Jemena Gas Networks (NSW) Ltd

2020-25 Access Arrangement Proposal

Attachment 6.7

Unaccounted for gas

Jemena
bringing energy to life

TABLE OF CONTENTS

Abbreviations

AA	Access Arrangement
CTM	Custody Transfer Meter
CTS	Custody Transfer Station
Frontier	Frontier Economics
HWGM	Howard Wright Gas Measurement Pty Ltd
JGN	Jemena Gas Networks (NSW) Ltd
I&C	Industrial & Commercial
MSP	Moomba-Sydney Pipeline
Opex	Operating expenditure
SUG	System Use Gas
TVN	Tariff Variation Notice
UAG	Unaccounted for Gas
WACC	Weighted Average Cost of Capital

Overview

Unaccounted for gas (**UAG**) refers to gas supplied into the gas network that is unaccounted for in deliveries from the network. It is calculated as the difference between the measured quantity of gas entering the network system (receipts) and metered gas deliveries (withdrawals). UAG is generally expressed as a percentage of receipts into the network. This allows UAG levels to be viewed in terms of efficiency and appropriately benchmarked between networks.

The underlying causes for UAG arise from gas measurement and calculation errors and physical losses. However, an important consideration when seeking to understand and manage UAG is the significant uncertainty around the estimates of the factors contributing to UAG. This significant uncertainty is accepted in the gas industry. UAG may be positive or negative where driven by measurement and calculation errors.

This document provides a summary of Jemena Gas Networks (NSW) Ltd's (**JGN's**) UAG performance and provides an overview of how we report and manage UAG across the network. It also sets out our UAG proposal for the 2020-25 period.

- Section 1 provides an overview of the UAG framework.
- Section 2 explains the sources of UAG and the uncertainty in the UAG calculation.
- Section 3 summarises JGN's historical UAG performance, and outlines how JGN manages UAG. It includes results from an independent review of our UAG management by Howard Wright Gas Measurement Pty Ltd (**HWGM**), and provides a comparison of how our UAG rates compare to other gas networks. It also includes a summary of the findings by KPMG, which undertook a review of JGN's UAG calculation within its enterprise reporting system, SAP.
- Section 4 sets out our proposed UAG target rates for the 2020-25 period. We commissioned Frontier Economics (**Frontier**) to recalculate the UAG target rates for the 2020-25 period using a similar methodology to that which it applied when setting targets for the current regulatory period. Based on its analysis, our proposed total UAG rate for the 2020-25 period is 2.866%. The updated estimates of the UAG coefficients are:
  - for forecasting UAG costs:
    - 0.705% of forecast withdrawals for the demand market
    - 5.925% of forecast withdrawals for the volume market
  - for annual true-ups:
    - 0.665% of withdrawals for the demand market
    - 5.593% of the balance of total market receipts for non-daily metered market (comprising volume market withdrawals and UAG).

1. UAG framework

As part of our contractual arrangements with network users—under the Reference Service Agreement—we procure gas to replenish any gas unaccounted for whilst in JGN's custody.[1] The total cost of UAG is a product of the volume of UAG and the replacement cost of gas purchased by JGN to replace UAG. This gas is acquired by JGN through a competitive market tender process.

JGN's 2015-20 Access Arrangement (**AA**) includes, as for a majority of operating expenditure (**opex**), an incentive to minimise the rate of UAG. JGN is provided a fixed allowance for a quantity of UAG based on target percentage rates of network receipts.

In the current period, separate UAG targets are applied to the demand (daily metered) and volume market as follows:

- For forecasting UAG costs in our 2015-20 AA opex allowance:
  - 0.450% of forecast withdrawals for demand market
  - 5.44% of forecast withdrawals for the volume market
- For annual true-ups
  - 0.427% of withdrawals for the demand market
  - 5.16% of the balance of total market receipts for non-daily metered market

If the actual UAG rate is below (above) the target rate, JGN over (under) recovers its actual UAG costs.

Gas receipts and the replacement cost of gas are outside JGN's control. As a result the current AA includes an automatic adjustment to account for these factors. The current AA stipulates a two year lag for the automatic adjustment of the recoverable amount.[2] The UAG incentive is specified in section 2 of schedule 3 to the 2015-20 AA.

[1] See clauses 9.4, 9.5(d) and 9.5(e) of the Reference Service Agreement.

[2] A time value of money (WACC) adjustment is applied to account for this lag.

2. Sources of UAG and the uncertainty of its calculation

2.1 Sources of UAG

The efficiency of JGN's UAG is best understood by considering what contributes to UAG. The causes for UAG can be grouped into gas measurement and calculation errors and physical losses:

- Measurement and calculation errors:
  - metering uncertainty in receipt meters
  - metering uncertainty in delivery meters - both high and low capacity meters
  - degradation of meter accuracy
  - measurement uncertainty, due to heating value allocation
  - measurement uncertainty, in the calculation of the fixed factor(s) used for billing, including errors incurred due to atmospheric pressure and temperature changes
  - measurement period errors
  - billing estimation
- Physical losses:
  - leakage, due to:
    - integrity of materials
    - network damage
  - theft
  - unmeasured gas used for operational purposes.

Further explanation of each error or loss is provided below.

2.1.1 Measurement error

Receipt meter uncertainty

- Receipt meters or Custody Transfer Meters (**CTM**) are installed at sites where JGN accepts gas into the network. The size and complexity of these meters varies subject to the volume of gas being receipted into the network (or network section). Typically, these meters operate in the range of +/- 0.5% (volumetric error) and are subject to validation checks on an annual basis.

Delivery meter uncertainty

- Low capacity meters – These are the meters that supply our volume market customers, which include residential, commercial and small industrial customers. These meters typically have an accuracy range of +/-1.5% to +/-2% (volumetric error).
- High capacity meters – These meters are used at large (demand market) customers. As these meters record larger volumes of gas, meters of a higher specifications are utilised providing more accuracy than the low capacity meters. Subject to their size and type, these meters generally operate in the range of +/- 0.5% to +/- 1% (volumetric error).

Degradation of meter accuracy

- The typical life of a customer meter ranges from 5 to 25 years. High capacity meter, such as turbine and rotary meters are used for large demand market customers, and are typically replaced after five (turbine meters) to 10 (rotary meters) years. While they generally remain within the accuracy requirements set by technical regulations, aging does cause meter degradation. These meters tend to read 'slow' as they age. Diaphragm meters are used for volume market customers and are replaced after 15 to 25 years. As they degrade they may either read 'fast' or 'slow', although they have an inherent bias to read slow.

Measurement uncertainty (metrology errors)

- Heating value allocation uncertainty. The heating value is one of the key factors (alongside pressure and temperature) used to convert volumetric quantities into energy quantities[3].
  - Receipt measurement. The heating values allocated to the volume of gas entering the network has a level of uncertainty due to:
    - Inherent accuracy of the heating value equipment. At larger receipt points heating value equipment is installed. This equipment has some inherent error due to its mode of operation and computational processes. Though the level of error is very small, a large volume of gas passes through these sites, creating measurement uncertainty.
    - At smaller receipt metering sites, the heating value is inferred from nearby sites where equipment exists. The calculation of the 'inferred' heating value does lead to another layer of uncertainty – although this is generally of a negligible level.
  - Delivery measurement. To account for the different sources of gas that have differing heating values, the network is broken up into a series of major network sections, representing 'heating value zones'. The application of a single heating value to delivery meters on major network sections is a practical approach to characterising the heating value of delivered gas, but it has inherent impact on the accuracy of measurement of gas deliveries, as these zones are often interconnected and subject to the network characteristics, gas can pass from one section to another section.
- High capacity meters – high capacity meters incorporate temperature and pressure measurement equipment. The combination of the errors in each of the contributing measurements allows a high capacity meter to be accurate to within +/- 1.5% of the true quantity being measured.
- Low capacity meters – to convert the volume measured to an energy quantity for low capacity meters, a fixed factor is used to adjust for temperature and pressure (both the pressure delivered to the customer gas system and the effect of barometric pressure).
  - The element of the fixed factor relating to the delivery pressure is based upon the pressure set by the regulator device on the meter.
  - The element of the fixed factor relating to temperature and barometric pressure is based on published long-term averages from the Bureau of Meteorology.

  While these corrections are essential for maximising the accuracy of gas measurement, they are imperfect representations of the conditions at each customer's meter, because actual monthly temperatures will vary from the historical average and the temperatures at a single location will be an imperfect proxy for the actual temperatures of gas passing through a customer's meter. The same is true of barometric pressure. As a result there is an inherent additional uncertainty in the measurement of gas being delivered from the network.

[3] Gas is measured on a volumetric basis (that is, m^3) but is converted to energy (that is, GJ) for billing purposes.

Measurement period errors

- Meters in the network are read at different intervals. For example large network customers are read daily, whereas small domestic customers are read on a three monthly cycle. In order to calculate UAG these periods need to be aligned and, in the case of the domestic customers, the readings need to be interpolated into smaller periods (ie months). This process includes a degree of estimation which introduces errors into the calculation.

Billing estimation

- Where meters are unable to be read, or are known to be faulty, the flow through the meter may be estimated and the bill created accordingly. Any estimation of gas consumption introduces errors into the UAG calculation.
- The failure of meters can lead to them not registering, "non-registering meters". A significant proportion of non-registering meters are identified and replaced after one or more billing cycles, although some may not be identified for some time.[4] Where a non-registering meter is identified an estimate is applied to the gas consumption.

Unread consumption

- In a small number of instances meters may be installed but not correctly recorded and hence not be part of the reading/billing cycle.

2.1.2 Physical losses

Leakage[5]

- Integrity of materials. Leakage from distribution networks can be the result of:
  - Deterioration of materials over time – mains and services. Older areas of the network (some are over 100 years old), where the materials used were cast iron, unprotected steel or early generation plastics have higher levels of leakage due to the deterioration of the materials through corrosion or other means by which the materials break down over time.
  - Deterioration of materials – meters. Similarly, the fittings used on meter sets also deteriorate and leads to leaks from the unions and other fittings. Meter set leaks (from either deterioration of venting regulators – see below – are the highest proportion of leaks reported by the public.
  - Changes in operating conditions. The change to ground conditions, due to drought, road movements, etc can lead to stress being applied to the materials used in the gas network, leading to areas of leakage.
- Network damage. While JGN's systems are designed to limit third party damage through participation in the 'Dial before you dig' service and patrols of its high pressure networks, third party impact is not an uncommon occurrence and contributes to UAG.
- Leakage from the high pressure pipelines is considered to be zero for practical purposes with the exception of some gas escape during maintenance. Small amounts of leakage may occur from above ground flanges and fittings, however, these are easily detected and rectified.

Theft

- Theft is considered to be uncommon, due to the inherent hazards of unskilled work with gas. This element is particularly hard to both detect and estimate. Theft is typically the bypassing or partial bypassing of a gas meter.

[4] For example, some customers only use gas for heating, so it is not unusual to have no consumption for these meters. This means that it may take longer to identify a non-registering meter.

[5] Many of the items of leakage identified here are very small volumes and are generally not considered a safety risk. The use of odorant provides for most leaks to be detected well before a safety issue arises.

Operational usage

- Meter regulator venting. Meter regulators incorporated in both network pressure control equipment and customer pressure control equipment can vent during some operational circumstances (such as pressure surges or temperature effects). The gas released from such venting is generally only small in quantity and is unmeasured.
- Operational usage, such as venting. A small amount of gas is lost from the systems during maintenance and operational activities.

System Use Gas (**SUG**) is used for operational purposes for water bath heaters. This is measured separately and is excluded from UAG.

2.2 Uncertainty of UAG calculation

An important consideration when seeking to understand and manage UAG is the significant uncertainty inherent in the calculation of UAG (as identified above). This is accepted in the gas industry.

With respect to the measurement related causes, these uncertainties are unavoidable because of limitations associated with any measurement process. Even the most accurate metering systems cannot provide an accuracy of much better than +/- 1%. Typically the cost of improving the accuracy of any of these elements is far greater than any benefit. Industry practice has determined the efficient levels of accuracy for each of these elements over many years of gas industry operation.

Similarly, estimating gas losses from the network from leakage, operational use and theft involves from high levels of uncertainty. While there is some scope to estimate gas lost from leakage, purging and filling mains and when there is a third party hit, estimates will be only order of magnitude level estimates. The cost of improving the estimates would significantly outweigh any benefit, which can be expected to be small.

3. UAG management and performance

3.1 Management of UAG

JGN actively monitors and manages UAG to ensure that it maintained at an economic level. The management of UAG is multi-faceted and targeted at each of its sources. Management of UAG is overseen by a senior cross-functional management committee.

UAG Management Oversight

JGN has a senior management committee whose scope is to review ongoing quantity and cost of UAG. The key objectives of the committee are to ensure that:

- the quantity of unaccounted for gas is minimised consistent with minimising total cost
- controls are in place to accurately capture, monitor and report UAG

The committee meets at least nine times per year and its membership is comprised of senior managers from across the business.

Monitoring and reporting of UAG is undertaken on a monthly basis, with investigations conducted as required to ensure UAG performance is maintained within acceptable thresholds.

3.1.1 Activities to manage measurement errors

JGN undertakes a range of activities and programs to manage measurement error.

Metering uncertainty (volumetric errors) and degradation of metering accuracy

- Meter testing to confirm accuracy – JGN undertakes meter type and batch testing of meters and meter repairs to ensure compliance with applicable accuracy standards. JGN applies meter sizing charts to ensure that the meter size is appropriately matched to customer loads in the network. All turbine and rotary meters are tested at 5 and 10 years respectively to confirm accuracy prior to refurbishment.
- Validation programs – JGN undertakes validation program of Custody Transfer Station (**CTS**) meters by obtaining calibration results and witness testing third party CTS meter calibrations.
- Aged and planned meter replacement program:
  - Statistical meter testing program – samples of meters are removed for testing and results are analysed and are applied to populations by age, meter type and manufacturer.
  - Meters are replaced once they reach an age when there is insufficient confidence of meter accuracy. This may be up to 30 years where statistical analysis demonstrates that meters remain accurate.
  - Resizing of industrial and commercial (**I&C**) meter sets when the flow rates through the meters are either greater or less than the accurate range.
  - Replacement of I&C rotary and turbine meters is more frequent than for smaller meters to minimise metering error.
- Defective review and response – Defective meters are examined under the field failure program to identify any trends which would result in loss of accuracy or failure. Defective meter removal statistics are reviewed periodically to identify any failure or inaccuracy issues resulting from type failure.

Measurement uncertainty (metrology errors)

- Pressure and temperature corrections are applied to large consumers. JGN undertakes reconciliations of pressure correction factors recorded in the asset management system and metering/billing system to ensure there have been no administrative errors in billing consumption details.
- JGN undertakes planned maintenance on meter sets operating 15kPa and above, including calibration of temperature and pressure transducers
- Gas heating value for the network is measured at all receipt points and a volume weighted value is applied in accordance with the heating value zones within the networks.
- Fixed factor billing is reviewed against Bureau of Meteorology data on a periodic basis

Billing estimation and profiling

- Meters that under-record consumption are detected in the billing system. In the first instance an estimate of consumption is applied and the meter is flagged for replacement.
- Ongoing review of large consumers - meter data is analysed on an individual meter basis to identify changes in consumption patterns that could result in UAG
- Daily metered customer data is monitored to detect any indications of plant breakdown or incidence of faulty equipment
- Contractors carrying out calibration and maintenance of daily metered sites are subject to audit, to ensure that they perform in accordance with required standards.
- Incorrect or missing data is substituted with estimated or recovered actual data, to ensure that the measurement of total UAG is as accurate as possible.

3.1.2 Activities to minimise losses

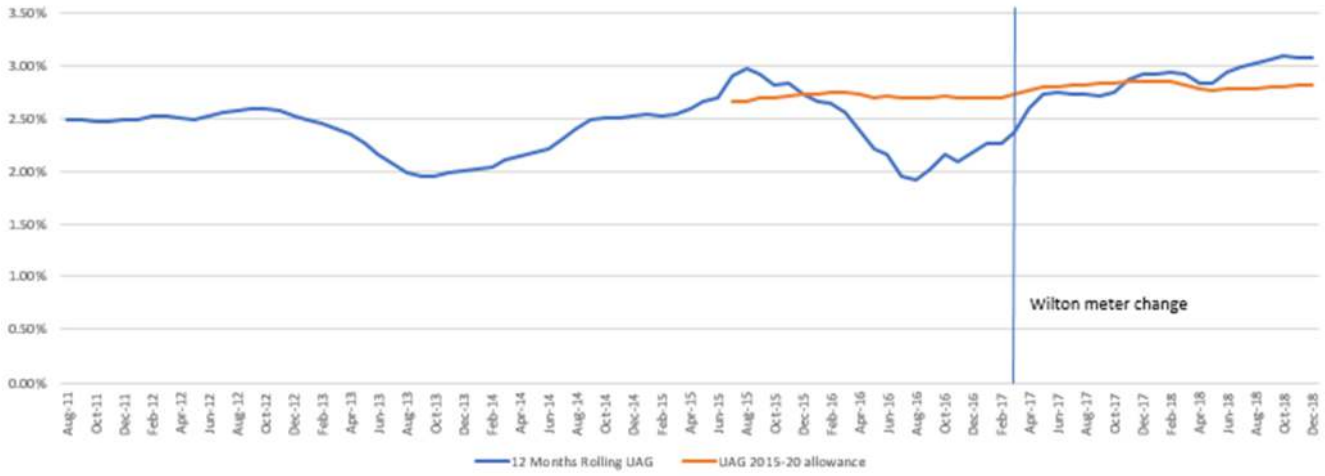
Key activities to minimises losses of natural gas from the network include:

- Prompt responses to all gas escapes and undertake repairs immediately where gas leaks are found
- Replacement of customer meter regulators with minor leaks
- Five yearly leakage survey which is used to inform mains repair
- Quality construction (joining of steel and plastic) to ensure joints are leak tight
- Continuous monitoring of all meters purchased but not yet installed and flowing gas to ensure all installed meters are read and billed.

3.2 Historical pattern of UAG

Figure 3–1 shows JGN's historical pattern of UAG.

Figure 3–1: JGN's historical UAG



Source: JGN

In the period between August 2011 and June 2015, JGN's UAG has fluctuated between ~2.0 to ~2.7% of total network receipts. However, due to the impacts of an enterprise reporting system change and a change in the meter at the Moomba-Sydney Pipeline (**MSP**) CTS at Wilton (owned by APA) there has been increasing volatility in the rate of UAG over the current AA period.

Commencing in July 15, JGN transitioned from its GASS+ enterprise reporting system to a new SAP system. UAG reporting transferred from GASS+ to SAP at that time. Cutover between the two systems took place in two stages, the second being in May 2016, after which GASS+ was decommissioned. Inaccuracies in UAG reporting within SAP were identified in mid-2016, and investigations to identify and correct reporting errors were carried out. Due to the complex nature of the UAG calculation methodology, multiple fixes to correct the errors in SAP were only finalised in late 2018.

Once the SAP fixes were effected, there was a step change in reported UAG. The increase in UAG was traced back to March 2017. Investigations identified that the increase in UAG was due to a change in the MSP CTS meter at Wilton. In March 2017, APA changed the orifice plate of the meter to one with a smaller diameter, which provides more accurate measurement of gas at lower flows. Prior to March 2017 the Wilton MSP receipt point had been undermeasuring flows into the JGN network, which understated UAG. The errors in the SAP report had masked the impact of the change at the Wilton MSP CTS metering station.

UAG is now tracking closer to ~3% of total network receipts, which translates to a UAG rate which is greater than the AER's 2015-20 allowance. The 2015-20 allowance was forecast using historical UAG rates over 2009-2013 period, which does not take into account changes in the network after this time (i.e. at Wilton CTS).

Despite this increase, UAG is still within the expected range for a network such as JGN's, and is comparable to other distribution networks.[6] Importantly, the UAG is primarily attributable to measurement errors, rather than physical losses from the network.

3.3 Independent review of JGN's UAG performance and management

JGN engaged an industry expert, HWGM, to undertake an independent review of JGN's UAG performance. Specifically, the review involved:

- providing an opinion of the efficiency of JGN's reported UAG from 2015-16 to present, with reference to other gas distribution networks
- reviewing the methodology used to calculated UAG to determine whether it is reasonable and in line with good industry practice

[6] See Attachment 6.8 – Review of JGN's UAG by HWGM

- providing an opinion on the suitability of JGN's processes for managing UAG.

The report by HWGM is provided in Attachment 6.8. It concludes that:

- JGN's methodology and approach to calculating and reporting UAG is appropriate and in keeping with good industry practice.
- JGN's current UAG is comparable to other distribution networks.
- JGN's processes for managing the various factors that may influence UAG are appropriate and in keeping with good industry practice.

HWGM states:[7]

> *The current JGN percent UAG can be seen to be within the spread of "normal" (1.5% to 4%) distribution network UAG…*

HWGM also recommended that an audit of JGN's UAG data collection, data processing and energy calculation processes be conducted.

We therefore engaged KPMG to undertake an independent review of JGN's UAG data processing and UAG calculation within our enterprise reporting system, SAP. KPMG's review included recalculating UAG over a 12 month period and on a sample basis recalculating raw metering data. Based on its review, KPMG did not find any errors with JGN's UAG calculation. KPMG's report is included in Attachment 6.11.

[7] HWGM, *Jemena Gas Networks – Review of JGN UAG*, June 2019, page 17 (included as Attachment 6.8)

4. UAG proposal for 2020-25 period

4.1 Target rate proposal

JGN proposes that:

- The current UAG incentive continues to apply based on efficient annual target rates of UAG.
- JGN is compensated for variation in total market volumes and costs of purchasing UAG (which remain outside JGN's control) through an automatic annual adjustment.
- Consistent with the current approach, the efficient level of UAG be represented as two different UAG target rates – one applied to daily metered customer withdrawals and the other to gas received to supply non-daily metered customers.
- A two year lag continue to be applied to cost recovery.

In section 8 of Attachment 6.1, we have set out our approach to forecasting UAG costs for the 2020-25 period. Increases or decreases in the cost of UAG and variations in total market volumes will be fully taken into account through the automatic annual adjustment in the reference tariff variation mechanism.

4.2 Two different target UAG rates

A significant majority of the contributors to UAG (identified in section 2) apply to the medium and low pressure parts of the network supplying our volume market customers. These are:

- metering uncertainty
- degradation of meter accuracy
- measurement uncertainty, including uncertainty introduced through fixed factor billing and heating value allocation
- measurement period errors
- billing estimation
- leakage
- theft
- unmeasured gas used for operational purposes.

Leakage is associated with low pressure cast iron mains and older plastic pipe technology operating at medium pressure. All operational gas used for commissioning gas mains arises on the medium and low pressure systems. Fixed factor metering uncertainty is also of much greater significance to volume customer metering. All non-daily metered customers are supplied from the medium and low pressure networks.

In contrast, almost all demand customers are supplied from JGN's high pressure network, which has negligible leakage and operational gas use. In addition, metering for demand customers is not affected by the same level of meter and metering system uncertainty as the volume market, because the meters are temperature and pressure compensated rather than fixed factor.

This strongly supports the continued approach to setting two different UAG rates for each market type, with an allocation of a higher UAG percentage allocation to volume customers and lower UAG percentage allocation to demand customers.

4.3 Derivation of UAG target rates

JGN engaged Frontier Economics (**Frontier**) to derive the UAG target rates for the 2020-25 period. Specifically, we engaged Frontier to:

- Update its 2014 analysis on the strength of the statistical correlation between UAG and withdrawals for the two separate markets with the most recent data up to December 2018.
- Determine the corresponding UAG rates/coefficients for the two markets.
- Calculate those rates and statistical relationship for the purposes of inclusion in JGN's 2020–25 AA proposal.

Frontier relied on the same approach to forecast JGN's UAG rates that it adopted in the 2015-20 period—which was accepted by the AER—but updated it to take into account the undermeasurement of receipts at the Wilton CTS that took place before March 2017 (discussed in section 3.2). It also updated its approach to include the most recent data[8] and undertook a sensitivity analysis to check the validity of its results. Frontier's report is provided as Attachment 6.9 and the relevant spreadsheet is provided as Attachment 6.10.

Frontier developed three models to estimate the UAG rates for each market and analysed each before selecting the best fitting model. Its selected model has a very good fit with an adjusted R-squared of 98.3%. Based on its analysis, our proposed total UAG rate for the 2020-25 period is 2.866%, and the updated estimates of the UAG coefficients are:

- for forecasting UAG costs in our 2020-25 AA proposal opex allowance:
  - 0.705% of forecast withdrawals for the demand (daily metered) market
  - 5.925% of forecast withdrawals for the volume market customers
- for annual true-ups:
  - 0.665% of withdrawals for the demand (daily metered) market
  - 5.593% of the balance of total market receipts for non-daily metered market (comprising volume market withdrawals and UAG).

4.4 Timing of recovery

JGN proposes that UAG costs continue to be recovered with a two year lag to allow the annual Tariff Variation Notice (**TVN**) to be submitted by 15 March. Applying a two year lag makes it easier for customers and stakeholders to review JGN's annual TVN, and allows the true-up to be made on a full year of actual demand data (see section 7.2.3 of Attachment 4.1 for more details).

A weighted average cost of capital (**WACC**) adjustment applies to the two year lag to take into account the time value of money.

[8] Frontier's analysis relies on monthly observations over the period July 2002 to December 2018.