ARGYLE CONSULTING

# ANALYSIS OF THE SIDE CONSTRAINT

## Report for the Australian Energy Regulator

June 2022

## Disclaimer



## Contacts

Dr Alexandra Sidorenko, Argyle Consulting Pty Limited
(Alexandra_sidorenko@argyleconsulting.com.au)

# Contents

## Summary

The Australian Energy Regulator (AER) asked Argyle Consulting to assist with reviewing the side constraint and recommend any amendments to ensure its continuing application in line with the intent for the side constraint under the National Electricity Rules (NER) and Control Mechanisms (revenue cap and CPI-X framework).[1,2] This report provides inputs into consultation with distributors on the application of the side constraint for the next round of regulatory resets.

We provide a closed form solution for the permissible percentage price change that should be justified by the revenue movement and as such, allowed by the side constraint, plus additional 2% flexibility provided in the NER. It appears that under certain conditions (eg, when the prior year *t-1* adjustments represent a significant portion of the revenue and when there is a substantial change in forecast quantities between the years), the side constraint as currently stated in Control Mechanisms may become binding, restricting the necessary price change.

We propose a *modified side constraint* that accounts for the movement in forecast quantities. The modified side constraint contains an additional adjustment, a *Q factor* ($Q_t$)*:*

$$\frac{\sum_i \sum_j p_t^{ij} q_t^{ij}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} \leq (1 + \Delta CPI_t)(1 - X_t)(1 + 2\%) + I_t' + B_t' + C_t' + Q_t \qquad (1^*)$$

where $Q_t$ is a weighted average change in quantities between the price years. The Q factor allows a simple calculation using a total revenue metric.

A further refinement of the side constraint is proposed to account for the introduction of the new and retiring of the existing tariffs from year to year. This provision can be used to incorporate trial tariffs if appropriate.

---

1 NER cl 6.18.6(c).

2 In this paper, Control Mechanisms is Attachment 13 in NSW, ACT, TAS, NT, QLD and SA distributors' current determinations; Attachment 14 for VIC distributors. See https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements. Accessed on 6 June 2022

# 1 Current Control Mechanisms

The current side constraint is set under the NER cl 6.18.6 and is specified in the AER's decision on the Control Mechanisms (Attachment 13).[3] For brevity, we will follow acronyms provided in the Control Mechanisms (see also Glossary).

## 1.1 Side constraint expression

Generally, the side constraint is provided by the following expression, with some variation across Distribution Network Service Providers (DNSPs) in costs that are included in a particular adjustment factor:

$$\frac{\sum_i \sum_j p_t^{ij} q_t^{ij}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} \leq (1 + \Delta CPI_t)(1 - X_t)(1 + 2\%) + I_t' + B_t' + C_t' \tag{1}$$

where

$p_t^{ij}$ – proposed price for component *j* of tariff *i* for year *t*

$p_{t-1}^{ij}$ – price charged for component *j* of tariff *i* for year *t-1*

$q_t^{ij}$ – the forecast quantity of component *j* of tariff *i* in year *t*

$\Delta CPI_t$ – inflation as defined in the Control Mechanisms

$X_t$ – X-factor from Post Tax Revenue Model (PTRM)

$I_t'$ - annual % change from the sum of payments due to Service Target Performance Incentive Scheme (STPIS) and Demand Management Incentive Scheme (DMIS)

$B_t'$ - annual % change from the sum of adjustments including the true-up of Distribution Use of System (DUOS) Unders and Overs (U&O)

$C_t'$ - annual % change from the sum of approved cost pass through amounts, $t \geq 2$.

The percentage for $I_t'$, $B_t'$ and $C_t'$ factors can be calculated by dividing the incremental revenues (as used in the total annual revenue formula) for each factor by the expected revenue for the regulatory year *t-1* (based on prices in year *t-1* multiplied by the forecast quantities for year *t*).

Note that this 'old prices, new quantities' revenue is the denominator in the left-hand-side (LHS) of the inequality (1) which we will refer to as the '**base revenue**'.

The purpose of the side constraint, as per NER cl 6.18.6, is to define a permissible percentage change of the weighted average revenue raised from a tariff class. The permissible percentage allows a CPI – X*(X < 0) increase in the smoothed revenue, plus additional 2%, plus a price change necessary to recover adjustments to the revenue under the revenue cap formula.[4]

---

3 Attachment 14 for VIC distributors.

4 The expression with the logical test (X<0) means that for a positive X factor, the permissible percentage is CPI+2%.

### 1.2 Revenue cap control mechanism

The revenue cap formula follows the notations of the Control Mechanisms:

$$TAR_t \geq \sum_i \sum_j p_t^{ij} q_t^{ij} \quad (2)$$

$$TAR_t = AAR_t + I_t + B_t + C_t \quad (3)$$

$$AAR_t = AAR_{t-1}(1 + \Delta CPI_t)(1 - X_t) \quad (4)$$

where

$TAR_t$ – the total allowable revenue in year $t$

$AAR_t$ – the adjusted annual smoothed revenue for year $t$ based on the PTRM

$\Delta CPI_t$ – inflation

$X_t$ – X-factor from PTRM

$I_t$ - the sum of payments due to STPIS and DMIS

$B_t$ - the sum of adjustments including the true-up of DUOS U&O

$C_t$ - the sum of approved cost pass through amounts, $t \geq 2$.

Any additive revenue adjustments (such as revenue variance, $RV_t$) in formula (3) can be treated similarly to the $I_t$, $B_t$ and $C_t$ adjustments.

# 2 Incremental factors for the side constraint

Historically distributors took different approaches in application of the side constraint. The AER has provided clarification for South Australia/ Queensland distributors of the meaning of 'incremental' revenue for revenue adjustment factors $I_t$, $B_t$ and $C_t$ in the Control Mechanisms. For example, for B factor, the annual % change from the sum of adjustments including the true-up of DUOS U&O for the purpose of side constraint (1) is defined as follows:

$$B'_t = (B_t - B_{t-1}) / \sum_i \sum_j p_{t-1}^{ij} q_t^{ij} \quad (5)$$

However, under this interpretation of 'incremental' the side constraint could become binding, potentially preventing distributors from recovering their total allowable revenue or moving along the tariff rebalancing path as part of the approved Tariff Structure Statement (TSS).

In these instances, distributors applied the 'raw' B-factor in the calculation of the permissible price change:

$$B'_t = B_t / \sum_i \sum_j p_{t-1}^{ij} q_t^{ij} \quad (6)$$

While the flexible approach taken by the AER in assessing compliance of pricing proposals allowed distributors to recover their revenue and progress along the TSS path, the need to review and confirm the interpretation of the 'incremental factors' became apparent, to ensure consistency in application of the side constraint in the next regulatory control period.

Hypothetically, the B factor could be treated differently from other adjustment factors ($I_t$ and $C_t$) in the revenue formula (3), due to its 'true-up' nature. This is the basis for the alternative approach taken by distributors when the side constraint formula became binding. A crucial distinction of the B factor is that it includes, sometimes along with other allowed costs, a balance of DUOS U&O account. By its very nature, the U&O account picks up the difference between the model forecast quantities that were used to calculate the prices and the actual (or revised forecast) quantities. By rolling forward the U&O account, the forecast quantities are replaced by actuals or revised forecasts, with the balance reflecting the most current value of the adjustment to the revenue, including the time value of money. As such, the B factor that provides an input to the year *t* model should already include the recalculated adjustment for any deviation of actual quantities from year *t-1* forecasts, as well as any adjustments for the deviations in the prior years.

We will demonstrate that the B factor could be treated similarly to other adjustment factors entering the side constraint (1), but only after adding a new adjustment factor. This factor would allow to adjust the permissible price change to account for the change in model quantities between years *t-1* and *t*. We will refer to it as a **Q factor**.

The analysis below demonstrates that proper accounting for changes in quantities rectifies the application of the side constraint. When the change in quantities is incorporated in the constraint, all additive revenue adjustment factors in formula (3) can be treated in a similar fashion, using the AER's current interpretation of 'incremental' provided in the expression (5).

# 3 Scrutinising the side constraint: what exactly is in it?

We will demonstrate that, mathematically, the left-hand-side (LHS) of the side constraint (1) represents a change in the weighted average revenue, or a change in the weighted average price, between years *t-1* and *t*. We will manipulate this expression to express it as a sum of weighted average changes in prices and quantities.

We will demonstrate how the right-hand-side (RHS) of the side constraint (1) could be modified to reflect the reasonable price change between years *t-1* and *t*, to allow recovery of the Total Allowable Revenue (TAR) based on the PTRM path for the smoothed revenue, CPI, X-factor, incentive schemes *I*, cost pass-throughs *C*, and adjustments for DUOS U&O, *B,* as well as the change in quantities between years *t-1* and *t*. The RHS of the side constraint formula represents a permissible change of CPI-X+2% prescribed in the NER, plus any adjustments for the allowed cost pass-throughs.

We will start with using the revenue cap expression, assuming that prices are set to achieve the TAR, ie, the inequality (2) is binding (satisfied as an equality).

We will manipulate the expressions (1), (2) and (3) using simple transformations.

## 3.1 Expressing change in TAR via revenue formula

Assuming that the tariffs are set to exactly achieve the revenue cap in both years *t-1* and *t*, the change in the TAR between years *t-1* and *t* can be expressed from (2) as follows:

$$\Delta TAR_t = TAR_t - TAR_{t-1} = \sum_i \sum_j p_t^{ij} q_t^{ij} - \sum_i \sum_j p_{t-1}^{ij} q_{t-1}^{ij} =$$

$$= \left| \begin{matrix} \text{subtract and add} \\ \text{the same expression} \\ \pm \sum_i \sum_j p_{t-1}^{ij} q_t^{ij} \end{matrix} \right| =$$

$$= \sum_i \sum_j (p_t^{ij} - p_{t-1}^{ij}) q_t^{ij} + \sum_i \sum_j p_{t-1}^{ij} (q_t^{ij} - q_{t-1}^{ij}) =$$

$$= \sum_i \sum_j \frac{p_t^{ij} - p_{t-1}^{ij}}{p_{t-1}^{ij}} p_{t-1}^{ij} q_t^{ij} + \sum_i \sum_j p_{t-1}^{ij} q_t^{ij} \frac{q_t^{ij} - q_{t-1}^{ij}}{q_t^{ij}} \quad (7)$$

Denote

$$\widetilde{p_t^{ij}} = \frac{p_t^{ij} - p_{t-1}^{ij}}{p_{t-1}^{ij}} \quad (8)$$

as a proposed percentage change in price for component *j* of tariff *i* from year *t-1* to year *t,* and

$$\widetilde{q_t^{ij}} = \frac{q_t^{ij} - q_{t-1}^{ij}}{q_t^{ij}} \quad (9)$$

as a proposed percentage change in model quantities of component *j* of tariff *i* from year *t-1* to year *t*, with **year *t* as a base**.

Then from equality (7) it follows that

$$\Delta TAR_t = \sum_i \sum_j \widehat{p_t^{ij}} p_{t-1}^{ij} q_t^{ij} + \sum_i \sum_j \widetilde{q_t^{ij}} p_{t-1}^{ij} q_t^{ij} \quad (10)$$

## 3.2 Setting base revenue weights

Divide both sides of the equation (10) by the expression for base revenue, $\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}$ (a constant), taking it as $1/\sum_l \sum_m p_{t-1}^{lm} q_t^{lm}$ under the summation side on the RHS of (10), to obtain:

$$\frac{\Delta TAR_t}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} = \sum_i \sum_j \widehat{p_t^{ij}} \frac{p_{t-1}^{ij} q_t^{ij}}{\sum_l \sum_m p_{t-1}^{lm} q_t^{lm}} + \sum_i \sum_j \widetilde{q_t^{ij}} \frac{p_{t-1}^{ij} q_t^{ij}}{\sum_l \sum_m p_{t-1}^{lm} q_t^{lm}} \quad (11)$$

Denote

$$\omega_{t-1,t}^{ij} = \frac{p_{t-1}^{ij} q_t^{ij}}{\sum_l \sum_m p_{t-1}^{lm} q_t^{lm}} \quad (12)$$

as weights of the revenue component $j$ of tariff $i$ in the total base revenue. Note

$$0 < \omega_{t,t-1}^{ij} \leq 1, \sum_i \sum_i \omega_{t-1,t}^{ij} = 1 \ \ \forall t \geq 2.$$

## 3.3 Change in TAR as a sum of weighted changes in price and quantities

With these notations, equation (11) is equivalent to

$$\frac{\Delta TAR_t}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} = \sum_i \sum_j \widehat{p_t^{ij}} \omega_{t-1,t}^{ij} + \sum_i \sum_j \widetilde{q_t^{ij}} \omega_{t-1,t}^{ij} \quad (13)$$

The intuitive interpretation of the equation (13) is that the rate of change of the total revenue (with respect to the base revenue) is the sum of the (weighted) rate of change of prices plus (weighted) rate of change in quantities. It is an extension of the one-good model that states that for the revenue $R = p \times q$, the percentage change in revenue equals to the percentage change in price plus percentage change in quantity, or, in our notation, $\hat{R} = \hat{p} + \hat{q}$.

## 3.4 Expressing change in TAR via its constituent components

Now let us express the change in TAR, $\Delta TAR_t$, using the definition of the total allowable revenue in the equation (3):

$$\begin{aligned} \Delta TAR_t &= TAR_t - TAR_{t-1} = \\ &= AAR_t + I_t + B_t + C_t - (AAR_{t-1} + I_{t-1} + B_{t-1} + C_{t-1}) = \\ &= (AAR_t - AAR_{t-1}) + (I_t - I_{t-1}) + (B_t - B_{t-1}) + (C_t - C_{t-1}) \end{aligned} \quad (14)$$

Divide both sides of equation (14) by the expression for base revenue, $\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}$, to obtain:

$$\frac{\Delta TAR_t}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} = \frac{AAR_t - AAR_{t-1}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} + \frac{I_t - I_{t-1}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} + \frac{B_t - B_{t-1}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} + \frac{C_t - C_{t-1}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} \quad (15)$$

Note that in equation (15) the last three terms in the RHS correspond to the $I'_t$, $B'_t$ and $C'_t$ as defined in the side constraint (1) under the current AER's definition of 'incremental' provided in equation (5).

To simplify the first term in the RHS of equation (15), multiply and divide it by $AAR_{t-1}$, and denote

$$\widehat{AAR}_t = \frac{AAR_t - AAR_{t-1}}{AAR_{t-1}} \quad (16)$$

as a rate of change in the adjusted annual smoothed revenue from the PTRM between years *t-1* and *t*, and

$$share_{AAR_{t-1}} = \frac{AAR_{t-1}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} \quad (17)$$

as a share of the year *t-1* model adjusted smooth revenue, $AAR_{t-1}$, in the base revenue.

### 3.5 Combining the two expressions for the change in TAR

Because the LHS of (13) and (15) are identical, their RHSs are also equal. Using notations (16) and (17) above yields:

$$\sum_i \sum_j \widehat{p_t^{ij}} \omega_{t-1,t}^{ij} + \sum_i \sum_j \widetilde{q_t^{ij}} \omega_{t-1,t}^{ij} = \widehat{AAR}_t \times share_{AAR_{t-1}} + I'_t + B'_t + C'_t, \quad (18)$$

or

$$\sum_i \sum_j \widehat{p_t^{ij}} \omega_{t-1,t}^{ij} = \widehat{AAR}_t \times share_{AAR_{t-1}} + I'_t + B'_t + C'_t - \sum_i \sum_j \widetilde{q_t^{ij}} \omega_{t-1,t}^{ij} \quad (19)$$

where $I'_t$, $B'_t$ and $C'_t$ are the annual % change in the adjustment factors defined in (1), (3) and (5). Note that this expression holds as equality under the assumption that prices are set to exactly achieve the revenue cap in both years *t-1* and *t*.

The RHS of equation (19) starts to look like the RHS of the side constraint (1). The difference is in the first and the last terms. We will start with the first term of the RHS.

### 3.6 Expressing change in AAR via its PTRM movement

Starting with the expression (16), substitute for $AAR_t$ from (4) to express the rate of change in the adjusted annual smoothed revenue from the PTRM via its prescribed path, CPI-X:

$$\widehat{AAR}_t = \frac{AAR_t - AAR_{t-1}}{AAR_{t-1}} = \frac{AAR_{t-1}(1+\Delta CPI_t)(1-X_t) - AAR_{t-1}}{AAR_{t-1}} =$$

$$= (1+\Delta CPI_t)(1-X_t) - 1 \quad (20)$$

The first term in the RHS of expression (19) now looks similar to the first term of the RHS of the side constraint (1). We will focus on LHS for the next step before tackling the last, new term in the RHS of (19).

### 3.7 Reverting from weighted average price change to revenue change

Re-write the LHS of (19) using definitions of weights in (12) and price change in (8) as

$$\sum_i \sum_j \widehat{p_t^{ij}} \omega_{t-1,t}^{ij} = \sum_i \sum_j \frac{p_t^{ij} - p_{t-1}^{ij}}{p_{t-1}^{ij}} \frac{p_{t-1}^{ij} q_t^{ij}}{\sum_l \sum_m p_{t-1}^{lm} q_t^{lm}} =$$

$$= \left| \begin{array}{c} p_{t-1}^{ij} \text{ cancel each other out,} \\ \text{open brackets} \end{array} \right| = \sum_i \sum_j \frac{\left(p_t^{ij} - p_{t-1}^{ij}\right) q_t^{ij}}{\sum_l \sum_m p_{t-1}^{lm} q_t^{lm}} =$$

$$= \sum_i \sum_j \frac{p_t^{ij} q_t^{ij}}{\sum_l \sum_m p_{t-1}^{lm} q_t^{lm}} - \sum_i \sum_j \frac{p_{t-1}^{ij} q_t^{ij}}{\sum_l \sum_m p_{t-1}^{lm} q_t^{lm}} =$$

$$= \frac{\sum_i \sum_j p_t^{ij} q_t^{ij}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} - \frac{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}}{\sum_l \sum_m p_{t-1}^{lm} q_t^{lm}} = \frac{\sum_i \sum_j p_t^{ij} q_t^{ij}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} - 1.$$

Hence,

$$\frac{\sum_i \sum_j p_t^{ij} q_t^{ij}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} = 1 + \sum_i \sum_j \widehat{p_t^{ij}} \omega_{t-1,t}^{ij} \qquad (21)$$

Note that equation (21) means that the change in the weighted average revenue equals 1 plus weighted average percent increase in price of each component of each tariff, with weights equal to the component's share in the base revenue.

## 3.8 Combining all together

Substituting from (19) and (20) into the expressions (21), obtain:

$$\frac{\sum_i \sum_j p_t^{ij} q_t^{ij}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} =$$

$$= 1 + [(1 + \Delta CPI_t)(1 - X_t) - 1] \times share_{AAR_{t-1}} +$$

$$+ I_t' + B_t' + C_t' - \sum_i \sum_j \widetilde{q_t^{ij}} \omega_{t-1,t}^{ij} \qquad (22)$$

The expression (22) specifies the (1 plus) weighted average price change that is required to recover total allowable revenue in year *t* when forecast quantities change between years *t-1* and *t*. If all quantities increase ($\widetilde{q_t^{ij}} > 0$), the adjustment is negative, leading to lower prices (or, more accurately, a lower required price increase). If all quantities decline ($\widetilde{q_t^{ij}} < 0$), higher prices (higher price increase) would be required. If some quantities increase from year *t-1* to *t* while other decline, the overall outcome on the weighted average price change would depend on the weights of the corresponding tariff components in the total base revenue.

Note from (4) that the rate of change of the smoothed revenue is $(1 + \Delta CPI_t)(1 - X_t)$-1, but there is an additional multiplicative adjustment factor in (22) that moderates this change, namely, the share of the previous year *t-1* smoothed revenue in the base revenue, $share_{AAR_{t-1}}$ defined in equation (17).

So far we have operated with equalities. However, the side constraint should specify a permissible upper bound for the price movement. Note that $share_{AAR_{t-1}} > 0$, but the rate of change in the adjusted annual smoothed revenue from the PTRM between years *t-1* and *t*, $\widehat{AAR_t}$, can be positive or negative.

If $\widehat{AAR_t}$<0, this means that the adjusted annual smoothed revenue is on the declining path, and the combined effect of CPI-X is negative. That is, not only the X-factor is positive, but it is also above the inflation.

For a positive X-factor, the NER cl 6.18.6 prescribes that it be set to zero for the purposes of calculating the side constraint. This would result in CPI+2% component of the side constraint.

### 3.9 Tackling the Q factor

We denote the last term in the RHS of equation (22) as a Q factor:

$$Q_t = -\sum_i \sum_j \widetilde{q_t^{ij}} \omega_{t-1,t}^{ij} \tag{23}$$

This is a negative of the weighted average change in quantities for each component of each tariff between years *t-1* and *t,* with weights equal to the component's share in the base revenue.

Fortunately, the Q factor allows a simpler calculation, as demonstrated by the deductions below.

Re-write equation (23) substituting from (9) for $\widetilde{q_t^{ij}}$ and from (12) for $\omega_{t-1,t}^{ij}$, to obtain:

$$Q_t = -\sum_i \sum_j \widetilde{q_t^{ij}} \omega_{t-1,t}^{ij} = -\sum_i \sum_j \frac{q_t^{ij} - q_{t-1}^{ij}}{q_t^{ij}} \frac{p_{t-1}^{ij} q_t^{ij}}{\sum_l \sum_m p_{t-1}^{lm} q_t^{lm}} =$$

$$= -\sum_i \sum_j \frac{(q_t^{ij} - q_{t-1}^{ij}) p_{t-1}^{ij}}{\sum_l \sum_m p_{t-1}^{lm} q_t^{lm}} = \frac{\sum_i \sum_j (q_{t-1}^{ij} - q_t^{ij}) p_{t-1}^{ij}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} =$$

$$= \frac{TAR_{t-1}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} - 1 \tag{24}$$

Equation (24) means that if quantities are expected to increase from year *t-1* to year *t*, the permissible price change should be less than that required at constant quantities. With increasing quantities, the base revenue in the denominator of RHS of expression (24) exceeds the previous year $TAR_{t-1}$, hence the ratio is less than 1 and the RHS is negative. The Q factor reduces the RHS of the expression (22), allowing for a lower permissible price change.

If quantities are expected to decrease, new quantities times old prices will not be enough to recover $TAR_{t-1}$, which would turn the ratio to be greater than 1 and the RHS of expression (24) positive. The Q factor thus is positive, increasing the permissible price change in RHS of expression (22) to allow for the shortfall in quantities.

Substituting from equation (24) into (22) and collecting terms yields:

$$\frac{\sum_i \sum_j p_t^{ij} q_t^{ij}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} =$$

$$= 1 + [(1 + \Delta CPI_t)(1 - X_t) - 1] \times share_{AAR_{t-1}} + I_t' + B_t' + C_t' + Q_t \tag{25}$$

# 4 When does the current side constraint hold true?

By examining expression (25), when

(i) there is no change in model quantities ( $\widetilde{q_t^{ij}} = 0 \; \forall i, j \; \Rightarrow \; Q_t = 0$) and

(ii) year *t-1* incremental factors ($I_{t-1}$, $B_{t-1}$ and $C_{t-1}$) are small compared to the base revenue ($share_{AAR_{t-1}}$ ≈1),

the permissible weighted average revenue change is close to

$(1 + \Delta CPI_t)(1 - X_t) + I_t' + B_t' + C_t'$,

but is not exactly equal to it.

Adding additional 2% flexibility to the expression above results in the current side constraint (1).

When the share of additional adjustments ($I_{t-1}$, $B_{t-1}$ and $C_{t-1}$) is non-negligible, and when there is a change in quantities between *t-1* and *t*, the RHS of the current side constraint (1) may not provide a sufficient price change. Our proposed modification addresses this issue.

# 5 Modified side constraint that allows 2% flexibility

When X<0, the adjusted annual smoothed revenue is on the increasing path. Assume that the bracket $[(1 + \Delta CPI_t)(1 - X_t) - 1] \approx \Delta CPI_t - X_t > 0$.

Assuming that $0 < share_{AAR_{t-1}} \leq 1$, it follows from (25) that:

$$\frac{\sum_i \sum_j p_t^{ij} q_t^{ij}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} \leq 1 + [(1 + \Delta CPI_t)(1 - X_t) - 1] + I_t' + B_t' + C_t' + Q_t =$$

$$= (1 + \Delta CPI_t)(1 - X_t) + I_t' + B_t' + C_t' + Q_t \qquad (26)$$

Adding the additional 2% flexibility prescribed by the NER cl 6.18.6, obtain the following expression for the modified side constraint:

$$\frac{\sum_i \sum_j p_t^{ij} q_t^{ij}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} \leq (1 + \Delta CPI_t)(1 - X_t)(1 + 2\%) + I_t' + B_t' + C_t' + Q_t \qquad (27)$$

The Q factor is a number (percentage) that could be calculated without any difficulty inside the pricing models. A simplified method to calculate the Q factor is provided in equation (24):

$$Q_t = \frac{TAR_{t-1}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} - 1$$

The $B_t'$ factor continues to reflect the true-up of unders and overs and is used in its current incremental form, similarly to other adjustment factors ($I_t'$ and $C_t'$). Other additive pass-through items can be added as required, using the similar incremental approach to establishing the permissible price change.

# 6 Additional refinements to allow for tariff changes

In practice, the modified side constraint (27) applies to the tariffs present in both years *t-1* and *t*. For new tariffs introduced in year *t*, there is no prior year *t-1* price, and as such these tariffs do not enter the calculation of the base revenue.

If we apply formula (27) to the continuing tariffs, we will overstate the permissible price change. This is because the new tariffs are recovering some of the $TAR_t$, hence a smaller amount of revenue would need to fall on the continuing tariffs, resulting in the lower permissible price change. An adjustment needs to be made to the side constraint formula recognising the share of the revenue attributable to the new tariffs.

For tariffs that existed in year *t-1* and retired in year *t*, their year *t* quantities would be zeros or missing and would not contribute to the calculation of the base revenue or $TAR_t$. However, the quantity adjustment Q factor captures the revenue funded by the retiring tariffs in year *t-1*, via $TAR_{t-1}$ in equation (24). Hence the Q factor takes care of the retiring tariffs, providing for an additional permissible price uplift on the continuing tariffs to account for the loss of revenue from the discontinued tariffs.

The price change required for the tariffs continuing from year *t-1* to year *t*, accounting for the creation of new tariffs and/or retiring of the old tariffs, is provided by the *refined modified side constraint*:

$$\frac{\sum_i \sum_j p_t^{ij} q_t^{ij}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} \leq$$

$$\leq (1 + \Delta CPI_t)(1 - X_t)(1 + 2\%) + I'_t + B'_t + C'_t + Q_t - share_{new\ tariffs_t} \qquad (28)$$

where

$$share_{new\ tariffs_t} = \frac{\sum_{i:\ new\ tariff\ in\ year\ t} \sum_j p_t^{ij} q_t^{ij}}{\sum_i \sum_j p_{t-1}^{ij} q_t^{ij}} \qquad (29)$$

New and retired tariff provisions can be used to incorporate trial tariffs if appropriate.

## Glossary

| | |
|---|---|
| AAR | Adjusted Annual (smoothed) Revenue |
| ACT | Australian Capital Territory |
| AER | Australian Energy Regulator |
| CPI | Consumer Price Index |
| DMIS | Demand Management Incentive Scheme |
| DNSP | Distribution Network Service Provider |
| DUOS | Distribution Use of System |
| LHS | Left Hand Side |
| NER | National Electricity Rules |
| NSW | New South Wales |
| NT | Northern Territory |
| PTRM | Post Tax Revenue Model |
| QLD | Queensland |
| RHS | Right Hand Side |
| RV | Revenue Variance |
| SA | South Australia |
| STPIS | Service Target Performance Incentive Scheme |
| TAR | Total Allowable Revenue |
| TAS | Tasmania |
| TSS | Tariff Structure Statement |
| U&O | Unders and Overs |
| VIC | Victoria |