

A cash flow-adjusted revenue calculation for Transpower

1. Excluding the EV adjustment, pass-throughs and recoverables and the voluntary revenue reduction

Start by deriving the revenue formula used by the Commission, but excluding the contribution from the EV adjustment and pass-through and recoverable costs, which will be treated slightly differently (see section below).

This starts with the financial capital maintenance principal, that our cash flows during the year maintain our assets at their present value (in time-value of money) when discounted at our rate of return

$$RAB_0 = PV_{start}(cash\ flows\ in\ the\ year) + \frac{RAB_1}{(1 + WACC)}$$

$$(1 + WACC)RAB_0 = PV_{end}(cash\ flows\ in\ the\ year) + RAB_1$$

Where PV_{start} and PV_{end} are the 'present value' of the cash flows at the start and the end of the year respectively and RAB_0 and RAB_1 are the value of the RAB at the start and end of the year respectively. We can substitute for RAB_1 by rolling forward the RAB using the value of commissioned assets (VCA) and depreciation (D).

$$RAB_1 = RAB_0 + VCA - D$$

$$(1 + WACC)RAB_0 = PV_{end}(cash\ flows\ in\ the\ year) + RAB_0 + VCA - D$$

$$WACC \cdot RAB_0 = PV_{end}(cash\ flows\ in\ the\ year) + VCA - D$$

The cash flows during the year, revenue, opex, tax are all adjusted by cash flow timing factors to give their value at the end of the year

$$PV_{end}(cash\ flows\ in\ the\ year) = Rev \cdot f_{rev} - Opex \cdot f_{mid} - VCA \cdot f_{vca} - TCSD \cdot f_{mid} - Tax \cdot f_{mid}$$

Where f_{rev} , f_{mid} and f_{vca} are the cash flow timing factors for revenue and mid-year things like opex and tax. These can be expressed

$$f_{rev} = (1 + WACC)^{(148+n)/365}$$

$$f_{mid} = (1 + WACC)^{182/365}$$

There are separate timing factors for the value of commissioned assets in each month, but for the time being it is easier to express the commissioning cash flows as $VCA \cdot f_{vca}$. This can easily be expanded at the end of the analysis.

The Commission's draft calculation for revenue uses a value of $n=90$ for the offset, to account for our April to March pricing year. We have shown that this does not give the correct outcome and we will show later what value n should take.

Substituting for PV_{end} gives

$$WACC \cdot RAB_0 = Rev \cdot f_{rev} - Opex \cdot f_{mid} - VCA \cdot f_{vca} - TCSD \cdot f_{mid} - Tax \cdot f_{mid} + VCA - D$$

And therefore

$$Rev = \frac{WACC \cdot RAB_0 + Opex \cdot f_{mid} + VCA \cdot (f_{vca} - 1) + TCSD \cdot f_{mid} + Tax \cdot f_{mid} + D}{f_{rev}}$$

Using the Commission's draft figure of $n=90$ gives the formula in Schedule D of the draft IPP2

$$Rev = \frac{WACC \cdot RAB_0}{(1 + WACC)^{238/365}} + \frac{Opex}{(1 + WACC)^{56/365}} + \frac{Tax}{(1 + WACC)^{56/365}} + \frac{TCSD}{(1 + WACC)^{56/365}} + \frac{D}{(1 + WACC)^{238/365}} + \sum_{i=July}^{June} \frac{(f_{vca,i} - 1)}{(1 + WACC)^{238/365}} VCA_i$$

In order to work out what value n should take, we need to go back to the previous equation and eliminate the Tax building block, expressing it as a function of revenue (because it is a function of revenue). Substituting

$$Tax = (Rev - Opex - D - TD) \cdot t$$

(where TD is tax timing differences (temporary and permanent), t is the rate of corporate tax and tax is assumed to be paid mid-year), gives the *tax building block-independent revenue expression*

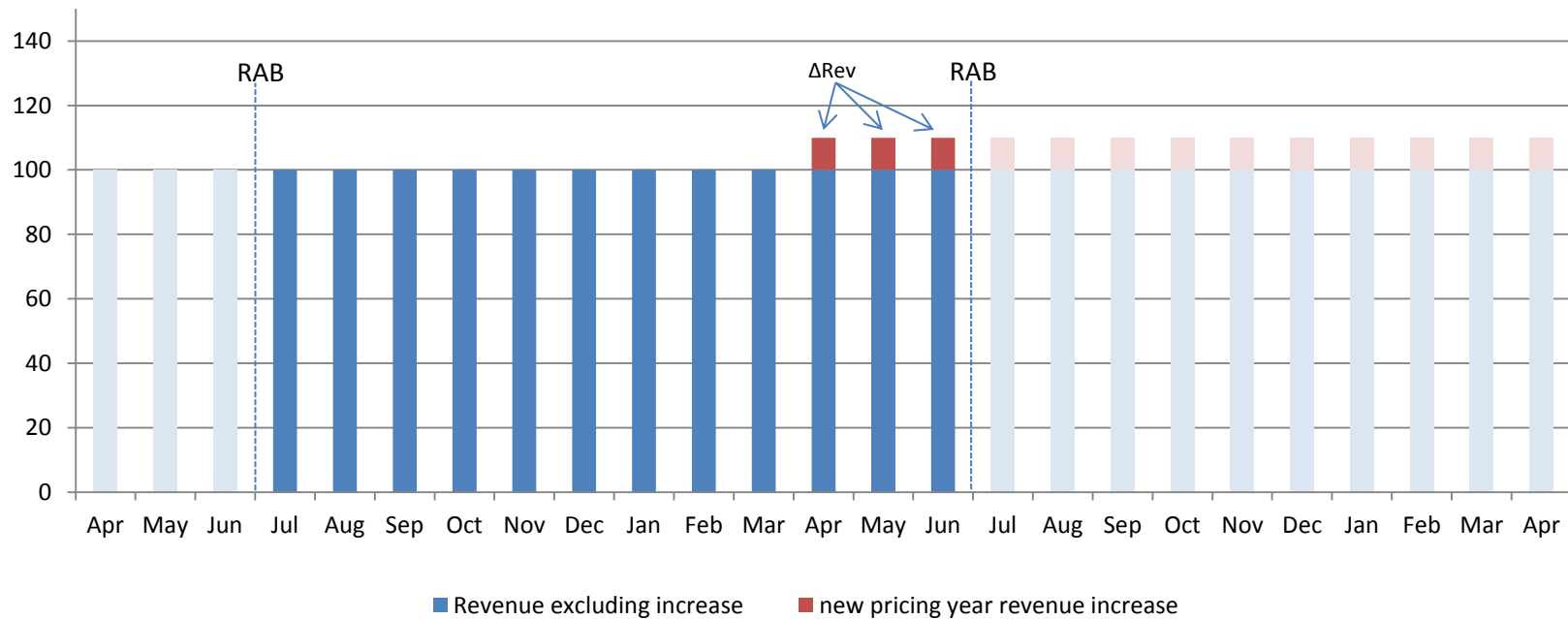
$$Rev = \frac{WACC \cdot RAB_0 + Opex \cdot f_{mid}(1 - t) + VCA \cdot (f_{vca} - 1) + TCSD \cdot f_{mid} + TD \cdot t \cdot f_{mid} + D(1 - t \cdot f_{mid})}{(f_{rev} - t \cdot f_{mid})}$$

It can be seen that this is identical to the expression derived for EDBs at paragraph 75 in "Electricity and Gas Input Methodologies Determination Amendments (No. 2) 2012 – Reasons Paper", but excluding deferred tax and RAB revaluation.

The expression for Rev above is derived by considering the cash flows between the opening and closing RAB values (RAB_0 and RAB_1), with the time value of money incorporated so as to apply *financial capital maintenance* to the cash flows and closing RAB. This expression would also apply to Transpower (to its *financial year*) if we were to disregard the change in revenue which takes effect from 1 April each year. Rev is the revenue that ensures that the cash flows between the opening and closing RAB give a return on investment (ROI) equal to the WACC.

But our revenues *do* change and so when we are considering the cash flows between the opening RAB date on 1 July and the closing RAB date on 30 June we should include the additional revenue (ΔRev) that we get between 1 April and 30 June as a result of the start of the new pricing year.

Figure 1: An incremental view of Transpower revenue cash flows



By replacing Rev with $Rev + \Delta Rev$ we get the amended revenue expression (the additional term being highlighted), which we can label Rev' so as to distinguish it from the unadjusted version. It must be noted that this expression yields a result whereby the total of $Rev' + \Delta Rev$ provides the ROI equal to the WACC. Rev' is lower than the amount calculated in when $\Delta Rev = 0$, because some of the ROI comes from the additional revenue at the end of the financial year (relating to the following pricing year). ΔRev is equal to one quarter of the change in revenue from the financial year in question to the next pricing year¹. The result we expect is that our revenues should be reduced by approximately the additional revenue received at the end of the year (i.e. ΔRev) in order to bring our cash flows back to the 'capital maintenance level'.

$$Rev' = \frac{WACC \cdot RAB_0 + Opex \cdot f_{mid}(1-t) + VCA \cdot (f_{vca} - 1) + TCSD \cdot f_{mid} + TD \cdot t \cdot f_{mid} + D(1-t \cdot f_{mid})}{(f_{rev} - t \cdot f_{mid})} - \Delta Rev \left[\frac{f_{\Delta rev} - t \cdot f_{mid}}{f_{rev} - t \cdot f_{mid}} \right]$$

In this case $f_{\Delta rev} = (1 + WACC)^{10/365}$

Rev' can be summarised as

$$Rev' = Rev - \Delta Rev \left[\frac{f_{\Delta rev} - t \cdot f_{mid}}{f_{rev} - t \cdot f_{mid}} \right]$$

Here Rev is just the revenue as expressed in the first equation (i.e. disregarding the increase in revenue when the pricing year changes). At a WACC of 7.87% (used in our RCP2 proposal revenue calculation), a tax rate of 28% and a value for ΔRev of 0.005 Rev the approximations below are obtained. This amounts to a 0.47% reduction in revenue as a result of the April to March pricing year. That's what we would expect – our revenue being reduced by approximately ΔRev .

$$Rev' = Rev - 0.936 \Delta Rev$$

or

$$Rev' = Rev - 0.0047 Rev$$

We can go further and derive the expression for $f_{rev'}$ that will give the adjusted value for revenue (Rev'), but without having to include the extra term (i.e. without having to change the form of the revenue calculation). For this exercise we use $f_{rev} = (1 + WACC)^{148/365}$.

We start by expressing ΔRev as a function of Rev , by assuming a constant annual rate of change, α . We get

$$Rev' = Rev \left(1 - \frac{\alpha}{4} \left[\frac{f_{\Delta rev} - t \cdot f_{mid}}{f_{rev} - t \cdot f_{mid}} \right] \right)$$

We also know (from the *tax building block-independent revenue expression*, noting that the top part of the division is invariant to $f_{rev'}$ or f_{rev}) that

$$Rev' = Rev \left[\frac{f_{rev} - t \cdot f_{mid}}{f_{rev'} - t \cdot f_{mid}} \right]$$

Combining these two gives

$$Rev \left(1 - \frac{\alpha}{4} \left[\frac{f_{\Delta rev} - t \cdot f_{mid}}{f_{rev} - t \cdot f_{mid}} \right] \right) = Rev \left[\frac{f_{rev} - t \cdot f_{mid}}{f_{rev'} - t \cdot f_{mid}} \right]$$

and therefore

$$f_{rev'} = \frac{(f_{rev} - t \cdot f_{mid})^2}{(f_{rev} - t \cdot f_{mid}) - \frac{\alpha}{4} (f_{\Delta rev} - t \cdot f_{mid})} + t \cdot f_{mid}$$

Note that this simplifies to give f_{rev} in the case where α is zero (no change in revenue). That's what we would expect. We can get the number of days to shift the revenue cash flow timing, by expressing $f_{rev'}$ in terms of the WACC.

$$f_{rev'} = (1 + WACC)^{(148+n)/365}$$

So,

$$n = 365 \frac{\log(f_{rev'})}{\log(1 + WACC)} - 148$$

¹ On average during RCP2 revenue changes by between 1.7% and 2%, including the effect of EV adjustments and wash-ups (i.e. ΔRev ranges between $(1/4) \times 0.017 Rev$ and $(1/4) \times 0.02 Rev$, but say 0.005 Rev for simplicity)

The table below shows how this timing shift n varies with the rate of change of revenue and the WACC rate. The highlighted numbers are those we have confirmed empirically by using the Commission's cash flow-adjusted revenue calculation and a goal seek (and substituting 148+n days for the Commission's 238 days in the revenue timing factor).

WACC	Annual change in revenue														
	-0.50%	0.00%	0.50%	1.00%	1.10%	1.20%	1.30%	1.40%	1.50%	1.60%	1.70%	1.80%	1.90%	2.00%	
7.00%	- 4.67	0.00	4.68	9.36	10.30	11.24	12.17	13.11	14.05	14.99	15.93	16.87	17.81	18.75	
7.05%	- 4.64	-	4.64	9.29	10.22	11.16	12.09	13.02	13.95	14.88	15.82	16.75	17.68	18.62	
7.10%	- 4.60	- 0.00	4.61	9.23	10.15	11.08	12.00	12.93	13.85	14.78	15.70	16.63	17.56	18.48	
7.15%	- 4.57	-	4.58	9.16	10.08	11.00	11.92	12.84	13.76	14.67	15.59	16.51	17.43	18.35	
7.20%	- 4.54	- 0.00	4.55	9.10	10.01	10.92	11.83	12.75	13.66	14.57	15.49	16.40	17.31	18.23	
7.25%	- 4.51	-	4.51	9.04	9.94	10.85	11.75	12.66	13.57	14.47	15.38	16.29	17.19	18.10	
7.30%	- 4.48	-	4.48	8.97	9.87	10.77	11.67	12.57	13.47	14.37	15.27	16.17	17.07	17.98	
7.35%	- 4.45	-	4.45	8.91	9.81	10.70	11.59	12.49	13.38	14.27	15.17	16.06	16.96	17.85	
7.40%	- 4.42	-	4.42	8.85	9.74	10.63	11.51	12.40	13.29	14.18	15.07	15.95	16.84	17.73	
7.45%	- 4.39	0.00	4.39	8.79	9.67	10.55	11.44	12.32	13.20	14.08	14.96	15.85	16.73	17.61	
7.50%	- 4.36	0.00	4.36	8.73	9.61	10.48	11.36	12.23	13.11	13.99	14.86	15.74	16.62	17.49	
7.55%	- 4.33	0.00	4.33	8.68	9.54	10.41	11.28	12.15	13.02	13.89	14.76	15.64	16.51	17.38	
7.60%	- 4.30	-	4.31	8.62	9.48	10.35	11.21	12.07	12.94	13.80	14.67	15.53	16.40	17.26	
7.65%	- 4.27	- 0.00	4.28	8.56	9.42	10.28	11.14	11.99	12.85	13.71	14.57	15.43	16.29	17.15	
7.70%	- 4.24	- 0.00	4.25	8.51	9.36	10.21	11.06	11.92	12.77	13.62	14.48	15.33	16.18	17.04	
7.73%	- 4.23	0.00	4.23	8.47	9.32	10.17	11.02	11.87	12.72	13.57	14.42	15.27	16.12	16.97	
7.75%	- 4.22	0.00	4.22	8.45	9.30	10.14	10.99	11.84	12.69	13.53	14.38	15.23	16.08	16.93	
7.80%	- 4.19	0.00	4.19	8.40	9.24	10.08	10.92	11.76	12.60	13.45	14.29	15.13	15.98	16.82	
7.85%	- 4.16	0.00	4.17	8.34	9.18	10.01	10.85	11.69	12.52	13.36	14.20	15.04	15.87	16.71	
7.87%	- 4.15	- 0.00	4.16	8.32	9.15	9.99	10.82	11.66	12.49	13.33	14.16	15.00	15.83	16.67	
7.90%	- 4.14	- 0.00	4.14	8.29	9.12	9.95	10.78	11.61	12.44	13.28	14.11	14.94	15.77	16.60	
7.95%	- 4.11	- 0.00	4.12	8.24	9.06	9.89	10.71	11.54	12.37	13.19	14.02	14.85	15.67	16.50	
8.00%	- 4.08	0.00	4.09	8.19	9.01	9.83	10.65	11.47	12.29	13.11	13.93	14.75	15.57	16.40	

Revenue calculated using the business plan wacc rate and allowances from the CC draft RCP2 decision
The indicative revenue calculation provided with the RCP2 proposal

The amended form of the revenue calculation, in terms of n , becomes

$$Rev = \frac{WACC \cdot RAB_0}{(1 + WACC)^{(148+n)/365}} + \frac{Opex}{(1 + WACC)^{(n-34)/365}} + \frac{Tax}{(1 + WACC)^{(n-34)/365}} + \frac{TCSD}{(1 + WACC)^{(n-34)/365}} + \frac{D}{(1 + WACC)^{(148+n)/365}} + \sum_{i=July}^{June} \frac{(f_{vca,t} - 1)}{(1 + WACC)^{(148+n)/365}} VCA_i$$

where the values for $f_{vca,month}$ are the same as those given in column 4 of Schedule D of the draft IPP2. This can be simplified if the final IPP specifies a value for n .

2. Treatment of the EV adjustment, pass-throughs and recoverables and the voluntary revenue reduction

These items can be derived in isolation because they can be considered to be *in addition* to the terms derived from the RAB-based financial capital maintenance equation. They are also treated slightly differently here, in that there is a more direct relationship between the revenue recovery on an April to March basis and the corresponding expenses, which are on a July to June basis.

The financial capital maintenance concept still applies, but the assets in question are the EV account balances.

$$EV_0 = PV_{start}(cash\ flows\ in\ the\ year) + \frac{EV_1}{(1 + WACC)}$$

$$(1 + WACC)EV_0 = PV_{end}(cash\ flows\ in\ the\ year) + EV_1$$

where EV_0 and EV_1 are the values of the EV accounts at the start and end of the year respectively. We can substitute for EV_1 in terms of the interest added to the opening EV account balance and the EV adjustment in the year.

$$EV_1 = EV_0 + WACC \cdot EV_0 - EV_{adj}$$

$$(1 + WACC)EV_0 = PV_{end}(cash\ flows\ in\ the\ year) + (1 + WACC)EV_0 - EV_{adj}$$

$$PV_{end}(cash\ flows\ in\ the\ year) = EV_{adj}$$

The cash flows during the year² are all adjusted by cash flow timing factors to give their value at the end of the year

$$PV_{end}(cash\ flows\ in\ the\ year) = Rev_{ptrs\ etc} \cdot (1 + WACC)^{238/365} - PTR \cdot (1 + WACC)^{182/365} + Vol \cdot (1 + WACC)^{182/365}$$

where $Rev_{ptrs\ etc}$ is the revenue we receive to recover pass-throughs and recoverable, plus the effect of the EV adjustment less our voluntary reduction. It represents the revenue items I, K, L and M in Schedule D of the draft IPP2. The revenue cash flow timing factor now includes the additional 90 days between 1 April and 1 July. Substituting this gives

$$Rev_{ptrs\ etc} \cdot (1 + WACC)^{238/365} - PTR \cdot (1 + WACC)^{182/365} + Vol \cdot (1 + WACC)^{182/365} = EV_{adj}$$

and therefore, the terms in the Commission's draft IPP2 decision

$$Rev_{ptrs\ etc} = \frac{PTR}{(1 + WACC)^{56/365}} - \frac{Vol}{(1 + WACC)^{56/365}} + \frac{EV_{adj}}{(1 + WACC)^{238/365}}$$

² These are: the revenue recovery of pass-throughs and recoverables, the expense of pass-throughs and recoverables (PTR) (putting to one side that these are not all expenses) and a notional cash inflow which 'explains' our voluntary revenue reduction (Vol) – treated as mid-year.