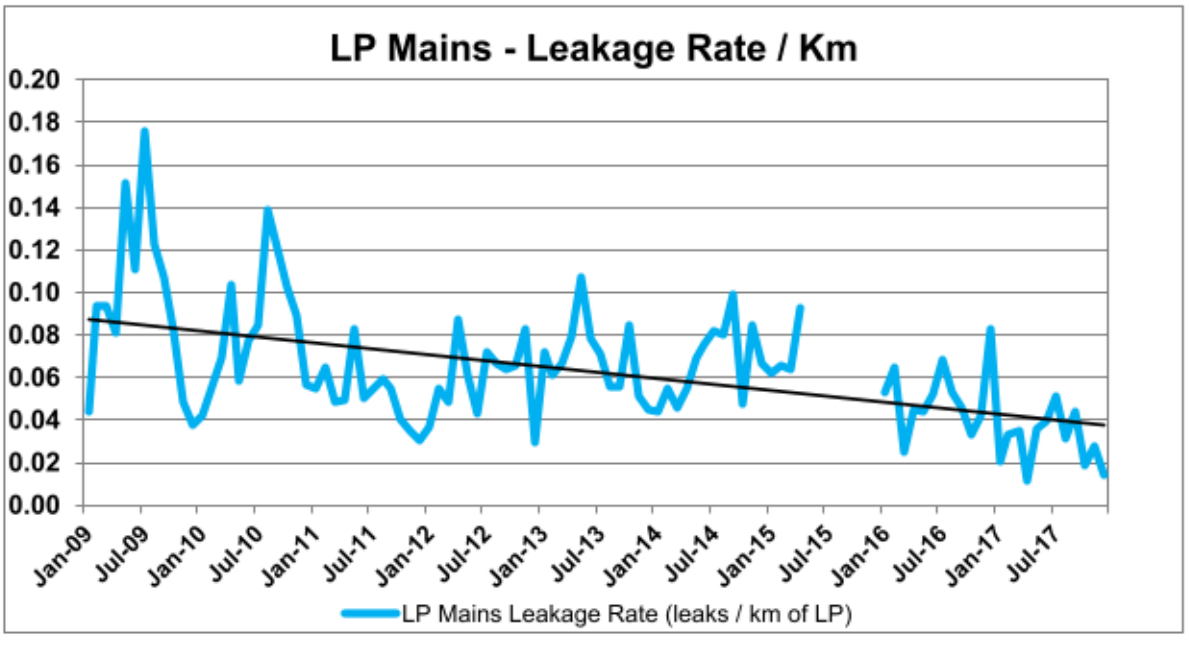


Figure 9-2 shows progress of mains replacement program progress against the internally set benchmark. As the program continues to replace the old ageing pipework with new generation PE pipework at an accelerated rate, the benefits of this can be seen through an overall trend of decline in leaks in low pressure mains network as shown in Figure 9-3.

Figure 9-3: LP Mains Replacement – Leakage rate / Km



9.7.1 Leakage survey

AusNet Services has a risk based leakage survey methodology that focuses leakage survey efforts to the areas of highest risk and relies on members of the public reporting leaks with pre-defined trigger levels to initiate further leakage surveys in areas not classified as high-risk.

Currently, all mains in high-risk locations are surveyed on an annual basis. Transmission pipelines, internal services and high-risk special crossing (e.g. railway line crossing) are also surveyed on an annual basis. The Technical Standard TS-5201 Leakage Survey outlines AusNet Services' leakage survey methodology.

A significant proportion of UAFG is attributable to regional and outer-metropolitan networks. As per the current strategy, a survey is only triggered if the threshold is reached for low risk areas. While many of these areas are not densely populated, there is a greater possibility of a leak going unnoticed or un-reported for a prolong periods and hence may not trigger a survey. The current leakage survey strategy is under review and will be updated by December 2018.

Several leakage surveys were triggered in 2017 and 2018 as part of investigations into UAFG levels across the gas distribution network (Refer Table 9-2).

Table 9-2: Leakage Survey Sites

Distribution network	Pressure	Leakage survey	Results / comments
Horsham, Stawell and Ararat	LP & HP	Dec 2017 – March 2018	84 leaks identified and rectified.
Melton	HP	Currently Underway	64leaks have been identified. The survey results will analysed once complete results are available.
Bacchus Marsh	HP	May 2018	8 leaks were identified and rectified

Recommendations:

1. Update Leakage Survey strategy to ensure it provides adequate coverage for regional areas, and areas with inherent poor performing pipework.

2. Analyse impact of leak repair on UAFG in Horsham, Stawell, Ararat, Melton and Bacchus Marsh to understand the economics of using leakage surveying and repair to manage UAFG.

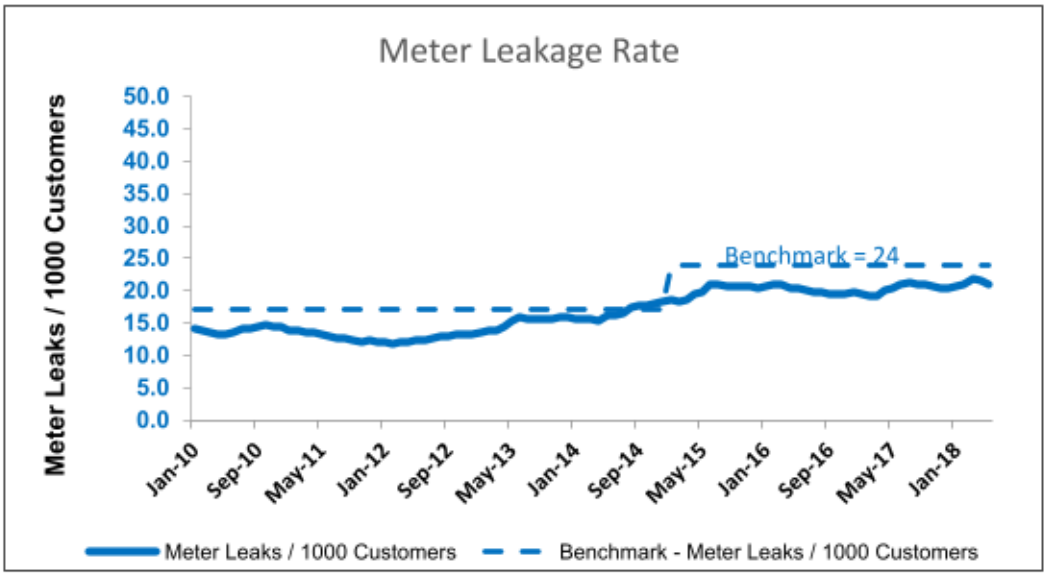
9.8 Equipment Losses

There is a potential for leaks at any point in the system where pipework is connected to another equipment i.e. meter or regulator connections. AusNet Services gas portfolio comprised of over 680,000 domestic connections and approximately 17,000 I&C connections. While the I&C meter regulators undergo routine maintenance due to high gas usage, domestic regulators are not maintained on a routine basis as they are considered as low usage units and the financial cost associated with routine maintenance of approximately 680,000 units is not justifiable against the benefit realisation due to low volume of gas involved per meter.

Replacement of the domestic meters is currently undertaken based upon the age and / or leakage statistics associated with a particular family of meter. Currently, parameters associated with a meter (i.e. make & model number) are stored in Hansen Hub, however asset data associated with regulators is not stored in Hansen or in the enterprise Asset Management System.

Figure 9-4 below shows an increasing trend associated with meter leaks over the last five years. While the volume of leaks through domestic meters are considered to be small, the cumulative affect over the entire portfolio of 680,000 units could have a significant contribution to UAFG and need to be analysed.

Figure 9-4: Meter Leaks



Recommendations:

1. Undertake engineering analysis of meter leaks within a standalone network to determine the extent of regulator failure issue and its contribution to UAFG.

9.9 SCADA Monitoring and Control

Supervisory Control and Data Acquisition (SCADA) systems are used to control and monitor station plant remotely from the Control and Energy Operations Team (CEOT) via Remote Telemetry Units (RTUs).

Gas leakage as a result of pipework corrosion, faulty material or faulty joints is the main source of UAFG. in a distribution network. The issue is further alleviated if the system comprises of significant proportion of older metallic & PVC pipes which are prone to failure over time. One of the most effective methods of reducing UAFG is, therefore, to monitor and ability to reduce the average pressure in the network in accordance with the demand. Currently a limited proportion of AusNet Services gas network has SCADA control capability which is utilised to regulate summer and winter pressure settings within the major networks.
At present there are no recommended strategies for implementation with regards to SCADA monitoring and control.

9.10 Process Improvements

At present, various databases such as, SAP/ Hansen Hub etc. are used within AusNet Services to record and manage customer data for the purpose of asset management, maintenance, billing and revenue related activities. While SAP is used for asset creation and generating maintenance plans all meter as data is stored in Hansen Hub.

Customer data from the Hansen Hub is also utilised by VIPAC / AEMO for the purpose of determining pressure & PCF settings for the I&C customers.

Inaccuracies / misalignments in customer data records between these databases could result in a customer not recorded for billing purposes or an incorrect PCF being applied to an I&C customer resulting in an incorrect usage determination, all of which is attributed to UAFG. There have been known instances where incorrect PCF were applied to I&C customers.

In addition to the above stated issue, currently there is no formal process to review data from AEMO, VIPAC and Downer which could also assist in early detection of data inaccuracy issues.

At present, there are no clear mapping of customers and asset data between SAP and Hansen Hub ensuring data integrity within both databases for accurate measurement of gas usage resulting in correct billing.

Recommendations:

1. Half yearly review of maintenance data from Downer & VIPAC to identify any misalignment between stated and recorded pressure & PCF's in SAP & Hansen Hub.
2. Undertake a review of I&C customer database in SAP & Hansen Hub to establish compliance.

9.11 Third Party Damages

Third party damages are a common occurrence on gas distribution assets. Some damage can be superficial without any detrimental long-term damage to the asset, while other damage can result in release of gas which results in UAFG. While third party damages can occur on any part of the network, the majority are related to service damages by consumers and contractors (i.e. fencing contractors) working in the vicinity of buried gas assets without adequately ascertaining their location.

Figure 9-5: Mains & Services Leaks

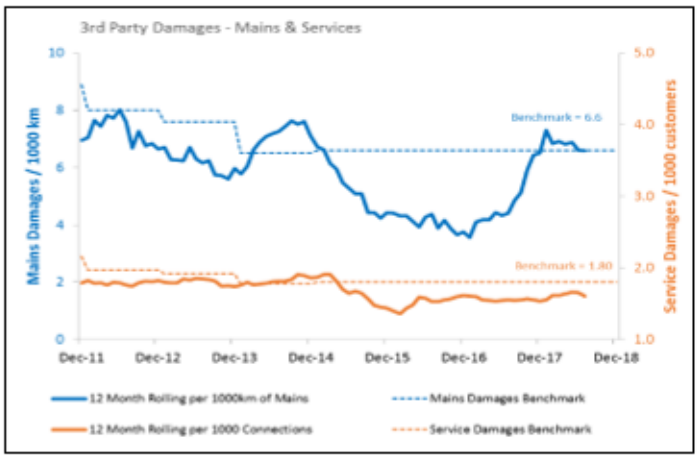
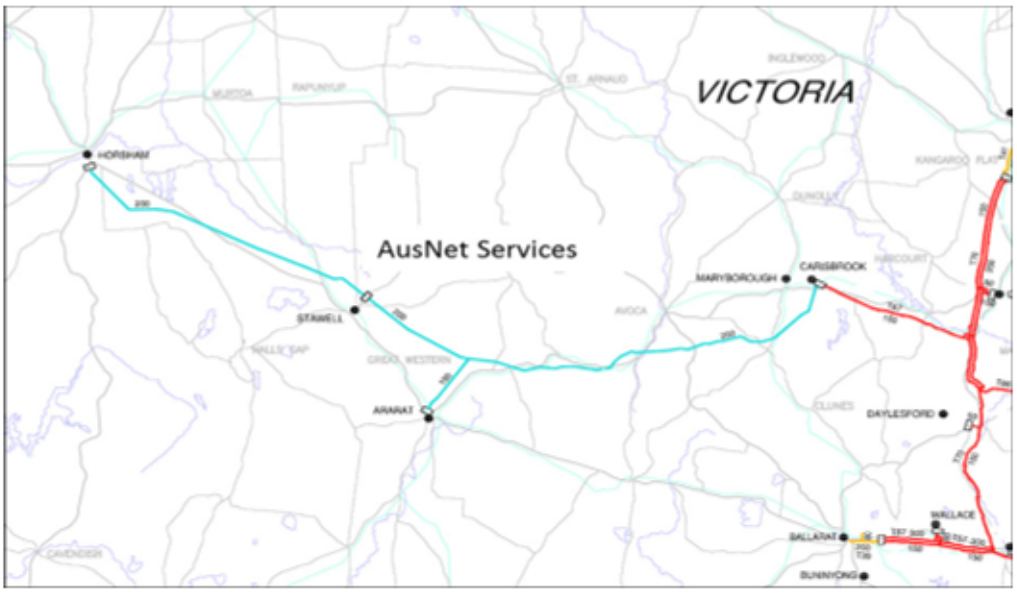


Figure 9-5 shows the 3rd party damages reported on mains and services within the Gas network. While there has been an increase in mains damage rate between 2016 – 17, the damage rates have dropped in 2018 and are currently at the benchmark levels set internally by AusNet Services.

10 Non DTS network strategy

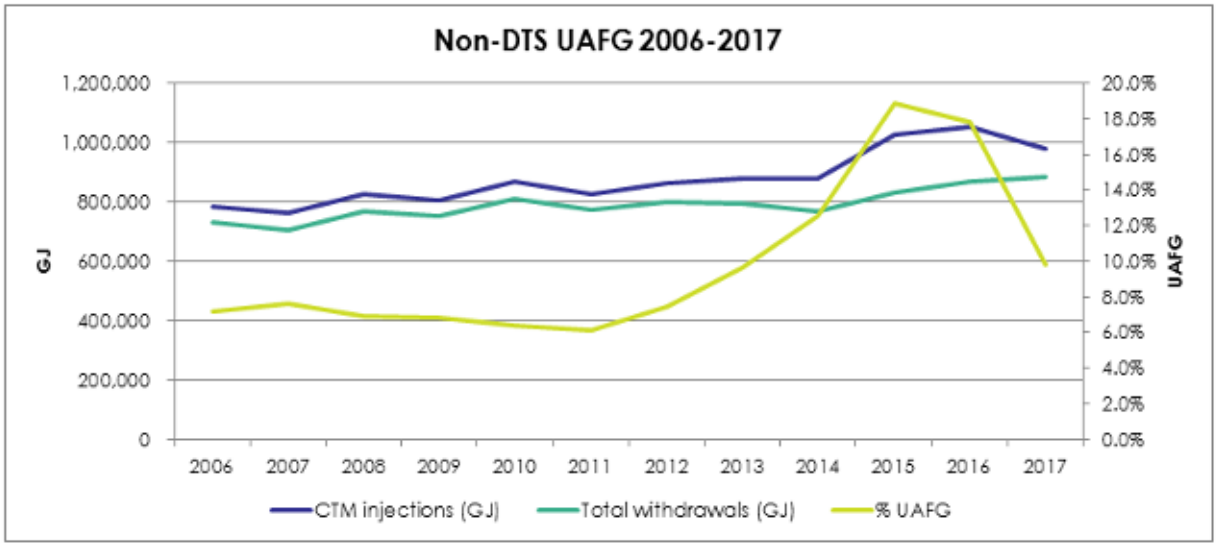
The non-DTS network comprise of Horsham, Stawell and Ararat township. These are located some 100-170km from the Carisbrook CTM. The pipeline connecting the Carisbrook CTM to AusNet Services distribution network in those towns is the Carisbrook to Horsham Gas Transmission Pipeline as shown below.

Figure 10-1: Non DTS Network Map



From 2012 onwards, there has been increasing trend in UAFG within the non DTS network with the peak recorded in 2015 (18.8 %). The graph below shows the comparison between actual injections, withdrawals and the percentage level of UAFG recorded in the Non DTS network from 2006 to 2017.

Figure 10-2: Non DTS Network UAFG Performance



Internal investigations undertaken by AusNet Services in 2017 determine several potential causes ranging from incorrect PCF's, potential pipeline leaks and meter inaccuracies. Remedial works undertaken on the identified issues has resulted in significant drop in UAFG levels.

In 2014, AusNet Services installed three Town meters at Ararat, Horsham and Stawell, which form the custody transfer points between the GPV pipeline and the entry point to each of the three towns. This will ensure accurate measurement of the volume injected at Carisbrook CTM vs the volume of gas injected between the three towns and will remove any uncertainties associated with the leakage through GPV infrastructure.

The UAFG reconciliation methodologies provided for in the National Gas Rules and AEMO's Wholesale Market Distribution UAFG Procedures (Victoria) (Wholesale Procedures) do not apply to the Grampians non-DTS network. To date, AusNet Services and EnergyAustralia (as the exclusive retailer in this area) have jointly adopted a methodology that aligns with the Wholesale Procedures and the Gas Distribution System Code (Code), including the UAFG benchmarks set out in the latter.

It is AusNet Services' position that the current methodology includes gas losses that occur within GPV's non-DTS network. We consider such losses should (and can) be excluded from the UAFG settlement calculations for the Grampians non-DTS network by using appropriate metering, and is pursuing a change to the current methodology to exclude these losses.

To this end, in 2018 AusNet Services presented a revised methodology to AEMO. Under the revised methodology, the Carisbrook custody transfer meter would be replaced as the injection point for non-DTS UAFG settlement calculations by the Horsham, Stawell, Ararat and Avoca town gateway meters located at the injection points to our distribution network. AEMO would use the sum of the withdrawals recorded in the settlement process.

The meters at Horsham, Stawell and Ararat meet the accuracy requirements of both the Code and the Retail Procedures. Currently, there is no town gateway meter installed at the injection point at Avoca as Avoca was only connected to the gas distribution system in 2017. We envisage a town meter will be installed in the future but, until then, we propose to assume use Avoca's total metered gas consumption data UAFG is equal to the non-DTS benchmark during a settlement year as a proxy.

AusNet Services intend to table the recommendation to AEMO to adopt the recommendation and to use the same for future UAFG reconciliation purposes.

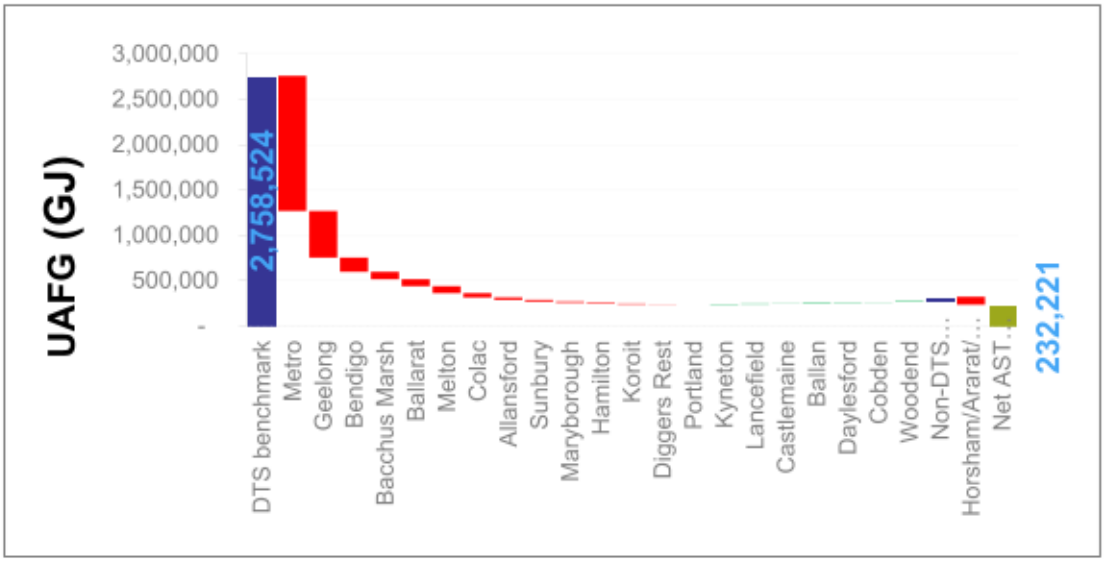
Recommendations:

1. Finalise and document changes to non-DTS UAFG reconciliation methodology with AEMO and Energy Australia.
2. Replace inaccurate Town Meter at Stawell.

11 Melbourne Metro and Regional Strategy

Figure 11-1 shows UAFG analysis undertaken by AusNet Services for CY 2017 based upon CTM injections and network withdrawals. As evident from this analysis, the majority of the UAFG is attributed to the Melbourne Metro and regional areas of Geelong, Ballarat, Bendigo, Bacchus Marsh, Colac and Allansford.

Figure 11-1: UAFG – Network Analysis



Various factors that can contribute to UAFG have been discussed in Section 7 of this document. The section below however aims to provide targeted recommendations specific to the regions with higher UAFG levels.

11.1 Melbourne - Metro Region

Recommendations

1. Delivery of mains replacement program to achieve corporate objective and planned benchmark.

11.2 Geelong & Bacchus Marsh Region

Recommendations

1. Delivery of LP mains replacement program as per the approved project scope and schedule.
2. Update Leakage Survey strategy to ensure it provides adequate coverage for outer metro & regional areas.

11.3 Bendigo & Ballarat Regions

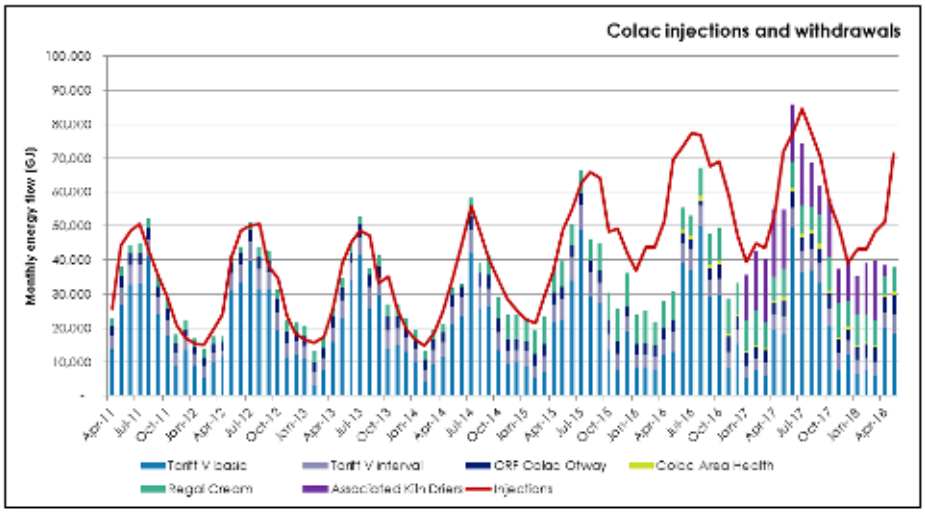
Recommendations

1. Update Leakage Survey strategy to ensure it provides adequate coverage for regional areas.
2. Undertake detailed gas usage analysis to identify an unusual usage patterns associated I&C customers within Ballarat region.

11.4 Colac and Allansford Regions

Internal gas consumption analysis undertaken by AusNet Services identified anomaly between gas injection and withdrawal volumes in Colac region (Ref Figure 11-2). Further investigations identified issues associated with a broken I&C customer meter at AKD Softwoods and incorrect PCF being applied to Regal Cream gas usage. Since, the meter has been replaced and PCF has been updated in the billing system. Metering team is in process to remediate the billing issues associated with both customers.

Figure 11-2: Colac - Monthly Gas Usage Analysis



Recommendations

1. Remediate billing issues in Colac associated with I&C customers.
2. Undertake detailed gas usage analysis to identify any unusual usage patterns associated I&C customers within Colac region.

12 Implementation Plan

The recommendations made in this strategy are categorised into the following two broad headings for implementation purposes:

a. Strategic Initiatives
Initiatives which are aimed at a high level strategy perspective to assist with reduction of UAFG.

b. Individual Initiatives
Initiatives which align with the day to day operations of a individual business group / unit.

Table 12 – 1: Strategic Initiatives

Action Number	Action Description	Business Group	Date
1	Monthly reporting of UAFG performance levels within the Gas Business monthly report by each sub-network.	Asset Strategy & Planning	Sep 18
2	Corporate UAFG targets to be set each year for the DTS and non-DTS UAFG networks and for FY19, these are to be set to the volume-weighted ESC benchmark levels	Asset Strategy & Planning	Sep 18
3	Annual UAFG performance report to be tabled with the Asset Management Committee of AusNet Services	Asset Strategy & Planning	Sep 18
4	Monthly meeting of UAFG Taskforce to monitor an review UAFG performance and pursue improvement initiatives outlined in this strategy and other improvement initiatives as they arise	Asset Strategy & Planning	Sep 18
5	Update Gas Metering Management Strategy (GMMS) to define and document a policy and process around telemetry requirement (data logger or a flow corrector) and back billing criteria associated with I&C customers.	Gas Metering	Dec 18
6	Review and update current Leakage Survey strategy to ensure it provides adequate coverage for regional areas and incorporate findings from recent surveys and learnings from recent surveys.	Asset Strategy & Planning	Dec 18
7	Finalise and document changes to non-DTS UAFG reconciliation methodology with AEMO and Energy Australia	Asset Strategy & Planning	Nov 18

Table 12 – 2: Individual Initiatives

Action Number	Action Description	Business Group	Date
8	Consultation with APA to determine priority CTM's for replacement.	Asset Strategy & Planning	Dec 19

9	Installation of a new town gate meter at Avoca	Gas Delivery	Dec 18
10	Review and analyse impact of HHV changes to injections by AEMO to AusNet Services, especially CTMs most impacted by changes in overall Victorian DTS system flow changes.	Finance Data Analytics	Jun 19
11	Review usage data of Tariff D customers from VIPAC & AEMO to validate accuracy of PCF, pressure setting and gas usage on half yearly basis.	Gas Metering	Dec 18
12	Updated guidelines and checks to be completed as part of regular I&C meter maintenance by Downer followed by a periodic review of data on six monthly basis to validate accuracy of PCF, pressure settings for current I&C and time expired replaced meters.	Gas Delivery	Dec 18
13	Identify meters at City Gate sites not listed in Hansen and update database accordingly and Incorporate a program of scheduled maintenance and routine meter reading for all the City gate sites	Gas Metering	Apr 19
14	Undertake engineering analysis of meter leaks within a standalone network to determine the extent of regulator failure issue and its contribution to UAFG.	Gas Delivery	Jun 19
15	Replace inaccurate Town Meter at Stawell.	Gas Delivery	Jun 19
16	Remediate billing issues in Colac	Gas Metering	Dec 18
17	Undertake detailed gas usage analysis to identify an unusual usage patterns associated I&C customers within Ballarat and Colac regions.	Finance Data Analytics	Mar 19

13 Summary

In the last five years, AusNet Service's has maintained UAFG levels within the benchmark levels for its DTS network. The non-DTS network has seen an increase in UAFG levels above the set benchmark since 2011 with the peak in 2015 (18.8%). Significant internal efforts have been undertaken through the formal establishment of UAFG Taskforce to understand and implement strategies to reduce UAFG performance focussed initially on the non-DTS network and then broadened to the DTS network. Non-DTS network performance has improved considerably since 2016.

This strategy represents an active management plan for the reduction of UAFG across the AusNet Service's gas distribution networks. It has also provided detailed context around the regulatory benchmark requirements, the potential UAFG drivers and outlined mitigation strategies required for efficiently managing UAFG levels to within the benchmark set by ESC and to pursue outperformance against these benchmarks.

With wholesale natural gas prices more than doubling over last few years, management of UAFG levels within the benchmark levels is critical to minimise the financial liability exposure to AusNet Services. The benchmark also provides an incentive for outperformance, which should be pursued over the current regulatory period, 2018 to 2022.

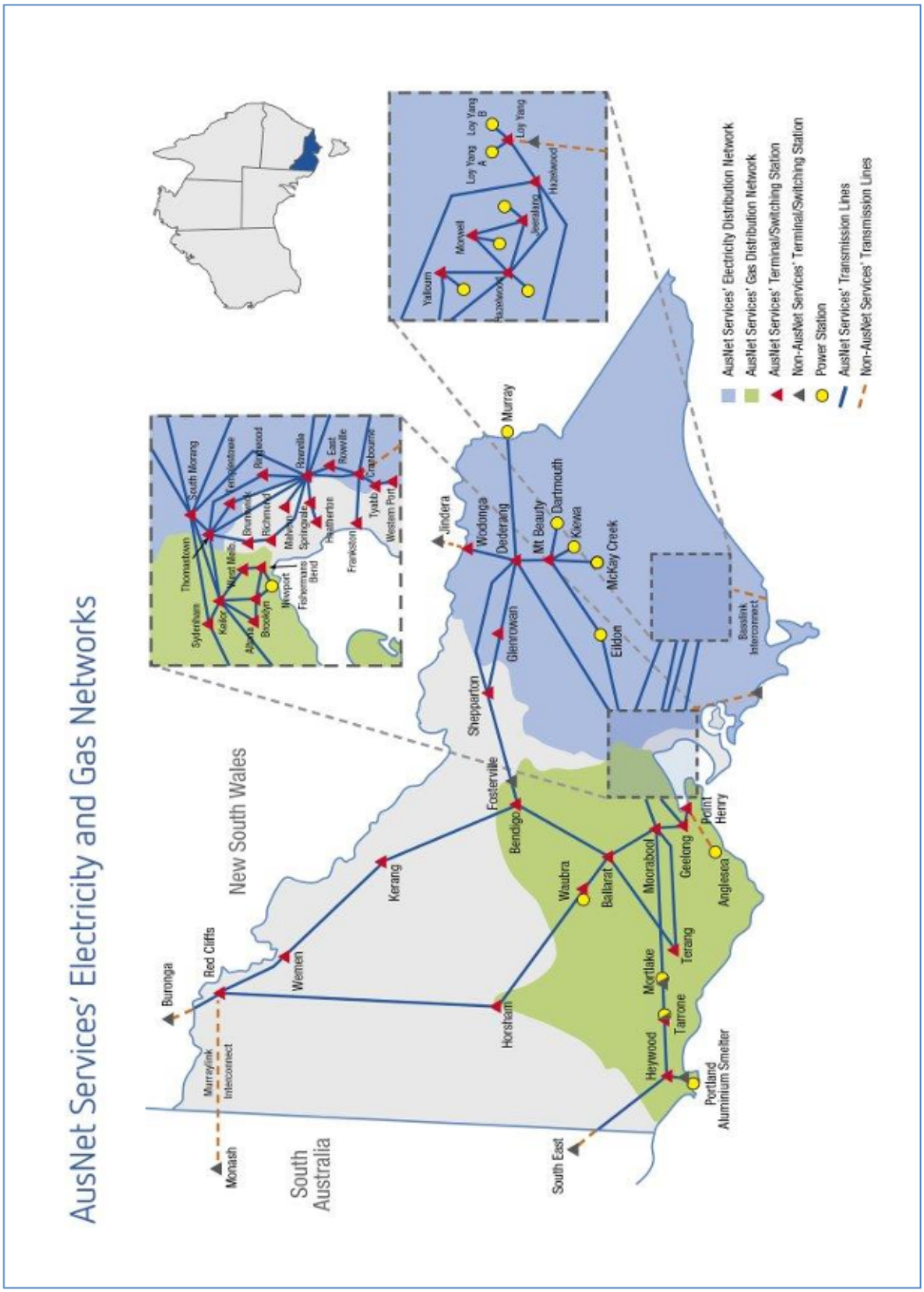
Section 12 of this document provides detailed recommendations on actions required to further improve AusNet Services UAFG performance against the regulatory benchmark in medium to long-term basis.

These actions and the management of UAFG will be done via an internal UAFG taskforce which will monitor performance across each of the AusNet Services gas distribution networks.

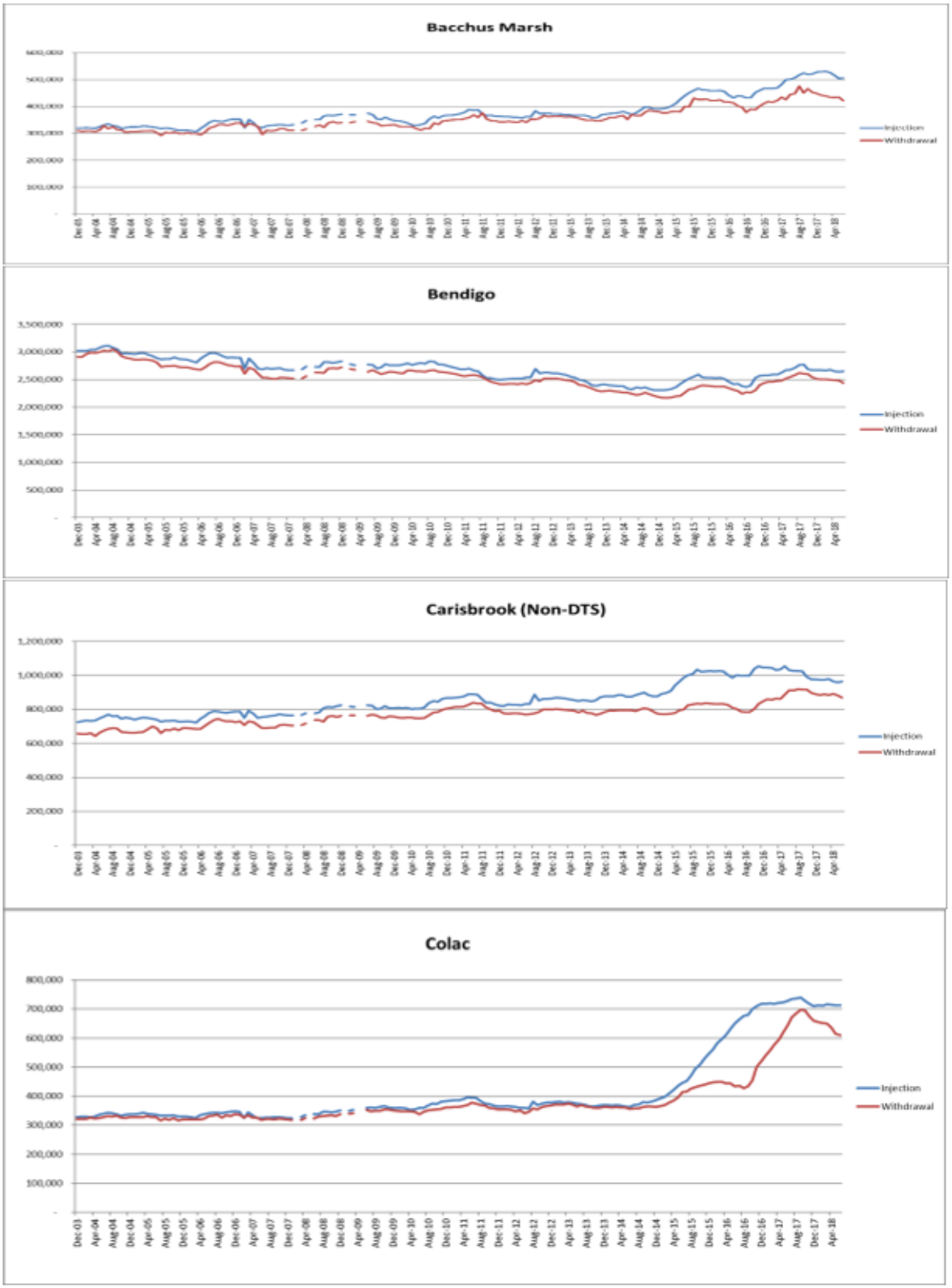
14 Abbreviations

Term	Meaning
AEMO	Australian Energy Market Operator
AMS	Asset Management Strategy
DTS	Declared Transmission System
ESC	Essential Services Commission
ESV	Energy Safe Victoria
FY	Financial Year
GDSC	Gas Distribution System Code
GJ	Gigajoules
HHV	Higher Heating Value
HP	High Pressure
I&C	Industrial and Commercial
LP	Low Pressure
MIRN	Meter Identification Number
MP	Medium Pressure
Non - DTS	Non Declared Transmission System
PE	Polyethylene
PCF	Pressure Correction Factor
PVC	Polyvinyl Chloride
SAP	Systems Application and Products
SCADA	Supervisory Control and Data Acquisition
TS	Technical Standards
TJ	Terajoules
UAFG	Un Accounted for Gas

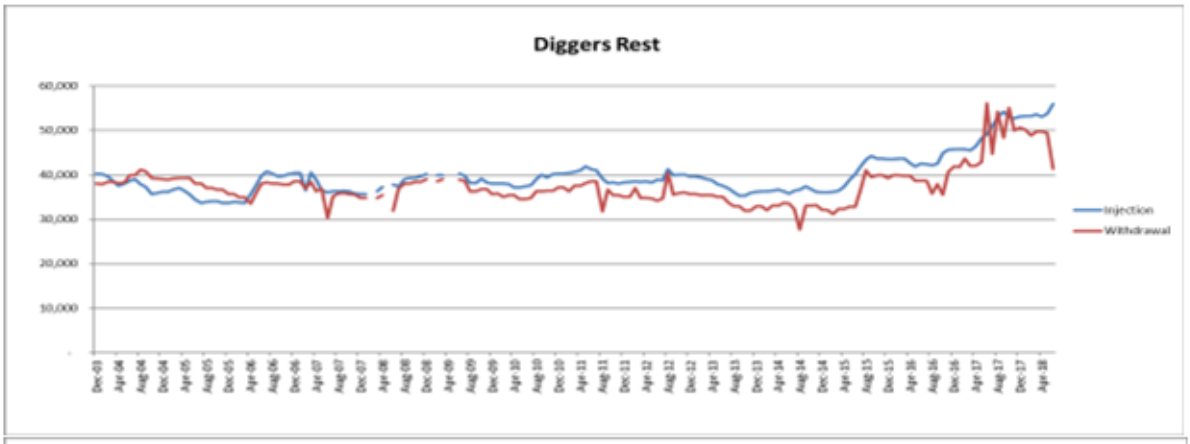
15 Annex A – AusNet Services Gas Distribution Network

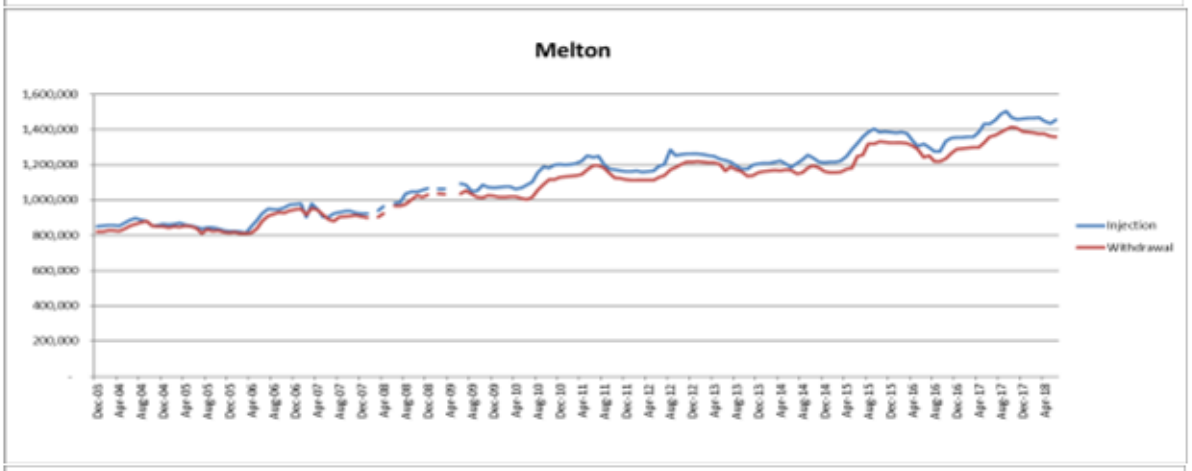


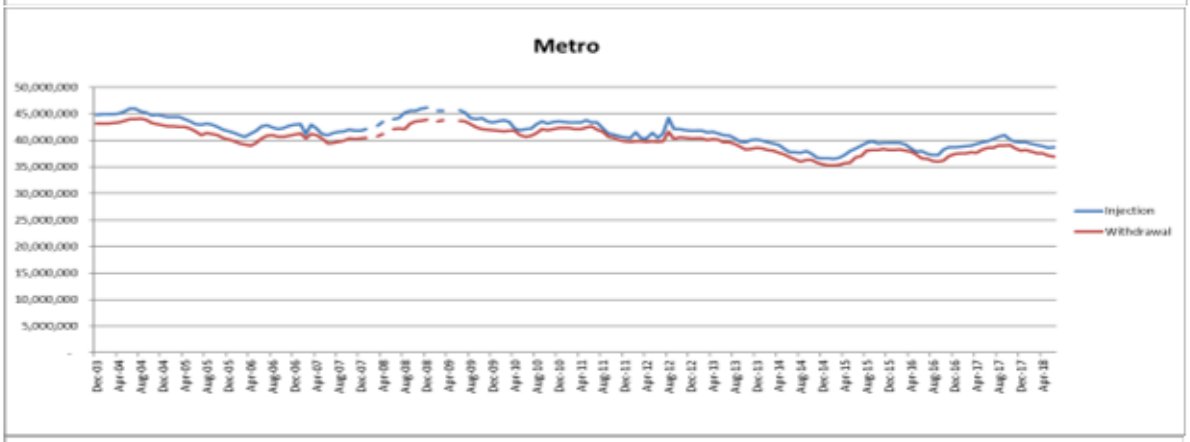
16 Annex B – Injection Vs Withdrawal Data for Key Regions

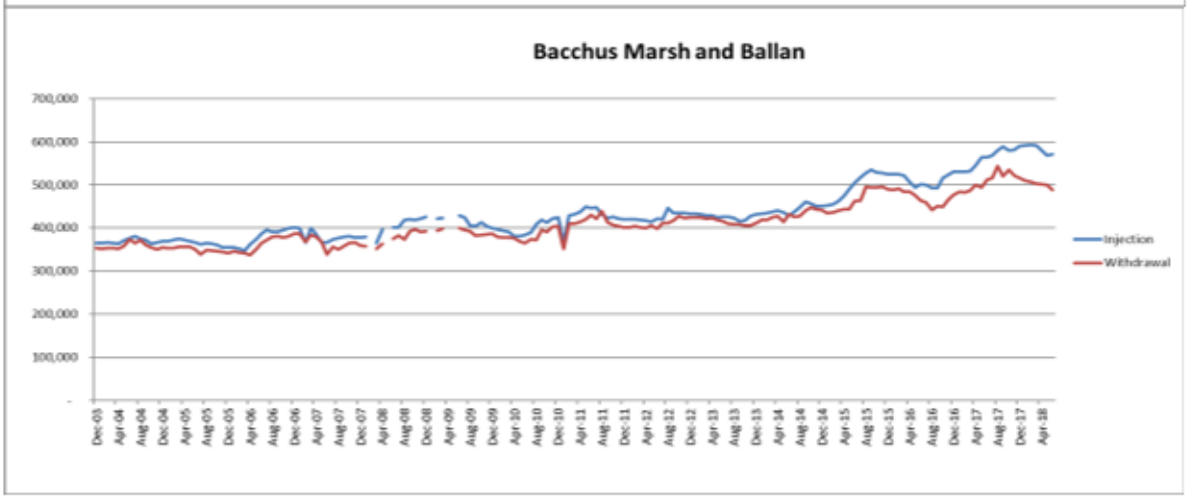


Un-Accounted for Gas (UAFG) Strategy









17 Annex C – Gas systems