Western Australia Gas Retail Market – IN001/15W WA Profiles

Important notice

PURPOSE

AEMO has prepared this document to provide information about the methodology used for the estimation of daily gas consumption quantities for basic meters in the Western Australia Gas Retail Market, as at the date of publication.

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1. Background

Daily gas energy consumption quantities are allocated to users within each gas retail market. A class of gas meters known as basic or non-daily meters have usage measured over several months, rather than on a daily frequency. As a consequence, estimation and profiling calculations are used to generate energy quantities for each gas day for basic meters.

Basic meter energy estimation and profiling calculations differ between gas jurisdictions in accordance with the Retail Market Procedures of each market jurisdiction. The calculation methodology implemented in the Western Australia gas jurisdiction was designed over one decade ago and is reviewed here to assess the accuracy of estimated profiled basic meter consumption. This review has been conducted by AEMO as requested by industry. Information is presented here to support AEMO's recommendation that no changes be made to the current methodology for the calculation of estimated basic meter consumption as it is sufficiently accurate.

The scope of this evaluation encompasses an assessment of the accuracy of estimated basic meter consumption quantities using the current calculation methodology. Content is limited to the Western Australia gas jurisdiction, unless otherwise specified. A similar review was conducted in 2016 by REMCo, the predecessor of AEMO as operator of the Western Australia Gas Retail Market.

Glossary

All terms as defined in the Retail Market Procedures

Term	Definition
Basic meter	A basic meter is a meter that is not an interval meter. This includes all meters which are not read daily by means of telemetry.
Delivery point	A delivery point is a point on a sub-network at which a network operator delivers gas out of the sub-network to a user.
Interval meter	An interval meter is a meter which is read by means of telemetry and aggregates the flow of gas across time and records the flow for each hour.
Meter	A meter is used to measure the amount of gas supplied to a delivery point.
Sub-network	A sub-network is a part of a gas distribution system. A sub-network is identified by a network operator for contractual and operational purposes.
Telemetry	Telemetry refers to the communication equipment used for the transmission of data collected from meters
User	A user means an entity that has a haulage contract for the transport of gas through a sub-network under the Retail Market Procedures
User's estimated basic-metered withdrawals (UEBW)	UEBW is calculated under clause 227 of the Retail Market Procedures (WA)
User's basic-metered withdrawals (UBW)	UBW is calculated under clause 230 of the Retail Market Procedures (WA)
Retail Market Procedures	Retail Market Procedures (WA), https://www.aemo.com.au/-/media/files/gas/retail_markets_and_metering/market-procedures/wa/2020/retail-market-procedures-wa-version-80-clean.pdf

2. Methodology

2.1 Introduction

Energy consumption is typically measured for basic meters over timescales of months. In the period before an energy measurement is received, energy consumption quantities are estimated for an individual meter and contribute to the total estimated basic meter energy allocated at a user, sub-network and gas day level. The output is termed 'User's Estimated Basic-Metered Withdrawals' (UEBW). Several calculations are performed to generate the UEBW. A detailed treatment of the relevant equations is given in the appendix.

UEBW quantities are the predicted total basic meter energy consumption in a sub-network for each user for a gas day. The accuracy of UEBW quantities as estimates of actual basic meter energy consumption is the focus of this review. UEBW inaccuracies may hold some consequence for users if the quantities are used for forecasting customer usage and allocation instructions.

UEBW quantities are used to allocate a portion of the forecast basic meter consumption within a sub-network on a given gas day to each user. This is performed through the aggregation of all estimated daily basic meter consumption for active meters held by a user within the sub-network. At an individual meter level, energy consumption is estimated using the meter's historical usage behaviour from a three-month time period centred over the same time the previous year. Scaling of energy consumption quantities is executed using the net system load (NSL), which should closely approximate the total basic meter consumption within a sub-network.

Analysis presented in this review was performed on sample data-sets from the WA Gas Retail Market System (WA GRMS) for the Metro north, Metro south, Rockingham and Bunbury sub-networks within the Western Australia Gas Retail Market. The scope of the analysis is limited to an assessment of the current basic meter consumption methodology implemented in this market. An objective was to compare UEBW quantities with actual basic meter consumption data and to provide a recommendation of whether improvements to the calculation methodology are required.

2.2 Comparison methods

Estimated basic meter consumption quantities are calculated for each gas day yet actual basic meter reads consist of a single measurement for a period of several months. The differing timescales of the estimated and actual basic meter read quantities prevent their direct one-to-one comparison.

Daily profiling comparison

Due to the like-to-like timescales, comparison of estimated basic meter consumption quantities to User's Basic-Metered Withdrawal (UBW) quantities was performed in this review to evaluate the accuracy of the estimated daily profiled quantities with respect to actual daily profiled quantities. UBW quantities are daily profiled quantities calculated at user and sub-network level from actual basic meter read data if the data is available for profiling. The details of UEBW and UBW calculations are shown in the appendix.

Aggregated comparison

An additional comparison was conducted to evaluate the accuracy of the estimated basic meter consumption quantities. This approach compared aggregated estimated basic meter consumption quantities over an extended time period with aggregated actual meter read data quantities over the same period. The time period aggregation of meter data was performed for estimated basic meter consumption at both a user and sub-network level. This holds similarities to the analysis approach previously used by REMCo.

Large-scale comparison of meter-level estimated daily basic meter consumption quantities against raw basic meter read data was not performed due to being both computationally intensive and due to the UBW quantities being those relevant in market calculations and billing. Small-scale meter-level comparison of UEBW and UBW quantities with raw meter data was conducted to successfully confirm that the quantities were calculated as per the Retail Market Procedures[1].

[1] This involved the verification of calculated UEBW and UBW quantities within a sub-network using raw historical meter read data falling within period of 410 to 321 days prior to a gas day and raw meter read data from the gas day period. The time period of 410 to 321 days prior to the gas day is the period used in the calculation of UEBW, as shown in the appendix.

3. Analysis

3.1 Daily profiling comparison

User's Estimated Basic-Metered Withdrawals (UEBW) and User's Basic-Metered Withdrawal (UBW) quantities were compared for the Metro north, Metro south, Rockingham and Bunbury sub-networks across the period of January 2016 to June 2019 with data extracted 6 months after the end of this period.

UBW quantities are calculated daily for each gas day within a reconciliation period of the 425 days prior to the preceding day of the current gas day and will contain either estimated or actual basic meter consumption profiled by gas day. Once received, actual meter read data supersedes estimated data in the calculation of UBW. The time period for analysis was selected to ensure that the UBW quantities were almost entirely constituted by profiled actual meter read data. The selected networks include both large and small sub-networks with the Western Australia Gas Retail Market.

Metro north sub-network

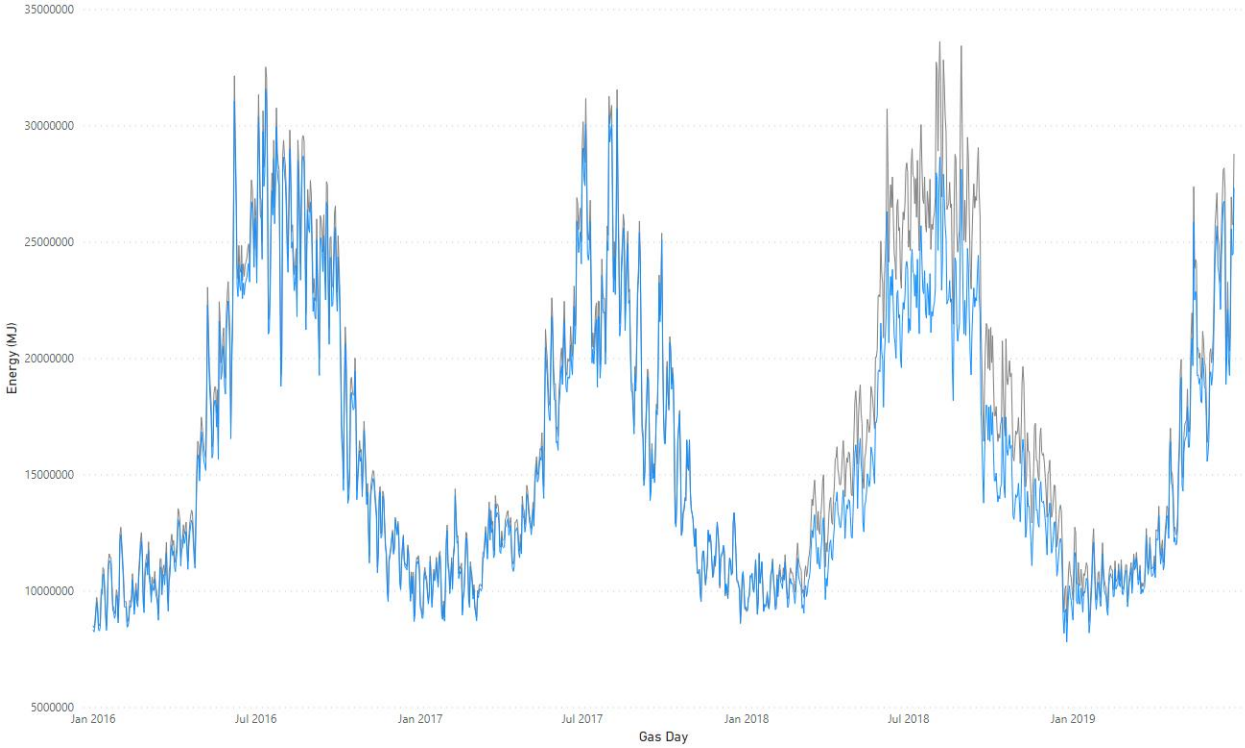

Figure 1 - total estimated/profiled energy consumption in Metro north sub-network; total UEBW across all users in grey (i.e. NSL), total UBW across all users in blue

Metro south sub-network

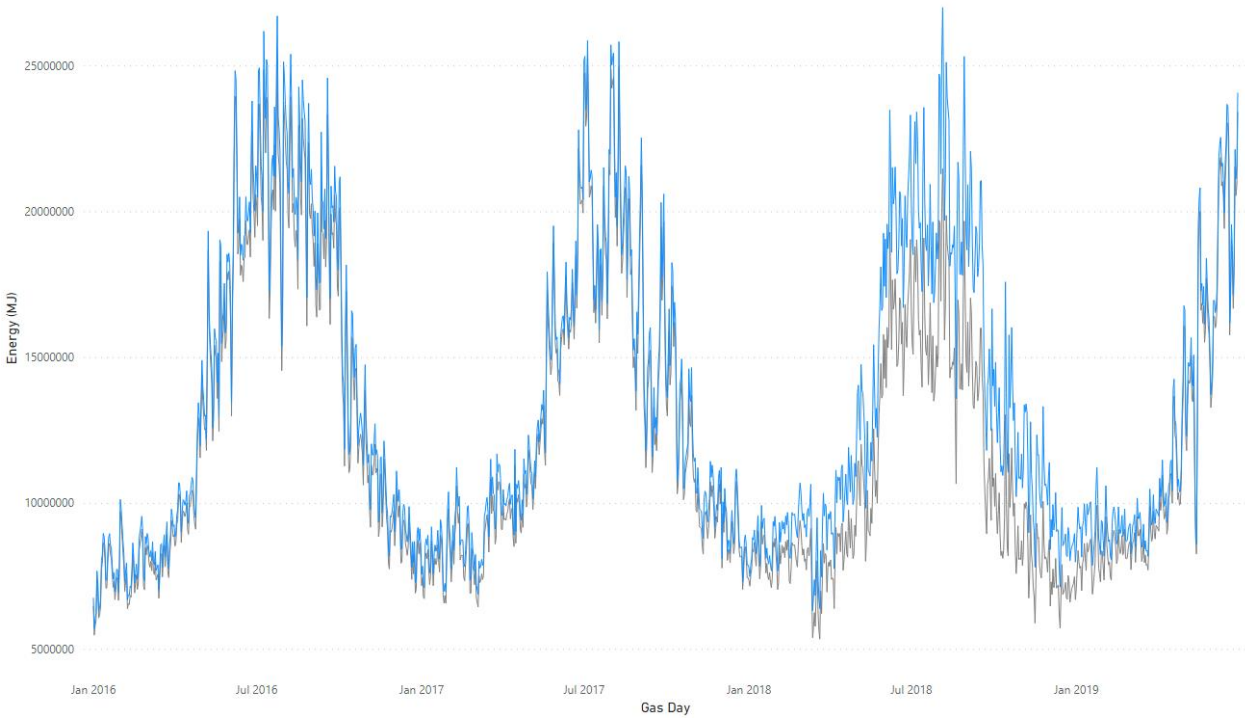

Figure 2 - total estimated/profiled energy consumption in Metro south sub-network; total UEBW across all users in grey (i.e. NSL), total UBW across all users in blue

Rockingham sub-network

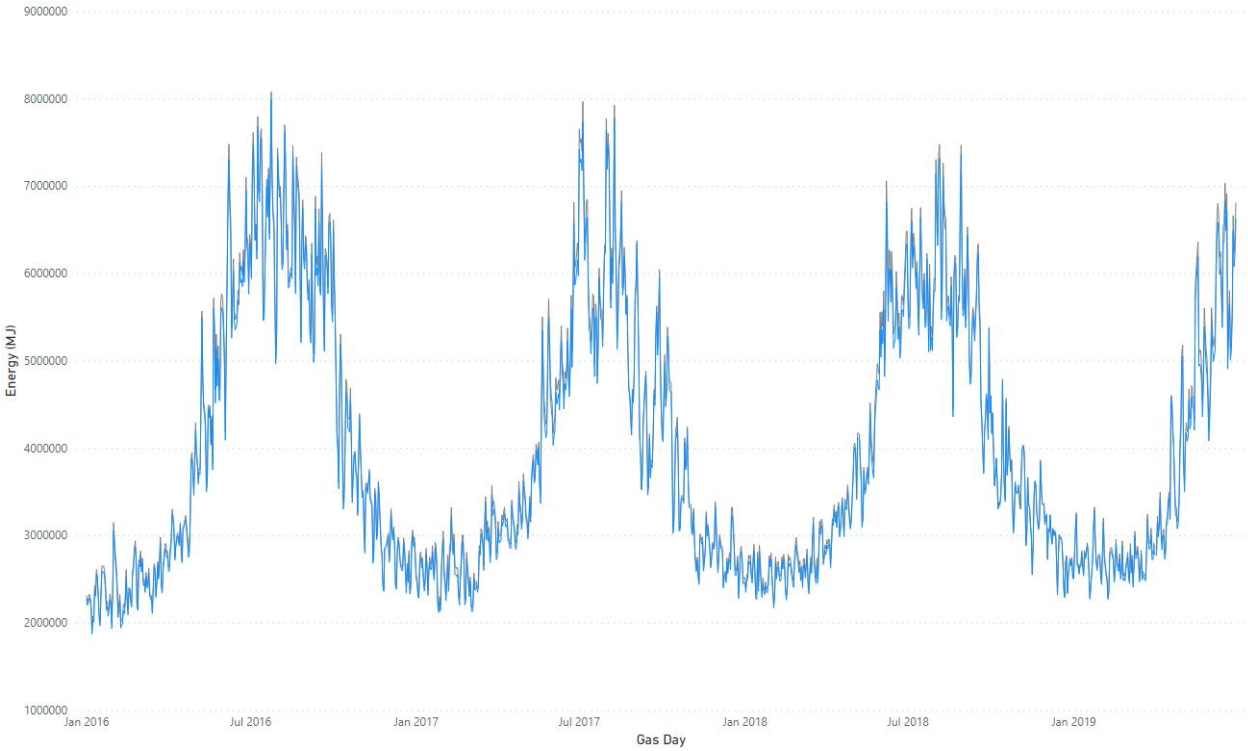

Figure 3 - total estimated/profiled energy consumption in Rockingham sub-network; total UEBW across all users in grey (i.e. NSL), total UBW across all users in blue

Bunbury sub-network

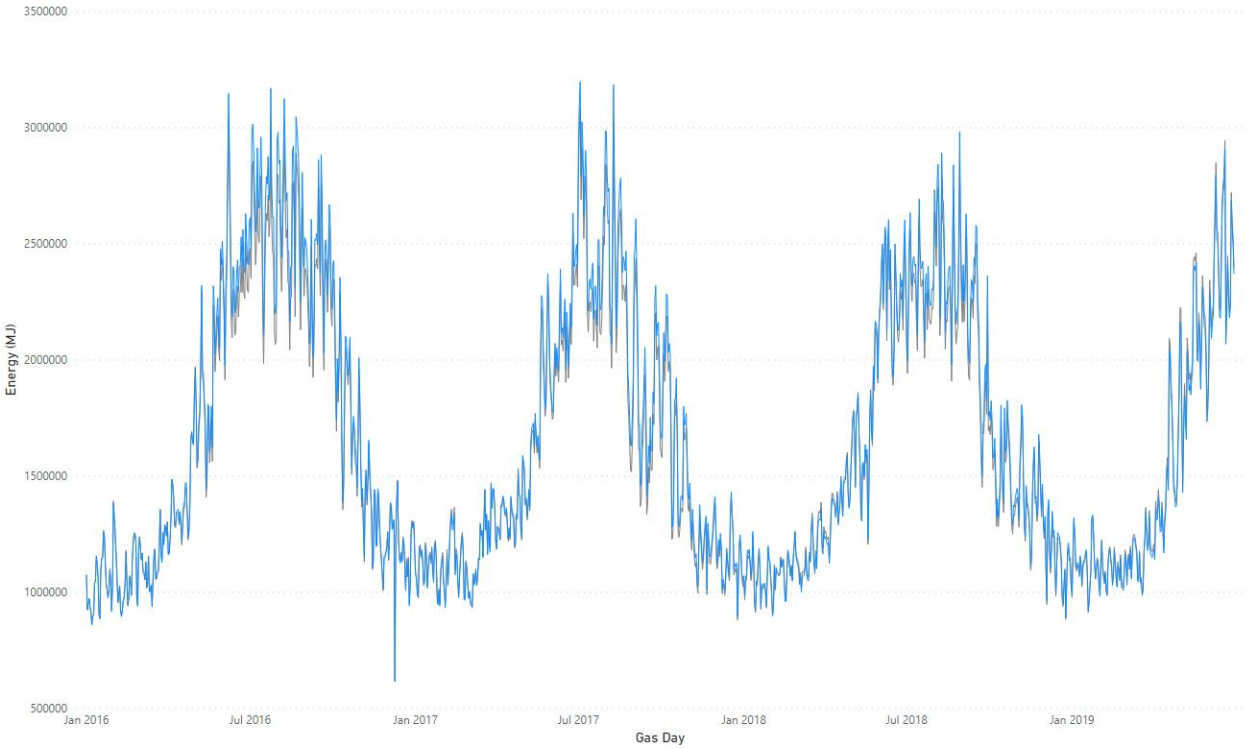

Figure 4 - total estimated/profiled energy consumption in Bunbury sub-network; total UEBW across all users in grey (i.e. NSL), total UBW across all users in blue

3.2 Aggregated comparison

Time-aggregated User's Estimated Basic-Metered Withdrawals (UEBW) were compared with aggregated actual meter read data for the Metro north, Metro south, Rockingham and Bunbury sub-networks. Time aggregation was performed over a period of January 2016 to June 2019.

Sub-network	1106	1107	1109	1114
UEBW	-6.39%	8.82%	-1.93%	1.96%

Table 1 – percentage difference between aggregated UEBW and aggregated actual meter read data. Aggregations were performed over all users and over the time period (January 2016 to June 2019) for sub-networks: Metro north (1106), Metro south (1107), Rockingham (1109) and Bunbury (1114)

Sub-network	1106	1107	1109	1114
User 1	-3.01%	8.18%	0.17%	0.77%
User 2	-4.99%	9.08%	-3.09%	-2.74%
User 3	-5.75%	11.43%	1.33%	2.19%
User 4	-6.13%	4.85%	-15.29%	3.46%
User 5	-6.61%	7.64%	-3.09%	1.93%
User 6	-9.11%	17.04%	1.82%	5.72%
User 7	-9.35%	15.82%	2.41%	11.11%

Table 2 – percentage difference between aggregated UEBW and aggregated actual meter read data. Aggregations were performed over the time period (January 2016 to June 2019) for sub-networks: Metro north (1106), Metro south (1107), Rockingham (1109) and Bunbury (1114). Each row represents a different user

3.3 Summary of findings

Daily profiled comparison

A closely similar profile is held between the total UEBW and UBW quantities across all selected sub-networks in the review period, as shown in Figures 1, 3, 5 and 7. This is as expected as both UEBW and UBW quantities are daily profiled quantities scaled by the net system load of the gas day. Some differences can occur as the weighting of the scaling factors for UEBW and UBW are not identical, as shown in detail in the appendix.

The total UEBW across all users in a sub-network is equal to the NSL in the sub-network for the gas day. Consequently, comparison of total UEBW and total UBW is equivalent to comparison of the NSL with the total UBW in a sub-network. On average, the percentage differences between the NSL and total UBW daily quantities across the selected time period were -5.89%, 8.74%, -1.90% and 1.45% in the Metro north, Metro south, Rockingham and Bunbury sub-networks, respectively. The greatest differences occurred in Metro north and Metro south sub-networks across 2018. These two sub-networks utilise Swing Service quantities for gas reconciliation and in the calculation of the net system load. Large Swing Service Quantities occurred during this period, which may have contributed to the greater variance between total UEBW and UBW quantities in 2018.

Figures 1, 3, 5 and 7 indicate that the current calculation methodology provides estimated quantities that are closely aligned to actual metering quantities and does not consistently over or under align the NSL and UBW, with variation found across sub-networks. Overall, the UBW was typically under-estimated in the Metro south and Bunbury sub-networks and typically over-estimated in the Metro north and Rockingham sub-networks. Possible sources of variances might include inadequacies in the UEBW calculation method, which is modelled using historical meter read data and does not account for weather or growth factors. Other sources of variance could also be in the UBW, which could arise from profiling to the NSL and from metering errors or metering uncertainties, such as the measurement uncertainty of physical metering devices. Percentage differences found between the NSL and UBW quantities are of similar magnitude as acceptable measurement uncertainty expected in energy calculations from physical metering devices, e.g. from ±1 to ±3%[2].

Differences between estimated profiled quantities (UEBW) and actual profiled quantities (UBW) may impact users if estimated quantities are utilised in users' forecasting and allocations. Market reconciliation calculations are performed using UBW quantities, which are constituted by both profiled estimated and profiled actual basic meter energy consumption, with actual meter data superseding estimated data once received. To assess the impact of estimated quantities on market reconciliation, the proportion of estimated UBW with respect to total UBW was evaluated. This is shown in Figure 9, where the percentage of estimated UBW to total UBW is represented for the selected sub-networks for gas days prior to the data extraction date. This shows that UBW is almost entirely composed of estimated data (i.e. UEBW) for recent gas days and drops to an insignificant proportion around 3 months prior and older. As such, differences

[2] Measurement uncertainty ranges used in the wholesale metering in the east coast gas markets, https://aemo.com.au/-/media/files/pdf/0091-0054-pdf.pdf

between estimated and actual quantities should hold immaterial impact by the end of the 425 day reconciliation period in the WA gas market.

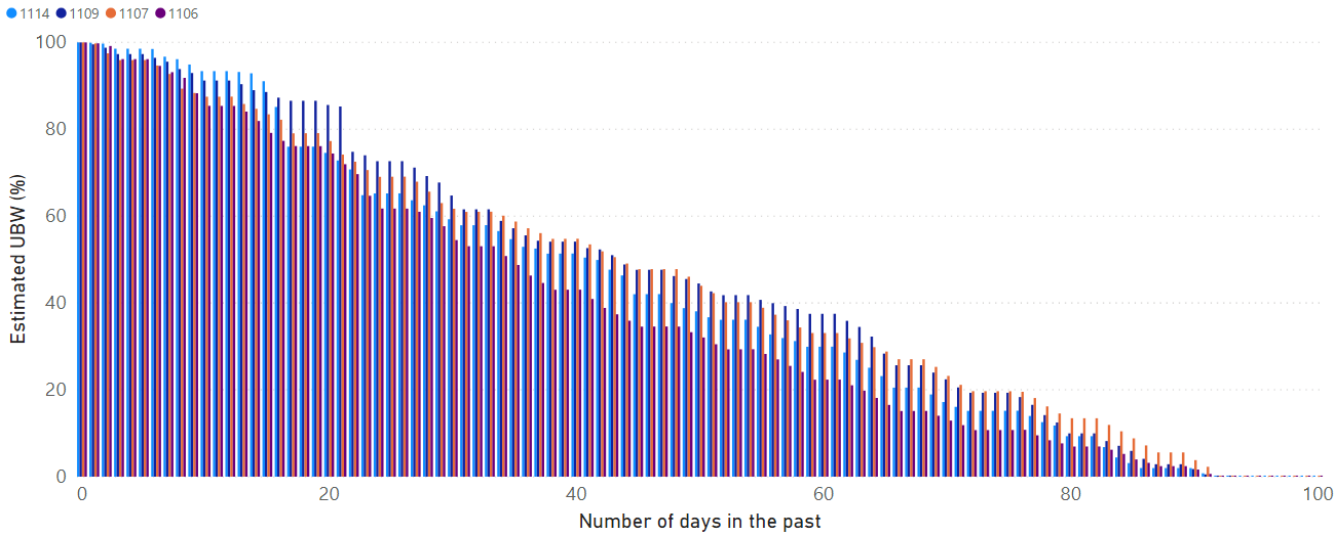

Figure 9 – estimated percentage of UBW contributing to total UBW within sample data-set for 100 historical days in Metro north (1106), Metro South (1107), Rockingham (1109) and Bunbury (1114) sub-networks

Aggregated comparison

Variances between UEBW aggregated over an extended time period compared to actual meter read data aggregated over the same period are shown in Table 1. Similar trends are evident to the daily profiled quantities with the largest variances occurring in the Metro north and Metro south sub-networks. Likewise to the variances in daily profiled values, variances between the aggregated quantities could arise from inadequacies in the estimated quantities and in metering errors and uncertainties. User-level comparison between the aggregated data is shown in Table 2 for each of the sub-networks. The largest user-level variances for each sub-network were found to be approximately 10%.

An overall trend observed across the selected sub-networks was that users with smaller market share (i.e. those with lower total metered usage) typically held higher user-level variances between UEBW and aggregated actual meter data than larger users. However, when compared to the total metered usage within a sub-network, the user-level variance for such users made up a small fraction of the overall sub-network usage.

A possible factor contributing to the higher user-level variances show in Table 2 is the handling of new meters. The calculation methodology of UEBW quantities for all users is reliant upon historical meter read data from the previous year to estimate basic meter energy consumption. In the absence of historical data such as when new basic meter is activated, the current methodology utilises an estimated annual usage provided by a network operator. The estimated annual usage is profiled in an equivalent manner to historical meter read data in the calculation of the UEBW. The inclusion of new meters can create significantly inaccurate UEBW quantities if the estimated usage of the new meter does not well approximate its actual usage. The potential impact of new meters is more significant for smaller users as the UEBW is calculated from all

meters held by a user. This consideration may become more critical if the market growth increases above the current rate of approximately 1% annually.

4. Outlook

4.1 Key observations

The performance of the current calculation methodology for the estimation of basic meter energy consumption in the WA Gas Retail Market was reviewed. Overall, the key observations were as follows:

- The daily profiled estimated basic meter consumption quantities hold closely similar trends to the daily profiled actual basic meter consumption quantities within the reviewed period and sub-networks;
- Time-aggregated estimated basic meter consumption and aggregated actual meter read data hold closely similar trends;
- A range of factors that are unrelated to the calculation methodology may contribute to differences between estimated and actual meter read data, including the physical measurement uncertainty metering devices;
- The proportion of estimated basic meter consumption in the UBW is insignificant by the end of the 425 day market reconciliation period;
- The greatest discrepancies between estimated and actual basic meter consumption occurred in sub-networks using Swing Service Quantities;
- Users with smaller market share typically held greater differences between their estimated and actual basic meter consumption quantities, yet these variances made up minor proportion of overall usage; and
- Handling of new meters in the current UEBW calculation methodology may contribute to inaccurate estimates and impact small users given there is no actual historical meter read data for such meters.

4.2 Recommendations

Based on the key outcomes of the review, the following is recommended:

- The UEBW calculation methodology be retained in its current form due to estimated basic meter consumption being sufficiently close to actual basic meter consumption for most users and due to the insignificant contribution of estimated basic meter consumption at the end of the 425 day market reconciliation period. It is expected that the benefit of small improvements in accuracy of UEBW due to revising the calculation methodology would not warrant the costs involved in implementing a new calculation approach.
- Requirements for the estimated annual energy consumption of new basic meters to be reviewed[3]. This review could be made without altering the UEBW calculation

[3] Appendix 2 of the WA Retail Market Procedures (see sub heading 'Anticipated Annual Consumption') currently contain guidelines for some basic meters, while other meters should have annual consumption estimated based on nominal usage of the consumer

methodology itself and be useful as the calculations rely upon either historical data for established meters or accurate estimated data for new meters.

A1. Calculation methodology

The current UEBW calculation methodology in the Western Australian gas jurisdiction is outlined here. The calculations are defined in the Retail Market Procedures (WA). Some differences from the mathematical notation in Retail Market Procedures (WA) have been used here for convenience and/or clarity.

User's estimated basic-metered withdrawal (UEBW) calculations

The raw estimated daily basic meter consumption is calculated for each basic meter in the sub-network as follows,

$$REBW_{U,D,S,i} = \frac{NSL_{D,S}}{\sum_{j=D-410}^{D-321} NSL_{j.S}} \sum_{p=D-410}^{D-321} \begin{cases} DABW_{U,S,p,i} & if\ DABW_{U,S,p,i}\ exists\ for\ p \\ EBW_{U,S,p,i} & otherwise \end{cases} \quad (A.1)$$

$$REBW_{U,D,S,i} = \frac{NSL_{D,S}}{\sum_{j=D-410}^{D-321} NSL_{j.S}} \sum_{p=D-410}^{D-321} HBW_{U,S,p,i} \quad (A.2)$$

where $REBW_{U,D,S,i}$ is the raw estimated basic meter consumption for meter, *i*, for user, *U*, for gas day, *D*, on sub-network, *S*. This is calculated from scaling and summation of the net system load of the gas day in the sub-network, $NSL_{D,S}$, and summation of either distributed actual withdrawals for the meter, $DABW_{U,S,p,i}$, or estimated reads, $EBW_{U,S,p,i}$, over a period of 410 days prior to the gas day to 321 days prior to the gas day. For convenience, the meter reads over this period is denoted as $HBW_{U,S,p,i}$ here to indicate either actual or estimated reads.

A normalisation factor, $NF_{D,S}$, is calculated as follows,

$$NF_{D,S} = \frac{NSL_{D,S}}{\sum_{U=1}^{M} \sum_{i=1}^{N} REBW_{U,D,S,i}} \quad (A.3)$$

where the raw estimated daily basic meter consumption is summed over all meters, *i*, and users, *U*, in the sub-network, *S*.

The normalisation factor is used in the allocation of total raw estimated basic meter consumption to each user in the form of the user's estimated withdrawals,

$$UEBW_{U,D,S} = NF_{D,S} \sum_{i=1}^{N} REBW_{U,D,S,i} \quad (A.4)$$

Equation A.4 can be re-expressed as follows:

$$UEBW_{U,D,S} = NF_{D,S} \sum_{i=1}^{N} REBW_{U,D,S,i} \tag{A.5}$$

$$= \frac{NSL_{D,S}}{\sum_{U=1}^{M} \sum_{j=1}^{N} REBW_{U,D,S,j}} \sum_{i=1}^{N} REBW_{U,D,S,i} \tag{A.6}$$

$$= \frac{NSL_{D,S}}{\sum_{U=1}^{M} \sum_{j=1}^{N} REBW_{U,D,S,j}} \frac{NSL_{D,S}}{\sum_{k=D-410}^{D-321} NSL_{k.S}} \sum_{i=1}^{N} \sum_{p=D-410}^{D-321} HBW_{U,S,p,i} \tag{A.7}$$

$$= \frac{NSL_{D,S}}{\sum_{U=1}^{M} \sum_{j=1}^{N} \frac{NSL_{D,S}}{\sum_{j=D-410}^{D-321} NSL_{j.S}} \sum_{p=D-410}^{D-321} HBW_{U,S,p,j}} \frac{NSL_{D,S}}{\sum_{k=D-410}^{D-321} NSL_{k.S}} \sum_{i=1}^{N} \sum_{p=D-410}^{D-321} HBW \tag{A.8}$$

$$= \frac{NSL_{D,S}}{\sum_{U=1}^{M} \sum_{j=1}^{N} \sum_{p=D-410}^{D-321} HBW_{U,S,p,j}} \sum_{i=1}^{N} \sum_{p=D-410}^{D-321} HBW_{U,S,p,i} \tag{A.9}$$

where

$$HBW_{U,S,p,i} = \begin{cases} DABW_{U,S,p,i} & if\ DABW_{U,S,p,i}\ exists\ for\ p \\ EBW_{U,S,p,i} & otherwise \end{cases} \tag{A.10}$$

It can then be verified that the total of all user estimated basic withdrawals in a sub-network for a given gas day is equal to the net system load for the sub-network for the gas day,

$$\sum_{U=1}^{M} UEBW_{U,D,S} = \sum_{U=1}^{M} \frac{NSL_{D,S}}{\sum_{U=1}^{M} \sum_{j=1}^{N} \sum_{p=D-410}^{D-321} HBW_{U,S,p,j}} \sum_{i=1}^{N} \sum_{p=D-410}^{D-321} HBW_{U,S,p,i} \tag{A.11}$$

$$\sum_{U=1}^{M} UEBW_{U,D,S} = NSL_{D,S} \frac{\sum_{U=1}^{M} \sum_{i=1}^{N} \sum_{p=D-410}^{D-321} HBW_{U,S,p,i}}{\sum_{U=1}^{M} \sum_{j=1}^{N} \sum_{p=D-410}^{D-321} HBW_{U,S,p,j}} \tag{A.12}$$

$$\sum_{U=1}^{M} UEBW_{U,D,S} = NSL_{D,S}. \tag{A.13}$$

User's basic-metered withdrawal (UBW) calculations

The distributed actual withdrawals, $DABW_{U,S,p,i}$, are calculated as profiled basic meter reads for a given gas day from a basic meter read covering a larger time period (i.e. the meter read period). This is performed as follows,

$$DABW_{U,S,p,i} = AQ_{U,i} \times NSLF_{p,S,i} \tag{A.14}$$

where $AQ_{U,i}$ is the energy quantity of gas for a meter for a total meter reading period that falls the period of 410 days prior to the gas day to 321 days prior to the gas da and $NSLF_{p,S}$ is the net system load factor for gas day *p* and sub-network *S*,

$$NSLF_{p,S,i} = \frac{NSL_{p,S}}{\sum_{k=u}^{v} NSL_{k,S}} \tag{A.15}$$

where $NSL_{k,S}$ is summed over the dates of the relevant meter reading period.

This provides the distributed actual basic-metered withdrawal, which is calculated as a meter read is profiled for each gas day within the meter read period and scaled by the total meter read with respect to the net section load for each gas day and the total net section load for the meter reading period,

$$DABW_{U,S,p,i} = NSL_{p,S} \frac{AQ_{U,i}}{\sum_{k=u}^{v} NSL_{k,S}} . \tag{A.16}$$

Users' basic-metered withdrawals, UBW, are calculated for each day within a 425-day reconciliation period, as follows,

$$UBW_{U,D,S} = \sum_{i=1}^{N} DABW_{U,D,S,i} + \sum_{j=1}^{M} EBW_{U,D,S,j} \tag{A.17}$$

where $DABW_{U,S,p,i}$ and $EBW_{U,S,p,j}$ are the profiled distributed or estimated withdrawals for a given gas day and sub-networks and the summation is performed for all meters held by a user. $DABW_{U,S,p,i}$ and $EBW_{U,S,p,i}$ are the profiled basic meter consumption quantities from the latest consumption data from basic meter, *i*, from a meter read covering gas day, *D*.

Summation of the users' basic-metered withdrawals over all users in a sub-network for a given gas day can be expressed,

$$\sum_{U=1}^{M} UBW_{U,D,S} = NSL_{D,S} \sum_{U=1}^{M} \sum_{i=1}^{N} \frac{AQ_{U,i}}{\sum_{k=u}^{v} NSL_{k,S}} + \sum_{U=1}^{M} \sum_{j=1}^{M} EBW_{U,D,S,j} \tag{A.18}$$

Unlike total UEBW quantities, the total UBW across all users does not simplify to the net system load for the sub-network for the gas day. This is the case as the net system load for a gas day is scaled by net system load values without a common factor for actual meter reads due to the differing start and end dates of the reads and due to the contribution of the estimated reads.

Net system load (NSL) calculations

The net system load for a gas day, *j*, and sub-network, *S*, can be calculated as follows,

$$NSL_{j,S} = TCI_{j,S} - \sum_{U=1}^{M} UIW_{U,j,S} - EUAFG_{j,S} \tag{A.19}$$

$$NSL_{j,S} = TCI_{j,S} - \sum_{U=1}^{M} \sum_{y=1}^{X} IW_{U,j,S,y} \quad - EUAFG_{j,S} \tag{A.20}$$

where $TCI_{j,S}$ is the total corrected injections for the sub-network for a gas day, $UIW_{U,j,S}$ is the interval meter withdrawals for each user, $IW_{U,j,S,y}$ is the interval meter withdrawals for a user's interval meter delivery point, *y*, and $EUAFG_{j,S}$ is the estimate of unaccounted for gas. The network section load must be calculated for historical gas days.

The total corrected injections are calculated as follows,

$$TCI_{j,S} = \sum_{g=1}^{L} PCI_g - \sum_{U=1}^{M} SRQ_{U,j,S} - \sum_{U=1}^{M} URAA_{U,j,S} \tag{A.21}$$

where PCI_g is the pipeline corrected injections for gate point, *g*, and $SRQ_{U,j,S}$ is the swing service repayment quantity for each user for the sub-network, *S*, and for gas day, *j*. Swing service quantities are only relevant for the Metro north and Metro south sub-networks. $URAA_{U,j,S}$ is the user's reconciliation amount for user, *U*, for repayment on gas day, *j*.