Jemena Gas Networks (NSW) Ltd

2020-25 Access Arrangement Proposal

Attachment 6.11

Independent review of JGN's UAG calculation

Jemena
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Transmittal Letter
The Australian Energy Regulator
35/360 Elizabeth Street
Melbourne VIC 3000
21st June 2019

Dear Sir/Madam

Release of letter – KPMG report in connection with Jemena Gas Networks (JGN) Unallocated Gas (UAG) calculation.

In connection with our advisory services provided to JGN ("the Licensee"), we have been asked by the Licensee to provide you with a copy of our report dated 21st June 2019 and attached as Appendix 1 ("the Report").

We understand that the Licensee wishes to make the Report available to the AER, upon request, in order to provide explanations as to the basis for the Licensee's arrangements in relation to their calculation of UAG.

We agree to make the Report available to you for information purposes on the condition you acknowledge and agree that:

- by consenting to the Report being given to you, we do not assume any duty (in tort, or contract or otherwise) to advise you or to consider your circumstances or position;
- the Report is only provided for information purposes and you are not entitled to rely and will not rely on any information, comment, or observations in the Report;
- the Report is strictly confidential and will be treated as such by you;
- you release and forever discharge KPMG, its affiliated entities, and their partners, officers and employees from, and not assert against them, any action, liability, claim, suit, demand, claim for costs or expenses or any other proceedings arising out of, or in connection with, the release of the Report to you; and
- This letter shall be governed by and interpreted in accordance with the laws of the State of New South Wales, Australia and the courts of that State shall have exclusive jurisdiction in relation to any claim, dispute or difference concerning this letter and any matter arising from it.

Should you not agree with the above terms, please let us know.

Yours faithfully,

Luke Eason
Partner

Unaccounted for Gas (UAG) Report of Factual Findings

Final Report

Jemena Gas Networks (NSW) Ltd
21 June 2019

kpmg.com.au

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Inherent Limitations

This report has been prepared as outlined in the Scope Section. The services provided in connection with this engagement comprise an advisory engagement, which is not subject to assurance or other standards issued by the Australian Auditing and Assurance Standards Board and, consequently no opinions or conclusions intended to convey assurance have been expressed.

Due to the inherent limitations of any internal control structure, it is possible that fraud, error or non-compliance with laws and regulations may occur and not be detected. Further, the internal control structure, within which the control procedures that have been subject to the procedures we performed operate, has not been reviewed in its entirely and, therefore, no opinion or view is expressed as to its effectiveness of the greater internal control structure. The procedures performed were not designed to detect all weaknesses in control procedures as they are not performed continuously throughout the period and the tests performed on the control procedures are on sample basis. Any projection of the evaluation of control procedures to future periods is subject to the risk that the procedures may become inadequate because of changes in conditions, or that the degree of compliance with them may deteriorate.

No warranty of completeness, accuracy or reliability is given in relation to the statements and representations made by, and the information and documentation provided by, Toll stakeholders consulted as part of the process. KPMG have indicated within this report the sources of the information provided. We have not sought to independently verify those sources unless otherwise noted within the report.

KPMG is under no obligation in any circumstance to update this report, in either oral or written form, for events occurring after the report has been issued in final form.

The findings in this report have been formed on the above basis.

Third Party Reliance

This report is solely for the purpose set out in Section 4 – 'Scope'. Our consent to releasing KPMG-branded final report to the Australian Energy Regulator (AER) is conditional upon the report being accompanied by our transmittal letter. Additionally, with respect to the release of this report, and to the maximum extent permitted by law:

(a) KPMG is not responsible to you or any other party for any loss you or any other party may suffer in connection with the release of KPMG-branded final report to, or use of KPMG-branded final report by the AER;

(b) you agree to release and forever discharge KPMG, its affiliated entities, and their partners, officers and employees from, and not assert against them, any action, liability, claim, suit, demand, claims for costs or other expenses or any other proceedings arising out of, or in connection with, the release of KPMG-branded final report to the AER; and

(c) you indemnify KPMG and its affiliated entities, and their partners, officers and employees against any loss, action, liability, claim, suit, demand, claim for costs or expenses or any other proceeding they may suffer arising out of, or in connection with, the release of KPMG-branded final report to the AER.

This report is not to be distributed to any other party without KPMG's prior written consent.

This report has been prepared at the request of SGSP (Australia) Assets Pty Ltd (Jemena), as parent entity of Jemena Gas Networks (NSW) Ltd, in accordance with the terms of KPMG's engagement letter dated 20 May 2019. Other than our responsibility to Jemena, neither KPMG nor any member or employee of KPMG undertakes responsibility arising in any way from reliance placed by a third party on this report. Any reliance placed is that party's sole responsibility.

1. Introduction

1.1 Objectives

The purpose of the engagement was to assist Jemena in understanding the integrity of the Unaccounted for Gas (UAG) calculation produced by Jemena's systems and identify any differences in the calculation when compared to the Jemena supplied methodology.

1.2 Supplied UAG Methodology

By definition, UAG is the difference between the gas measured into a pipeline system and the gas measured out of the same system with appropriate allowance made for any change in quantity of gas within the system[1]. Multiple factors can contribute to UAG, including meter inaccuracy, network faults or leakage, fraudulent extraction of gas, inaccurate metering data, and network maintenance activities.

The basic equation for UAG for a distribution network is:

UAG Equals: Gas received into distribution network

Minus: Gas delivered by distribution network

Minus: Change in quantity of gas within the distribution network

Jemena have supplied KPMG with their interpretation of how UAG is calculated ('supplied methodology'). For the Jemena Gas Networks (JGN) gas distribution system, the supplied UAG methodology equation is expressed (in JGN terms[2]) as:

UAG = I/P – IM_B – BM_B – WBH - CLP	
UAG	Monthly quantity of un-accounted for gas (in Terajoules (TJ))
I/P	Monthly quantity of gas injected into the networks from Custody Transfer Meter (*Daily*) in TJ
IM_B	Monthly quantity of gas from Interval meters (*Daily data*) in TJ
BM_B	Monthly quantity of gas from Basic meters (*Billing period data, profiled across the billing period into daily quantities, using the daily residuals (DR)*) in TJ
WBH	Monthly quantity of gas used by water bath heaters (*Monthly data*) in TJ (and any other system use gas)
CLP	Change in line pack from start of month to end of month in TJ

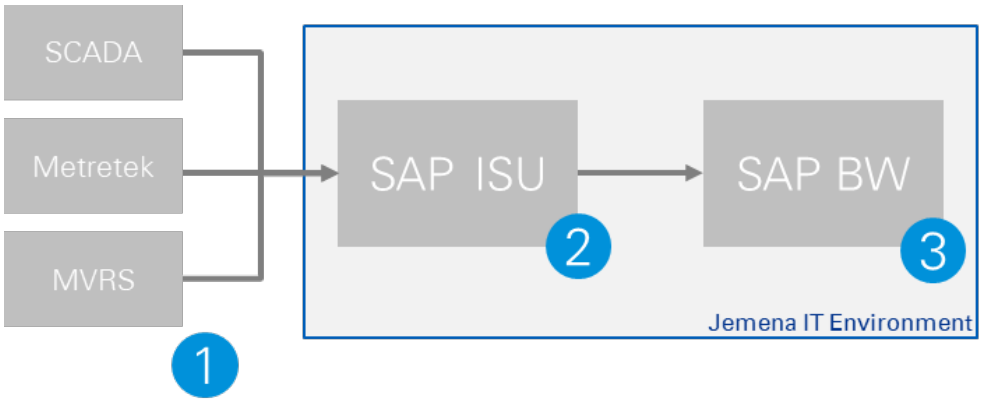
1.3 Overview of UAG Data Flow between Jemena Systems

UAG is calculated by Jemena per network cluster within SAP Business Warehouse (SAP BW) utilising historical billed gas consumption data up to 3 months before the month of report execution in addition to the available consumption data for the remaining 3 months. The billable consumption data is updated from SAP ISU into SAP BW data on a nightly basis from SAP ISU through a series of automated system processes.

The high level process flow of metering data is depicted on the following page:

[1] "Jemena Gas Networks – Review of JGN UAG" – Dr Howard Wright. 17 June 2019

[2] "Design Basis – Unaccounted for Gas" Measurement – Jemena. 31 March 2016.



1	Meter data, representing volume gas consumption, is captured within external systems SCADA, Metretek or MVRS as per the defined billing schedule of the individual meter. The format of the data may vary depending on the nature of the meter at the point of delivery – e.g. basic meter or interval meter. A data extraction process facilitates the transfer of this data into Jemena's SAP ISU environment on a periodic basis.
2	Within SAP ISU, the raw volume meter data is normalised into consumption by energy content utilising a series of business rules as defined by Jemena. This data represents billable gas consumption data.
3	On a nightly basis, a series of automated system processes transfers the delta of billable gas consumption data into SAP BW. The delta represents the change in consumption figures per meter from the previous nightly data transfer. Within SAP BW, the UAG calculation is performed, upon user request, by the execution of a series of custom reports and processes which have been designed in accordance with defined Jemena UAG methodology and associated business rules.

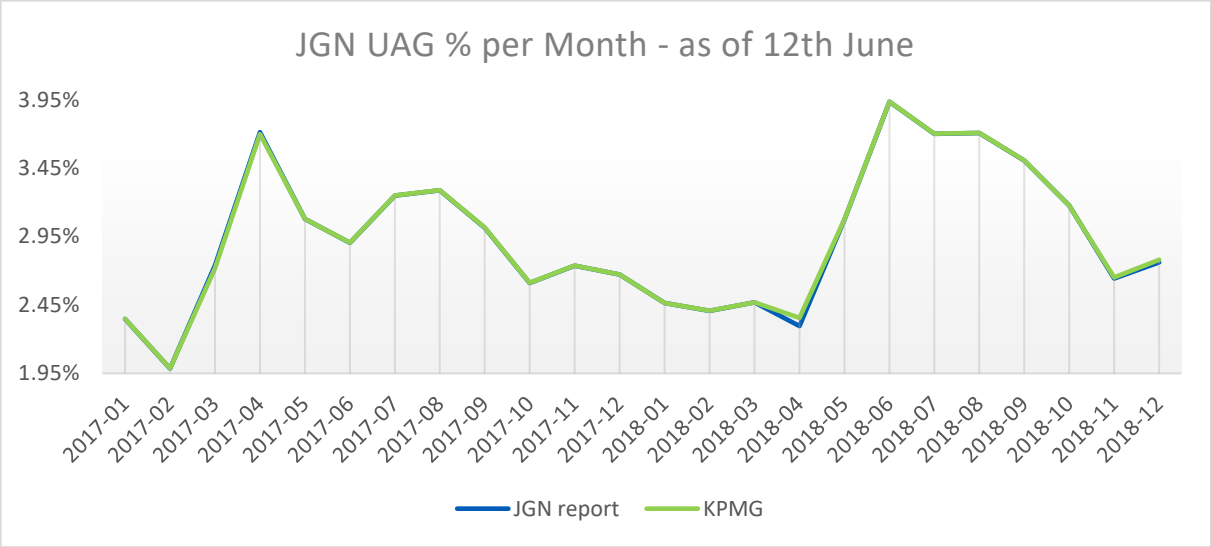
2. Summary of Findings

In undertaking our procedures, our calculations required us to obtain multiple extracts of metering data from SAP ISU covering the period of 1st January 2017 to 31st December 2018. Upon obtaining this data, which was extracted on 12th June 2019, three primary procedures were conducted:

1 A re-calculation of the month-by-month UAG percentage covering 1st January 2017 to 31st December 2018, and the rolling 12 month UAG percentage covering calendar year 2018, was performed within KPMG's data analytics environment. The output of this procedure was compared to the Jemena produced UAG percentages, grouped by month, as calculated within SAP BW.

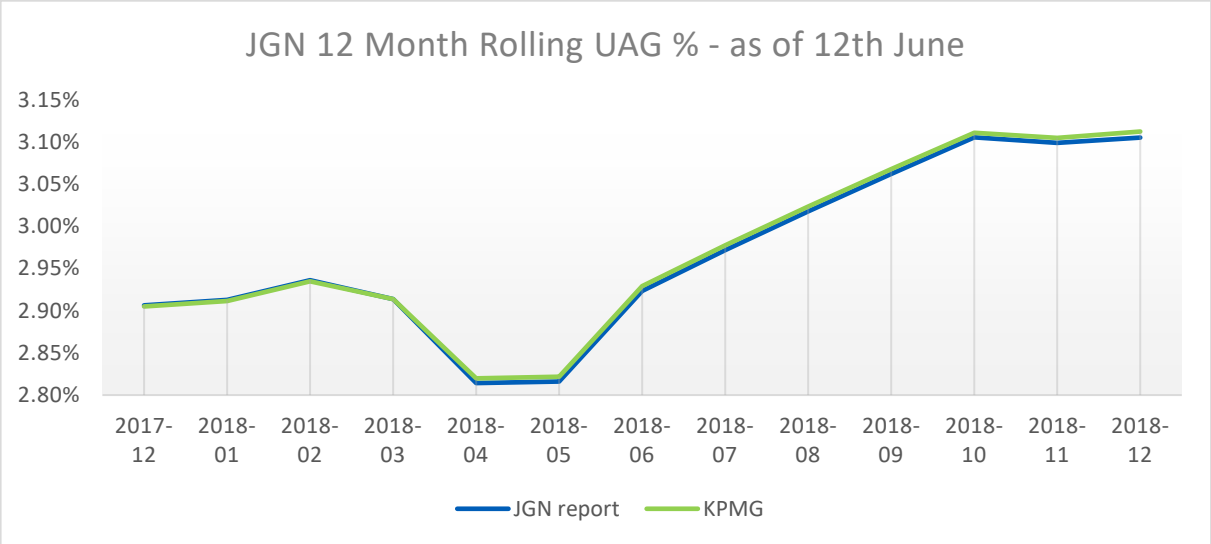
From our procedures, we noted that:

– For **UAG percentage by month**, the **KPMG calculation agreed to the Jemena SAP BW calculated UAG percentage figure** to within an average variance of 0.003%.



The difference may be attributed to a 24 hour timing delay between the data transfer interface of SAP ISU data into SAP BW.

– For **UAG percentage for a rolling 12 month period**, the **KPMG calculation agreed to the Jemena SAP BW calculated UAG figure** to within an average variance of 0.004%.



This difference may be attributed to a 24 hour timing delay between the data transfer interface of SAP ISU data into SAP BW.

2 Utilising post-normalised basic metering data extracted from SAP ISU, a re-performance of the 'profiling' of the volume data across billing periods, using the daily residuals, was conducted within KPMG's data analytics environment to re-calculate the daily quantity consumption in TJ. The output of this procedure was compared to the Jemena system calculated daily quantity consumption, grouped by month, within SAP BW.

From our procedures, we noted that between the 1st January 2017 to 31st December 2018 period, the **KPMG calculation of daily quantity consumption (grouped by month) agreed to the Jemena SAP BW calculated figures** to within an average monthly variance of 0.228 TJ. This represents 0.002% of total daily quantity consumption during the period.

This difference may be attributed to a 24 hour timing delay between the data transfer interface of SAP ISU data into SAP BW.

3 On a sample basis utilising raw metering data extracted from SAP ISU, a recalculation was conducted to normalise the data into standardised energy content in accordance with the supplied methodology. The output of this procedure was compared to the Jemena system calculated normalisation within SAP ISU.

From our procedures, we noted the following outcomes:

Meter Type	Outcome
Basic Meters	**KPMG's calculation of the normalisation of Basic Meter data agreed to the Jemena SAP ISU figures** to within 0.1%. This calculation includes the Volume Correction Factor (VCF) and energy quantity for each Basic Meter sample. The difference may be attributed to rounding effects.
Interval Meters	**KPMG's calculation of the normalisation of Interval Meter data agreed to the Jemena SAP ISU figures** to within 0.1%. This calculation included the energy quantity for each Interval Meter sample. The difference may be attributed to rounding effects.
Water Bath Heaters	**KPMG's calculation of the normalisation of Water Bath Heater data agreed to the Jemena SAP ISU figures** to within 0.23%. This calculation included the energy quantity for each Water Bath Heater sample. The difference may be attributed to rounding effects, including for calculation of gas compressibility.

3. Scope

Scope & Exclusions

The scope of the Engagement was defined as follows:

- Perform a walkthrough of system workflow relating to the calculation of UAG to understand how the process aligns to the methodology provided to KPMG by Jemena.
- On a sample basis, obtain an extract of metering data from SAP and recalculate the normalisation of the data into standardised energy content in accordance with the supplied methodology. Compare recalculation output to the system calculated normalisation within SAP. Identify any differences.
- Utilising data analytics, obtain an extract of basic metering data for a selected period from SAP and re-perform the 'profiling' into daily consumption. Compare the output to the system calculated profiling output within SAP BW. Identify any differences.
- Utilising data analytics, obtain an extract of relevant data for a selected period and recalculate the UAG output. Compare the output to the system calculated UAG figure from SAP. Identify any differences.

Please note that our scope excluded the following areas:

- Assessment of source metering data systems, outside of SAP
- Assessment or evaluation of the UAG calculation methodology provided by Jemena.
- Validations of explanations provided by management in relation to exceptions identified during our work.
- Performing any root cause analysis in the event that any deviations from expected results are identified.

Our role as external auditor of Jemena

We are conscious of the importance of KPMG's role as Jemena's external auditor and are committed to ensuring that the independence considerations and responsibilities of our audit role are not compromised through KPMG providing this scope of work to Jemena. We do not consider the proposed scope of work poses an independence risk and have in place strict rules and protocols to maintain our independence, as we do for all services provided to Jemena. These rules and protocols are communicated to the Audit and Compliance Committee on a regular basis.

In respect of this Engagement, we note that KPMG's role has been to provide a report of factual findings based on the results of our testing noting that our scope excludes performing any management functions or make any management decisions for Jemena or performing any form of advocacy role. For example KPMG will not promote Jemena's positions, opinions, views, or ideas to one or more third parties.

Jemena was responsible for determining the objectives, scope, and extent of KPMG's work for this engagement.

4. Detailed Procedures & Results

We performed the following detailed test procedures:

- **Test Procedure 1**: Calculation of UAG utilising SAP ISU data
- **Test Procedure 2**: Calculation of the 'profiling' of the basic meter reads to re-calculate the daily quantity consumption in TJ.
- **Test Procedure 3**: Re-calculation, via sampling, of the normalisation of raw metering data into standardised energy content.

Test Procedure 1: Calculation of UAG

A re-calculation of the month-by-month UAG percentage covering 1st January 2017 to 31st December 2018, and the rolling 12 month UAG percentage covering 2018, was performed utilising a full data extraction from SAP ISU representing each component of the supplied UAG methodology

Summary of Procedures Undertaken

The following procedures were performed to determine each component of the supplied UAG formula:

$$UAG = I/P - IM_B - BM_B - WBH - CLP$$

1) Gas injected into the network (I/P)

For each month from 1st Jan 2017 to 31st Dec 2018, the total network gas receipts by network sector were calculated by summating the relevant daily network receipts by network sector. The grand total network receipts by month were obtained as the sum of the total network receipts in all JGN network sectors for each month. The results were then converted from Megajoules (MJ) into TJ.

2) Interval Meters (IM_B)

For each month from 1st Jan 2017 to 31st Dec 2018, the total demand consumptions by network sector were determined by summing up the relevant daily demand consumptions for each network sector. The monthly grand total demand consumptions were calculated by adding up the monthly total demand consumptions of all JGN network sectors. One SGAS (Master Deduct Setup - Sub Meters) meter was excluded from the calculation to avoid double counting. The results were then converted from Gigajouls (GJ) into TJ.

3) Basic Meter Reads (BM_B)

The volume consumptions are defined as the consumptions which were measured by normal basic meters (i.e. not water bath heater meters), whose Point of Deliver ID does not start with '333'. The monthly amounts of volume consumptions were calculated via the profiling process. Meters labelled as MCHW (Centralised Hot Water Unit – Master), SGAS, MSEC (Gas Embedded Networks - Master Secondary), in addition to billing group JDCI (JGN Demand Interval Meter & Period Reads), were excluded from the calculation to avoid double counting consumption.

Please refer to Test Procedure 2 for details of the profiling process.

4) Water Bath Heaters (WBH)

According to the meter information master table, all water bath heater meters are basic meters, whose consumptions were calculated by following the same profiling process as for BM_B. The Point of Deliver ID of a water bath heater meters is starting with '333'. The reads of the water bath heater meters were extracted from the SAP ISU together with the normal basic meter reads.

Please refer to Test Procedure 2 for details of the profiling process.

5) Change in Line Pack (CLP)

Monthly change in line pack was calculated by the summation daily difference between the SCADA line pack value of the current day and the SCADA line pack value of the previous day over the whole month. The results were then converted into TJ.

With the results from the above steps, the UAG and UAG% re-calculation was performed via the following:

a) Total UAG by Month:

UAG (in TJ) amount was calculated with the formula below:

$$UAG_{month} = I/P_{month} - IM_{B\ month} - BM_{B\ month} - WBH_{month} - CLP_{month}$$

With the results from the above steps, the monthly UAG figures were calculated for each month staring from 1st January 2017 to 31st December 2018

b) UAG Percentage (UAG%) by Month

UAG% by month was calculated :

$$UAG\%_{month} = \frac{UAG_{month}}{I/P_{month}}$$

The UAG percentages by month were calculated for each month covering the 1st Jan 2017 to 31st Dec 2018 period.

c) Average UAG% for a Rolling 12-Month period

A 12-month rolling average UAG% has been defined as:

$$\text{Average UAG\% 12-Month-Rolling} = \frac{\text{Sum of the } UAG_{month} \text{ which fall into the 12-month window ends in the required month}}{\text{Sum of the } I/P_{month} \text{ which fall into the 12-month window ends in the required month}}$$

E.g.

$$\text{Average UAG\% 12-Month-Rolling}_{\text{Jan-2018}} = \frac{\text{Sum of monthly UAG from Feb 2017 to Jan 2018}}{\text{Sum of monthly I/P from Feb 2017 to Jan 2018}}$$

Summary of Results

As a result of the above procedures, KPMG calculated the (a) Total UAG by Month, (b) UAG Percentage by Month, and (c) Average UAG Percentage for a rolling 12 month period. These calculations utilised SAP ISU data for the period of 1st January 2017 to 31st December 2018.

The results of the calculation were compared against data supplied from Jemena within the UAG report, produced from SAP BW on 12th June 2019.

a) Total UAG by Month:

KPMG calculated the Total UAG by Month in TJ, from January 2017 to December 2018, for all JGN network clusters. This was compared to the supplied Jemena calculation, as taken from the UAG report dated 12th June 2019.

The difference between the KPMG and Jemena calculated UAG figures was 5.4859 TJ, with an average monthly variance of 0.02286 TJ, as shown below:

	Total UAG by Month in TJ		
	KPMG	JGN	Difference
Jan-17	137.7717	137.7399	-0.0318
Feb-17	107.9599	107.9023	-0.0575
Mar-17	159.6621	160.8678	1.2057
Apr-17	218.1445	219.0133	0.8688
May-17	249.2293	249.1683	-0.0610
Jun-17	271.8582	271.7217	-0.1365
Jul-17	317.6040	317.4801	-0.1239
Aug-17	313.6661	313.5455	-0.1205
Sep-17	238.7321	238.5303	-0.2017
Oct-17	181.2155	181.1540	-0.0616
Nov-17	186.5035	186.4133	-0.0902
Dec-17	168.5019	168.4994	-0.0024
Jan-18	151.0616	151.0375	-0.0241
Feb-18	141.9382	141.8801	-0.0581
Mar-18	166.9497	166.9381	-0.0116
Apr-18	163.0668	158.9182	-4.1486
May-18	273.1566	272.8784	-0.2782
Jun-18	374.2871	374.1725	-0.1145
Jul-18	362.1295	362.0249	-0.1046
Aug-18	363.9904	363.8405	-0.1499
Sep-18	293.1547	293.0372	-0.1175
Oct-18	246.1345	246.2028	0.0682
Nov-18	178.8333	178.2752	-0.5581
Dec-18	174.3067	173.1305	-1.1762
Totals:	**5439.8577**	**5434.3718**	**-5.4859**

b) UAG Percentage (UAG%) by Month

KPMG calculated the total UAG % by Month across the two year period for all JGN network clusters. This was compared to the supplied Jemena calculation, as taken from the UAG report dated 12th June 2019.

The KPMG calculated figures was, on average, 0.00299% lower than the Jemena calculated figure, as shown below:

	UAG % per Month		
	KPMG	Jemena	Difference
Jan-17	2.34818%	2.34764%	-0.00054%
Feb-17	1.98649%	1.98544%	-0.00106%
Mar-17	2.71847%	2.73900%	0.02053%
Apr-17	3.69767%	3.71239%	0.01473%
May-17	3.07869%	3.07794%	-0.00075%
Jun-17	2.90544%	2.90398%	-0.00146%
Jul-17	3.25012%	3.24885%	-0.00127%
Aug-17	3.28864%	3.28737%	-0.00126%
Sep-17	3.01632%	3.01377%	-0.00255%
Oct-17	2.61153%	2.61064%	-0.00089%
Nov-17	2.73782%	2.73650%	-0.00132%

Dec-17	2.67214%	2.67210%	-0.00004%
Jan-18	2.46419%	2.46379%	-0.00039%
Feb-18	2.40800%	2.40702%	-0.00099%
Mar-18	2.46907%	2.46890%	-0.00017%
Apr-18	2.35530%	2.29538%	-0.05992%
May-18	3.07606%	3.07293%	-0.00313%
Jun-18	3.93582%	3.93462%	-0.00120%
Jul-18	3.70109%	3.70002%	-0.00107%
Aug-18	3.70741%	3.70589%	-0.00153%
Sep-18	3.50594%	3.50453%	-0.00140%
Oct-18	3.17537%	3.17625%	0.00088%
Nov-18	2.65130%	2.64302%	-0.00827%
Dec-18	2.78033%	2.76157%	-0.01876%
		Average:	**-0.00299%**

c) Average UAG% for a Rolling 12-Month period

KPMG calculated the Average UAG % for a Rolling 12-month period, from December 2017 to December 2018, for all JGN network clusters. This was compared to the supplied Jemena calculation, as taken from the UAG report dated 12th June 2019.

The KPMG calculated figures was, on average, 0.00374% lower than the Jemena calculated figure, as shown below:

	Rolling UAG% over 12 Months		
	KPMG	**Jemena**	**Difference**
Dec-17	2.90501%	2.90637%	0.00135%
Jan-18	2.91143%	2.91278%	0.00136%
Feb-18	2.93469%	2.93604%	0.00135%
Mar-18	2.91368%	2.91365%	-0.00003%
Apr-18	2.81980%	2.81422%	-0.00557%
May-18	2.82177%	2.81601%	-0.00576%
Jun-18	2.92914%	2.92341%	-0.00573%
Jul-18	2.97746%	2.97175%	-0.00571%
Aug-18	3.02326%	3.01754%	-0.00572%
Sep-18	3.06767%	3.06207%	-0.00560%
Oct-18	3.11071%	3.10530%	-0.00541%
Nov-18	3.10469%	3.09877%	-0.00592%
Dec-18	3.11217%	3.10498%	-0.00719%
		Average	**-0.00374%**

Test Procedure 2: Profiling of Basic Meter Consumption

Utilising post-normalised basic metering data extracted from SAP ISU, a re-performance of the 'profiling' of the basic meter reads across billing periods, using the daily residuals, was conducted to re-calculate the daily quantity consumption in TJ. The output of this procedure was compared to the system calculated daily quantity consumption, grouped by month, within SAP BW.

Summary of Procedures Undertaken

To re-perform the profiling process of the basic meters, all post-normalised basic metering data relevant to the period starting from 1st January 2017 to 31st December 2018 were extracted from SAP ISU.

Each record stands for one read of one meter towards a specific billing group, associated with the unique Point of Delivery ID of that meter (i.e. Meter Installation Registration Number (MIRN)) and the meter network sector information (i.e. DS code). Each billing group has a corresponding billing period. Meters labelled as MCHW (Centralised Hot Water Unit – Master), SGAS (Master Deduct Setup - Sub Meters) and MSEC (Gas Embedded Networks - Master Secondary), in addition to billing group JDCI (JGN Demand Interval Meter & Period Reads) were excluded from the calculation to avoid double counting consumption.

1) Calculate the subtotal consumption by network sector and billing group

Metering records were aggregated by the Point of Delivery ID and the billing group to obtain the consumption over the corresponding billing period for each delivery point. For each network sector, the subtotal consumptions by billing group were then calculated by summating the consumption of each delivery point within that network sector by its billing group.

2) Calculate daily consumption rate for each billing group in different network sectors

To quantify the daily consumption, the daily consumption rate of each billing group in different network sectors was calculated by the following formula:

$$\textit{Daily Consumption Rate}_{\textit{Day}} = \frac{\textit{Daily Residual}_{\textit{Day}}}{\textit{Sum of Daily Residuals for the corresponding billing period}}$$

3) Quantify subtotal daily consumption by network sector and billing group

According to the network sector and the billing group, the daily consumptions by network sector and billing group were obtained by multiplying the subtotal consumptions obtained from Step 1 and the daily consumption rates calculated in Step 2.

4) Calculate total daily consumption by network sector

The total daily consumption was calculated by taking summation all relevant subtotal daily consumptions over the month based on its billing group.

Summation the daily consumptions by network sector over each month between 1st January 2017 and 31st December 2018 determined the monthly gas consumption within the different network sectors and the calculated amounts were summed up to obtain the monthly grand total consumptions for all JGN network sectors.

Summary of Results

As a result of the above procedures, KPMG calculated the total daily consumption for (a) Basic Meter Reads and (b) Water Bath Heaters for all JGN network clusters utilising SAP ISU data for the period of 1st January 2017 to 31st December 2018.

The result of the calculations were compared against data supplied from Jemena within the UAG report, produced from SAP BW on 12th June 2019.

a) Basic Meter Reads (BM_B)

KPMG calculated the total BM_B consumption across the two year period for all JGN network clusters as 78667.6608 TJ's.

The supplied Jemena calculation, as taken from the UAG report dated 12th June 2019, was 78673.1509 TJ's.

The difference between the two total calculated consumption figures was 5.49 TJ, representing 0.0069% of total JGN BM_B consumption across the two year period. The average monthly variance was 0.228 TJ.

b) Water Bath Heaters (WBH)

KPMG calculated the total WBH consumption across the two year period for all JGN network clusters as 29.47287 TJ's.

The supplied Jemena calculation, as taken from the UAG report dated 12th June 2019, was 29.27320 TJ's.

The difference between the two total calculated WBH consumption figures was 0.00014 TJ. The average monthly variance was 0.00001 TJ.

Detailed results per month are shown below:

	Volume [Basic Meter Reads] in TJ			Water Bath Heaters (in TJ)		
	KPMG	**Jemena**	**Difference**	**KPMG**	**Jemena**	**Difference**
Jan-17	1886.8426	1886.8566	0.0141	0.61545	0.61547	0.00002
Feb-17	1866.0812	1866.1507	0.0695	0.60204	0.60202	-0.00002
Mar-17	2361.8026	2360.6033	-1.1993	0.73969	0.73968	0.00000
Apr-17	2708.9277	2708.0625	-0.8652	1.00505	1.00507	0.00002
May-17	3788.6493	3788.7137	0.0644	1.45542	1.45544	0.00003
Jun-17	4796.5464	4796.6816	0.1352	1.78231	1.78232	0.00000
Jul-17	5200.6841	5200.8024	0.1184	1.95774	1.95777	0.00003
Aug-17	4877.4068	4877.5421	0.1353	2.04367	2.04363	-0.00004
Sep-17	3615.3622	3615.5721	0.2099	1.61028	1.61031	0.00003
Oct-17	2784.0019	2784.0598	0.0578	0.98467	0.98472	0.00005
Nov-17	2547.8390	2547.9380	0.0991	0.86757	0.86755	-0.00002
Dec-17	2148.8427	2148.8514	0.0087	0.67949	0.67950	0.00001
Jan-18	2060.7547	2060.7766	0.0219	0.59835	0.59834	-0.00002
Feb-18	2026.3479	2026.4022	0.0543	0.62992	0.62997	0.00005
Mar-18	2361.3813	2361.3782	-0.0032	0.78586	0.78578	-0.00008
Apr-18	2419.8784	2424.0296	4.1511	0.80499	0.80503	0.00004
May-18	3942.7247	3943.0031	0.2783	1.54822	1.54821	-0.00002
Jun-18	5063.3240	5063.4315	0.1075	`1.87030	1.87031	0.00001
Jul-18	5213.0238	5213.1211	0.0974	2.09919	2.09923	0.00004
Aug-18	5014.7672	5014.9218	0.1545	2.07295	2.07294	-0.00001
Sep-18	3908.1421	3908.2601	0.1181	1.50152	1.50153	0.00001
Oct-18	3247.2970	3247.2380	-0.0590	1.15812	1.15813	0.00001
Nov-18	2589.6768	2590.2303	0.5535	0.93867	0.93873	0.00005
Dec-18	2237.3564	2238.5243	1.1679	1.12140	1.12133	-0.00006
Total:	**78667.6608**	**78673.1509**	**5.4901**	**29.47287**	**29.47302**	**0.00014**

Test Procedure 3: Normalisation of Meter Data into Standardised Energy Content

On a sample basis utilising raw metering data extracted from SAP ISU, a recalculation was conducted to normalise the data into standardised energy content in accordance with the supplied methodology. The output of this procedure was compared to the system calculated normalisation within SAP ISU.

Summary of Procedures Undertaken

To re-calculate, on a sample basis, the normalisation of raw metering data into standardised energy content, a selection of data was obtained from SAP ISU ranging from 1st January 2017 to 31st December 2018. This data represented raw metering data as obtained from source systems SCADA, Metretek and MVRS. The following procedures were undertaken by meter category:

a) Basic Meter Reads (BM_B)

A sample of twelve Basic Meters was selected. For each of these, the raw data on initial and final meter reading, daily temperature, temperature area, pressure (gauge and atmospheric), pressure area, Heating Value (HV) zone and daily HV; was obtained.

Jemena's calculation of Volume Correction Factor (VCF), outlined within the Jemena supplied artefact titled "Billing factors for gas v2", was reviewed and found to be consistent with our understanding of thermodynamic rules for normalisation of gas volume to standard conditions of temperature and pressure.

The VCF was then re-calculated from the atmospheric pressure, gauge pressure and temperature (which was taken as the average value across the measurement period) reading for each sample. A check was carried out to ensure that the correct temperature/pressure area, and HV area had been chosen for each sample. The gas compressibility factor was equal to 1 for each of these samples. This was consistent with the Jemena document.

Once the VCF had been re-calculated, gas consumption was then calculated by multiplying gas volume by the VCF and the average HV across the measurement period.

b) Water Bath Heaters (WBH)

Three Water Bath Heater (WBH) samples were selected. As each WBH has a Basic Gas Meter, the test procedure was the same as that used for the Basic Meter samples (above) with the exception that a different calculation was used for compressibility, due to the higher gas pressures at these meters. This procedure was outlined in the Jemena supplied artefact titled "Billing factors for gas v2" and was consistent with KPMG's understanding of gas calculations.

One meter in the sample of Basic Meters was a 'Water Meter', representing the volume of hot water consumed in which the source gas energy value can be calculated. KPMG checked that the application of factors to this reading was consistent with Jemena business rules. As this was a very small sub-set of the meter data, no further re-calculation was carried out.

c) Interval Meters (IM_B)

A sample of ten (10) Interval Meters were selected. For each of these, the raw data on initial and final meter reading, VCF, Heating Value (HV) zone and daily HV, was obtained. Volume was reported as either or both of a Standard End Index (normalised to standard temperature and pressure) or Actual End Index (actual temperature and pressure).

For each sample, the gas volume was initially calculated by subtracting the previous day's Standard (or Actual) End Index, for the corresponding figure for the measurement day. This volume was them multiplied by the relevant daily HV value to obtain energy quantity.

In three of the samples, the Interval Meter recorded the Actual End Index which is the un-normalised gas volume. In these instances, the Standard End Index was calculated by multiplying the volume reading by the VCF. The tests carried out on the Basic Meter samples were relied upon for accuracy of VCF calculation.

Summary of Results

As a result of the above procedures, KPMG calculated on a sample basis normalisation of meter data into standardised energy content. These calculations utilised non-normalised SAP ISU data obtained from the period of 1st January 2017 to 31st December 2018, and the output was compared to post-normalised data obtained from SAP ISU.

a) Basic Meter Reads (BM_B)

KPMG's calculation of VCF and energy quantity for each Basic Meter sample, agreed to the supplied Jemena figures to within 0.1%.

The difference is likely to be due to rounding effects.

b) Water Bath Heaters (WBH)

KPMG's calculation of VCF and energy quantity for each Water Bath Heater sample, agreed to the Jemena figures to within 0.23%.

The difference is likely to be due to rounding effects, including for calculation of gas compressibility.

c) Interval Meters (IM_B)

KPMG's calculation of energy quantity for each Interval Meter sample, agreed to the Jemena figures to within 0.1%.

The difference is likely to be due to rounding effects.

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