Post-tax revenue handbook

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revenue HANDBOOK

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Australian Competition & Consumer Commission

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Glossary

ATO
Australian Taxation Office

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capital asset pricing model

CED
cumulative extra depreciation

CPI
consumer price index

DRP
draft regulatory principles

ICB
initial capital base

IRR
internal rate of return

MAR
maximum allowable revenue

NF
normalisation factor

NPV
net present value

O&M
operating and maintenance costs

PTRM
post-tax revenue model

RAB
regulatory asset base

WACC
weighted average cost of capital

1. Introduction

This publication introduces and explains the post-tax revenue model (PTRM) as applied by the Australian Competition and Consumer Commission in its regulation of various Australian utilities.

The basic modules described are illustrations. They are not intended to be comprehensive, and intentionally abstract from the complexity of actual business operations. Nevertheless, the PTRM requires a working knowledge of Excel and an understanding of basic finance concepts such as NPV (net present value) and IRR (initial rate of return). The modules may be modified and expanded to suit a particular application.

The Commission may update the PTRM in the future to include features for modelling other scenarios of interest, such as:

- capital expenditure occurring in periods after operations commence;
- multiple asset classes;
- implications of timing of cash-flow payments and working capital requirements;
- updating the regulatory asset base roll-forward value to take account of errors in inflation forecasts;
- alternative depreciation options including kinked depreciation schedules;
- price path design to minimise financial risks linked to bypass threat;
- multiple services and tariffs;
- changing gearing assumptions over the life of the asset; and
- Monte Carlo simulations to assess the consequences of specific risks on expected returns.

This publication discusses each topic relatively briefly. For more detail of key issues please refer to ACCC publications:

- *Statement of principles for the regulation of transmission revenues*, May 1999, (referred to as the Draft Regulatory Principles or DRP); and
- various Commission final decisions such as, *Access Arrangement by AGL Pipelines (NSW) Pty Ltd for the Central West Pipeline*, June 2000.

In addition to the description and set of instructions for each module or sheet in the PTRM, this document contains an overview of post-tax cash flow modelling.

Before using the PTRM, Excel's iteration mode of calculation needs to be selected. To do so, select *Options* from the *Tools* menu in Excel, then select the *Calculation* tab. Make sure that *Manual* (rather than *Automatic*) is selected and tick the iteration box.

Conventions are adopted in the layout of the modules to assist in the understanding and linkages of the data elements. The labelling of periods (years) is in row 5 in each module and is shaded aqua. Various key cells throughout the PTRM are colour coded for easy reference. Colour codes are as follows.

Colour convention
Period / Year
Input cell
Parameter - either input or derived
Technical adjustor
Internal rate of return (IRR)
Effective tax rate
Macro button
Non-input / Appearance only
Smoothed tariff

It should be noted that the parameter values used in the modelling (including those in the capital asset pricing model (CAPM) equation) are only examples. While some figures may be identical to previous Commission decisions this is coincidental, and the values should not be thought to indicate the Commission's current thinking.

2. The basic model

Input sheet

Key input variables should be entered into the **Input** sheet. They will be automatically linked to the corresponding cells in the module (sheet) of interest. Values should be entered into each cell with light blue shading. Input parameters have been split into three categories (General input, CAPM input and Year by year input) and are discussed below.

There is scope for making inputs into the sheets themselves but this is not advisable until the operation of the model is understood. There are, however, a few items that may need to be specified outside of this sheet to capture a specific situation (e.g. carried forward tax losses is specified on the **Building block** sheet). These cases are described in the notes specific to each sheet/module.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**Input variable**	**Shorthand**	**Value**	**Discussion**									
2													
3	**General input**												
4	Regulatory asset base ($m)	RAB	$ 1,000										
5	Analytical time horizon	*Time horizon*	*10*										
6	Residual asset value		$0										
7	Remaining asset life		10										
8	Tax life		6										
9	**CAPM input**												
10	Nominal risk free rate	Rf	5.81%										
11	Real risk free rate	rrf	3.23%										
12	Debt margin	dm	1.20%										
13	Market risk premium	MRP	6.00%										
14	Proportion of franking credits attributed value by shareholders	γ	75.00%										
15	LT proportion of equity funding	E/V	40.00%										
16	Debt beta	Bd	0.06										
17	Asset beta	Ba	0.53										
18													
19	**Year by year input**												
20	**PERIOD**		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
21	Operating & maintenance costs (current prices)	O&M		50	51	53	54	55	57	58	59	61	62
22	Volume forecast (petajoules pa)			30	60	70	80	80	80	80	80	80	80

General input

Regulatory asset base

The regulatory asset base (RAB) is the value of assets on which a return will be earned. The **Input** sheet requires the value of the RAB at the end of Year 0 (for illustrative purposes this has been set at $1000 million). In practice the RAB will fluctuate from year to year to reflect new capital expenditure, asset disposals and depreciation. In the PTRM, however, capital expenditures and disposals are not featured so that the RAB will only fluctuate in real terms as a result of depreciation.

Analytical time horizon

The time horizon is an important part of the cash-flow analysis. In keeping with the regulatory objective of providing a commercial return over the life of the assets, the time horizon is normally set equal to the remaining economic life of the assets, after which the regulatory asset value should have been reduced to zero. The default value is set at 10 years. If the value is set at greater than 10 years the relevant columns in the sheets will need to be added.

Residual asset value

When the time horizon is less than the remaining asset life specified the RAB will not have reached zero during the course of the cash flow analysis. In the building block model this does not matter, but in the cases of the price path approach a value may be specified as part of the access arrangement. The default value is set at zero.

Remaining asset life

In this model the economic life of the assets constituting the RAB is set at a default value of 10 years, corresponding to the time horizon of the cash-flow analysis. For a new asset the value is usually set as the lesser of the economic life or the technical life of the infrastructure.

Tax life

Linked to the life of the assets is their remaining life for tax purposes. For illustrative purposes the tax life has been assumed to be six years. However, this can be changed if required.

CAPM input

Nominal risk free rate

The Commission uses the five-year government bond rate as a proxy for the nominal risk free rate to be used in access arrangements of five years duration.[1]

Real risk free rate and inflation[2]

The Commission uses the indexed bond rate (of similar duration to the regulatory period) as a proxy for the real risk free rate. The real risk free rate is essentially the nominal risk free rate adjusted for inflation. The Commonwealth's prospectus for Treasury Indexed Bonds outlines the formula for this adjustment. It can be found at <http://www.rba.gov.au/FinancialServices/prospectus_ib.html>.

Debt margin

The debt margin is defined as the difference between interest charged by a lender and the risk free rate. The model assumes a debt margin of 1.2 per cent.[3]

Market risk premium

The market risk premium represents the additional expected return for investing in the market as a whole over investing in risk free instruments such as government bonds. That is, the level of compensation required to induce investors to assume the risk of the market (in the absence of franking credits). The model assumes a market risk premium of 6 per cent.[4]

[1] See section 6.4 of the DRP for a discussion of the risk free rate.

[2] See section 6.9 of the DRP for further discussion of the link between inflation and nominal and real bond rates.

[3] See section 6.8 of the DRP.

[4] Ibid., section 6.5.

Gamma (proportion of franking credits used)

Gamma is used in the CAPM model to reflect the value of imputation credits to investors as a component of their after tax returns. The Commission has used a value of 50 per cent for gamma in its decisions to date. Recent research indicates, however, that a value closer to 100 per cent may be more realistic for Australian investors.[5] The PTRM assumes a value of 75 per cent for gamma.

Gearing ratio

The Commission has previously adopted a benchmark gearing ratio of 60:40 (60 per cent debt, 40 per cent equity) and this is also assumed as the default value in the model.[6]

Debt beta

The debt beta enters the calculation of the equity beta to reflect the fact that debt holders take on some non-diversifiable risk.

Asset beta

The asset beta is a measure of correlation between returns expected to be earned by an ungeared investment in the particular asset and returns earned in a diversified portfolio. The Commission uses betas of industries rather than specific firms, consistent with its benchmarking approach to regulation. Normally it is necessary to unravel the impact of geared investments on equity returns. Similarly, it is necessary to modify the asset beta when investment is partly funded by debt and to obtain an equity beta for the equity in the investment to determine benchmark commercial returns for investors in the business.[7]

Year by year input

Operating and maintenance costs

Forecast values for operating and maintenance costs (O&M) expenditure can be entered for each year. O&M expenditure includes items such as wages and salaries, leasing costs and other service contract expenses paid to third parties, fuel costs and materials costs. If the expenditures are not forecast it is assumed they will remain unchanged from the last specified value in future periods.

Volume forecast

Forecast volume is assumed to be in petajoules per annum. It is used in the model for deriving the reference tariff (in the **Smoothing** sheet) in dollars per gigajoule. While these units are appropriate for a gas transmission business, they can be altered to accommodate other industries.

[5] Ibid., section 6.7.

[6] Section 6.6 of the DRP discusses the impact of the gearing assumption on the equity beta. The gearing ratio was also discussed recently in the Commission's final decision for the Moomba to Adelaide Pipeline. See section 2.5.7 of the Commission's final decision, *Access Arrangement proposed by Epic Energy South Australia Pty Ltd for the Moomba to Adelaide Pipeline System*, September 2001.

[7] See section 6.6 of the DRP.

WACC sheet

The **WACC** sheet is where the CAPM input parameters are used to derive the required return on equity, the cost of debt, inflation forecasts and the vanilla weighted average cost of capital (WACC). The effective tax rate calculated as part of the cash-flow analysis is also reported in this sheet along with various measures of WACC calculated from the forecast cash-flows. These outcomes vary with the different revenue profiles generated under alternative regulatory models (e.g. cost of service, price path, NPV and IRR), and the sheet includes a column of results linked to each of the models included in the PTRM.

	A	B	C	D	E	F	G	H
1		**CAPM PARAMETERS**						
2					**INPUT DATA & CALCULATED INPUTS**	**Basic Building Block Model**	**Normalisation Model**	**Price Path Cash Flow (PPCF) Model**
3								
4								
5		Nominal Risk Free Rate		r_f	**5.81%**			
6		Real Risk Free Rate		rr_f	**3.23%**			
7		Inflation Rate		f	**2.50%**			
8		Cost of Debt Margin over rf		dm	**1.20%**			
9		Nominal pre-tax cost of debt		rd	**7.01%**			
10		Real pre-tax cost of debt		rrd	**4.40%**			
11		Market Risk Premium		MRP	**6.00%**			
12		Corporate Tax Rate		T	**30.00%**			
13		Effective Tax Rate for Equity (from Relevant Cashflows)		Te	**16.91%**	**16.91%**	**16.96%**	**13.74%**
14		Effective Tax Rate for Debt (Effective Debt Shield)		Td	**25.48%**	**25.48%**	**25.72%**	**26.47%**
15		Proportion of Franking Credits attributed value by shareholders		γ	**75.00%**			
16		LT Proportion of Equity Funding		E/V	**40.00%**			
17		LT Proportion of Debt Funding		D/V	**60.00%**			
18		Debt Beta		Bd	**0.060**			
19		Asset Beta		Ba	**0.530**			
20		Equity Beta (uses Te)		Monkhouse Formula	**1.233**			
21								
22								
23		**WACC Analysis**			**Formula Approximation**		**Derived From Cashflow**	
24		Post-tax nom return on equity(pre-imp)		Rf+Be x MRP	**13.21%**	13.21%	13.21%	13.21%
25		Post-tax real return on equity(pre-imp)			**10.45%**	10.45%	10.45%	10.45%
26		Nominal Vanilla WACC			**9.490%**	9.490%	9.490%	9.490%
27		Real Vanilla WACC			**6.820%**	6.820%	6.820%	6.820%
28		Post-Tax Nominal WACC			**7.719%**	8.67%	7.63%	7.77%
29		Post-Tax Real WACC			**5.091%**	6.01%	5.00%	5.14%
30		Pre-Tax Nominal WACC			**9.723%**	9.75%	9.75%	9.70%
31		Pre-Tax Real WACC			**7.047%**	7.07%	7.07%	7.03%
32		Nominal Tax Allowance			**0.233%**	0.26%	0.26%	0.21%
33		Real Tax Allowance			**0.228%**	0.25%	0.25%	0.21%

The cost of debt

The cost of debt is the sum of the risk free rate and the debt margin. The PTRM uses the five-year government bond rate as a proxy for the risk free rate.[8] A firm's debt margin will vary with debt duration, the firm's credit rating, and the gearing level. Therefore the Commission may use an industry-wide benchmark for the debt margin to promote the

[8] Ibid., section 6.4.

use of efficient financing structures.[9]

rd = rf + dm

where:

rd = cost of debt

rf = the risk free rate of return (usually based on government bond rates of an appropriate term); and

dm = the debt margin.

As noted, a benchmark gearing ratio of 60:40 (60 per cent debt 40 per cent equity) is used as the default. Regardless of the value specified it is assumed that the ratio remains constant over time to maintain consistency with the CAPM assumptions that are assumed fixed for the time horizon of the cash-flow analysis.

The cost of equity (risk assessment)

The regulatory framework seeks to provide investors with a commercial return on their equity investment commensurate with the business risks involved. To establish the appropriate equity return the Commission has tended to rely on benchmarks indicated by the CAPM. The basis of the CAPM is the relationship between return and risk.

Capital asset pricing model [10]

The CAPM specifies the required return on equity given the opportunity cost of investing in the market, the market's own volatility, and the systematic risk of holding equity in the particular company according to the formula:

re = rf + βe(rm - rf)

where:

re = required return on equity

rf = the risk free rate of return (usually based on government bond rates of an appropriate term);

(rm - rf) = the market risk premium — the return of the market as a whole less the risk free return; and

βe = the equity beta for companies facing systematic risks similar to equity holders in the service provider business.

Risk can be divided into two categories: systematic (non-diversifiable), and non-systematic (diversifiable) risk. Systematic risks are market-related risks faced by an investor irrespective of the industry. Examples are the risk of political upheavals and economic up-turn or down-turn. Compensation for systematic risk is made though the market-risk premium and beta factors found in the CAPM.

The CAPM requires compensation for systematic risk only, as firm specific risk can be eliminated through diversification.

Diversifiable risk encompasses all risk that is firm or industry specific. It is this risk that attracts the most attention when considering new investment. Examples in the gas transmission industry include the risk of assets becoming stranded, weather, and operations risk. Such risks by their nature are specific and need to be assessed separately for each access arrangement.

The Commission prefers to assess all identified specific risks for their expected impact on revenues. This allows such risks to be dealt with as part of recognised cash flow costs rather than via a higher CAPM-based regulated rate of return. Specific risk may also be mitigated by design of the regulatory framework. Examples include:

- faster than normal rate of regulatory depreciation to provide a more timely return of capital for assets at risk of bypass;[11]
- economic depreciation (price path approach) in conjunction with reviews on the basis of unfulfilled market expectations;[12] and
- a longer regulatory period.[13]

[9] Ibid., section 6.8.

[10] Ibid., section 6.2 for a discussion of the CAPM.

[11] Ibid., section 5.3.

[12] See section 3.1 of the Commission's final decision, *Access Arrangement by AGL Pipelines (NSW) Pty Ltd for the Central West Pipeline*, June 2000.

[13] Ibid., section 4.7.

Assets sheet

The **Assets** sheet calculates the value of the RAB for each period in real and nominal terms. It also calculates regulatory and tax depreciation. This module illustrates straight-line depreciation of the asset base in real terms.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
6	**PERIOD**		**Parameter**		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
7	Inflation assumption (CPI % increase)		2.50%			2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
8	Cumulative Inflation Index (CPI end period)				100%	102.5%	105.1%	107.7%	110.4%	113.1%	116.0%	118.9%	121.8%	124.9%	128.0%
9															
10	**Initial Capital Base**				1,000										
11															
12	**Real Asset Values**														
13	Real Depreciation	Econ Life (yrs)	10			100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
14	Real Residual Asset Value (end period)				1,000	900.0	800.0	700.0	600.0	500.0	400.0	300.0	200.0	100.0	0.0
15	Real Residual Asset Value (start period)				-	1000.0	900.0	800.0	700.0	600.0	500.0	400.0	300.0	200.0	100.0
16	**Nominal Asset Values**														
17	Nominal Depreciation					77.5	82.0	86.7	91.5	96.6	101.8	107.3	112.9	118.8	124.9
18	Nominal Residual Asset Value (end period)				1,000	922.5	840.5	753.8	662.3	565.7	463.9	356.6	243.7	124.9	0.0
19	Inflated Nominal Residual Asset Value (start period)				-	1025.0	945.6	861.5	772.7	678.8	579.8	475.5	365.5	249.8	128.0
20	**Tax Values**														
21	Tax Depreciation	Tax Life (yrs)	6			166.7	166.7	166.7	166.7	166.7	166.7	0.0	0.0	0.0	0.0
22	Residual Tax Value (end period)				1,000	833.3	666.7	500.0	333.3	166.7	0.0	0.0	0.0	0.0	0.0

Rolling forward the regulatory asset base and depreciation costs

The initial capital base (ICB) is:

- for a new facility — the actual capital cost of the infrastructure; and
- for an existing facility — the commercially fair value of comprising assets, derived using relevant principles and criteria such as those set out in the Gas Code.

Rolling forward the RAB serves two purposes:

1. to establish the asset base on which a rate of return must be earned in any period; and
2. to form the basis for calculating the depreciation expense over any period.

For consistency the depreciation in a period must equal the difference between the RAB at the start and end of the period. Further, as depreciation is intended to represent the return of capital expenditures over the life of the asset, accumulated depreciation should not exceed the initial actual capital cost of the infrastructure. Apart from this requirement not to double count, the time path for depreciation can be viewed as arbitrary. As long as the rate of return on the residual RAB value at any point in time is expected to be achieved, the NPV of expected cash flows will equate to the RAB.

Many depreciation profiles have been devised, some with accounting convenience in mind rather than any economic significance.

Common approaches proposed include:

a. straight-line depreciation of the real value of the asset base;

b. diminishing balance depreciation whereby the remaining RAB is reduced by a constant fraction over each period; and

c. annuity depreciation — configured so that the sum of depreciation and return on capital remains constant.

The rolling forward of the RAB is complicated by the need to include the effect of ongoing capital expenditures, which must also be depreciated. For this reason the RAB is usually modelled separately from the building block cash flow calculations. While this version of the model does not consider capital expenditure, it is a straightforward extension of the model to incorporate multiple asset classes, ongoing capital expenditure and associated depreciation.

The basic equation for rolling forward the RAB is:[14]

Opening value of RAB in next period = closing value of RAB in current period

=	opening value of assets in current period
-	depreciation over the period
+	capital expenditure
-	asset disposals

Straight-line depreciation (approach a.) is used in the illustrative spreadsheet module. For simplicity a single asset costing $1000 million with an expected life of 10 years is considered (real asset values are depicted in rows 13 to 15). In real terms the RAB reduces by $100 million per year, but to compensate the investor for inflation the residual value at the end of the year is adjusted upwards for the amount of inflation that is expected to occur during the year. This reflects the nominal value of the RAB. Nominal asset values are depicted in rows 17 to 19. The change in the nominal value of the RAB from period to period is the depreciation allowance used in the building block framework.

The pattern of depreciation applied determines the time profile of tariffs and for this reason some constraints on the depreciation path are desirable. The DRP suggests that regulated tariffs should mimic the properties of prices in competitive markets. Such an objective may favour depreciation profiles that produce a level time profile for tariffs. However, there may be some circumstances (e.g. threat of bypass) where other depreciation profiles (such as accelerated depreciation) may be more appropriate.[15]

Depreciation for tax purposes is also calculated in this sheet (rows 21 and 22). The initial value of the assets for tax purposes is normally assumed to be the same as the initial value for regulatory purposes. This would indeed be true in the case of a new asset. However, for an existing asset the starting value for tax purposes could be different to the regulatory value, depending on the circumstances. If this is the case the starting value for tax purposes can be specified in cell E22 (coloured dark orange), and the value inserted in cell C21 is the remaining tax life of the asset. In this example tax depreciation is assumed to be straight-line over the remaining tax life of the asset (six years).

[14] See chapters 4 and 5 of the DRP for a detailed discussion of each element.

[15] Ibid., chapter 5.

Building block sheet (labelled BldgBlks)

The basic costs are itemised in the **Building block** sheet. The building blocks are summed together to calculate the total costs which equate to the maximum allowable revenue (MAR).

That is, **MAR = post-tax return on equity + interest payments on debt + regulatory depreciation + O&M costs + net tax payable.**

Expenses for tax purposes are calculated to establish taxable income or any tax loss to be carried forward (should that be the case).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
11	RAB (start period)			Nominal value		1,000.0	922.5	840.5	753.8	662.3	565.7	463.9	356.6	243.7	124.9
12	- Equity	E/(E+D)=	40.00%			400.0	369.0	336.2	301.5	264.9	226.3	185.6	142.6	97.5	50.0
13	- Debt	D/(E+D)=	60.00%			600.0	553.5	504.3	452.3	397.4	339.4	278.3	214.0	146.2	74.9
14															
15	**Revenue Building Blocks**														
16	Nominal Vanilla WACC		9.49%												
17	Return on Asset														
18	- Return on Equity		13.21%			52.8	48.7	44.4	39.8	35.0	29.9	24.5	18.8	12.9	6.6
19	- Return on Debt		7.01%			42.1	38.8	35.4	31.7	27.9	23.8	19.5	15.0	10.3	5.3
20															
21	Depreciation					77.5	82.0	86.7	91.5	96.6	101.8	107.3	112.9	118.8	124.9
22															
23	O&M					50.0	51.3	52.5	53.8	55.2	56.6	58.0	59.4	60.9	62.4
24															
25	Tax Payable					-	-	-	-	-	-	-	16.3	42.7	42.6
26	Less Value of Imputation Credits	γ	75.00%			-	-	-	-	-	-	-	(12.3)	(32.0)	(32.0)
27															
28	**Maximum Allowable Revenue**				-	**222.4**	**220.8**	**219.0**	**216.9**	**214.6**	**212.1**	**209.3**	**210.3**	**213.5**	**209.8**
29															
30	**PERIOD**		**Parameter**		-	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
31	**Tax Expenses**														
32	- O&M					50.0	51.3	52.5	53.8	55.2	56.6	58.0	59.4	60.9	62.4
33	- Tax Depreciation					166.7	166.7	166.7	166.7	166.7	166.7	-	-	-	-
34	- Interest					42.1	38.8	35.4	31.7	27.9	23.8	19.5	15.0	10.3	5.3
35	**Total Tax Expenses**					**258.7**	**256.7**	**254.6**	**252.2**	**249.7**	**247.0**	**77.5**	**74.4**	**71.2**	**67.7**
36															
37	**Tax Calculation**														
38	**Taxable Income**					(36.3)	(72.3)	(107.8)	(143.1)	(178.2)	(213.2)	(81.4)	54.5	142.3	142.1
39	pre-tax income					(36.3)	(35.9)	(35.6)	(35.3)	(35.1)	(35.0)	131.8	135.9	142.3	142.1
40	Tax loss carried forward				-	(36.3)	(72.3)	(107.8)	(143.1)	(178.2)	(213.2)	(81.4)	-	-	-
41	**Tax payable**		30.00%			-	-	-	-	-	-	-	16.3	42.7	42.6
42	Value of Imputation Credits	γ	75.00%			-	-	-	-	-	-	-	12.3	32.0	32.0

The building block approach to deriving annual cash flows

The Commission has adopted a building block approach to assess the revenues required by a service provider so it can provide the regulated service and obtain a commercial return on its investment. The logic of the approach is simple. Revenues calculated in this way automatically cover the service provider's costs including an adequate return.

In the cash flow models considered by the Commission the key building blocks are:

- the post-tax return on equity invested in the project (row 18);
- the cost of debt or the interest payments incurred that are required to service borrowings (row 19);

  [Together these two items are referred to as the overall cost of capital. A vanilla WACC may be separately calculated that can apply to the totality of funds (equity + debt) employed.]
- depreciation or return of capital to reflect the gradual recovery of capital costs associated with the project. There is considerable flexibility available in the time profile of depreciation to smooth the revenues over time or to achieve desired price paths (row 21);[16]
- operations, maintenance and administrative costs (O&M) associated with the day-to-day running of the business and attending to the operations and maintenance of existing infrastructure (row 23); and
- net tax liabilities payable (the figure is net in the sense that it is the annual tax payable by the business (row 25) less the value of imputation credits available to investing shareholders (row 26)).

Costs can be expressed in real dollars (based on the price level of a particular year) or nominal dollars (dollars of the day) terms. The Commission always calculates costs in nominal terms for two main reasons:

- actual tariffs derived from revenues applying to services will always have to be expressed in dollars of the day; and
- the Australian Taxation Office (ATO) always calculates tax liabilities based on nominal income.

The costs are determined for each year of the period under review to derive the actual revenue requirement. As costs may be forecast to fluctuate from year to year, the revenue requirement can be smoothed over time. Importantly, this can be done in a way that leaves the service provider indifferent. (See **Smoothing** sheet on page 23 for more detail.)

[16] Ibid., chapter 5.

Operating and maintenance costs

Operating and maintenance costs (O&M) are expressed as a single line item in the cash flow analysis but it is intended to include all the ongoing costs of a non-capital nature for running the regulated business. It may include such items as:

- wages and salaries;
- leasing costs and other service contract expenses paid to third parties; and
- fuel costs and materials costs.

Forecasts of such costs will be made on the basis of previous experience and contractual arrangements in place. Industry benchmarks for such costs may also provide a valuable guide. These costs are treated as a pass through item in establishing regulated revenues and have a direct bearing on associated tariffs. It is important that the estimates be the best available and amendable to audit procedures.

Beyond the regulatory period it may be desirable to link costs to changes in the inflation index (CPI) in combination with a productivity growth factor (g) as follows:

$$O\,\&\,M\,(t+1) = O\,\&\,M\,(t)\,\frac{CPI_{t+1}/(1+g)}{CPI_t}$$

The PTRM does not apply a CPI or a productivity growth factor, rather the year by year O&M as specified on the **Input** sheet are the pass through values. If values are not specified for the full time horizon the O&M will be assumed to remain constant at the value in the last period specified.[17]

Taxation and related costs and benefits

Tax is payable on revenue less tax costs recognised by the ATO. Tax-deductible costs include interest or debt servicing, accelerated depreciation allowances and other operating and maintenance expenditure (rows 32 to 34). The statutory corporate tax rate used in the model is set at the legislated tax rate in each year for which cash flows are modelled.

Tax concessions associated with accelerated depreciation defer actual tax liabilities. This deferral of tax reduces the tax burden on the business and results in an effective tax rate over the life of the investment that is below the statutory rate. The effective rate, being different from the statutory rate, has an impact on the gross revenue needed to provide the net rate of return required by investors.

The regulated rate of return must be adjusted to properly take account of the benefits provided to shareholders via franked dividends. Gamma is included in the WACC calculation to represent the portion of franking credits which can, on average, be used by shareholders of the company to offset tax payable on other income. The higher the gamma the lower will be the required return to equity holders and the estimated WACC required for a commercial return. Estimates of the average value of gamma range from 50 per cent to 100 per cent. The Commission has used a value of 50 per cent for gamma in recent decisions. The value of gamma assumed in the analysis needs to be specified in the **Input** sheet.

The Commission assumes private Australian ownership of the regulated entity. The CAPM

[17] Ibid., section 7.2.2 (pages 93 and 94).

parameters are determined on this basis and it is assumed that the regulated business is taxed as an Australian resident company. While an overseas investor may believe it should be treated differently (e.g. owners may not be able to make use of imputation credits), it is not appropriate to consider changes to gamma in isolation from potential changes to other parameters.

Spreadsheet calculations

Tax payable by the firm in each period is calculated in rows 31 to 41, in three steps.

1. Pre tax income is calculated as maximum allowable revenue minus the estimated total tax expense (row 39).
2. Tax loss carried forward is calculated (row 40).
3. Taxable income (row 38) is calculated as the sum of pre-tax income (row 39) and tax loss carried forward from the previous period (row 40).

The revenue in the period is assumed to be equal to the revenue requirement calculated from the building blocks (row 28). Tax costs recognised by the ATO are totalled and deducted from the revenue to deduce the pre-tax income in the period (row 39). The tax costs (rows 31 to 35) are the same costs included in the building blocks with the exception of depreciation. In the case of the building blocks, depreciation (row 21) is calculated based on the economic life of the asset (see row 17 of the **Assets** sheet). Tax depreciation is based on a much shorter tax life (accelerated depreciation) or calculated in a different way. This is specified in the **Assets** sheet (row 21).

The taxable income may be positive or negative. Before calculating taxable income for the period, pre-tax income needs to be added to any tax loss carried forward from the previous period. If the business has been operating for some time, an accumulated tax loss may have existed before regulation commenced. In this case the accumulated carried forward tax loss prior to period one needs to be specified as a negative quantity in the spreadsheet at cell E40 (coloured orange). If the net taxable income is negative no tax is payable, and the amount is recorded as the carried forward accumulated tax loss in row 40. If the result is positive then tax is payable and is calculated by multiplying the net taxable income by the corporate tax rate (Tc) expected to be applicable in that period (row 41).

The tax payable is recognised as a building block cost and added to the revenue building blocks (row 25 in **Building Blocks** module) which must be added to derive the MAR for that period. Offsetting this tax cost is the benefit that shareholders can receive from imputation credits available by virtue of the tax paid by the business. This offsetting benefit is equal to gamma times the tax payable and is recorded in rows 26 and 42.

There is circularity in this calculation as the tax liability is one of the costs used to calculate the revenue requirement, which is then used to calculate the tax payable. This is not of concern since the spreadsheet is set up to calculate a set of values that are mutually consistent.

The **Analysis** sheet

The analysis of forecast cash flows provides rate of return measures estimated from forecast revenues and costs. These include expected post and pre-tax returns on equity, effective tax rates, the effective cost of debt and selected measures of the WACC.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
44	CASH FLOW ANALYSIS BELOW THIS LINE														
45															
46	**Nominal Cash Flow Analysis**														
47	Capital Expenditure				1,000	-	-	-	-	-	-	-	-	-	-
48	Interest Payments				-	42.1	38.8	35.4	31.7	27.9	23.8	19.5	15.0	10.3	5.3
49	Repayment of Debt				(600)	46.5	49.2	52.0	54.9	58.0	61.1	64.4	67.8	71.3	74.9
50															
51	**Nominal Cash Flow to Equity Holders**														
52	- pre-tax	Te =	16.91%	13.74%	(400)	83.8	81.5	79.1	76.4	73.6	70.6	67.4	68.1	71.1	67.2
53	- post-tax			11.42%	(400)	83.8	81.5	79.1	76.4	73.6	70.6	67.4	51.8	28.4	24.6
54	- post-tax + val of imputation credits			13.21%	(400)	83.8	81.5	79.1	76.4	73.6	70.6	67.4	64.0	60.4	56.6
55	**Real Cash Flow to Equity**														
56	- pre-tax			10.97%	(400)	81.8	77.6	73.4	69.3	65.1	60.9	56.7	55.9	56.9	52.5
57	- post-tax			8.70%	(400)	81.8	77.6	73.4	69.3	65.1	60.9	56.7	42.5	22.7	19.2
58	- post-tax + val of imputation credits			10.45%	(400)	81.8	77.6	73.4	69.3	65.1	60.9	56.7	52.5	48.4	44.2
59	**Net Cash Flow to Debt**														
60	Deduction utilised to reduce tax					5.7	2.9	-	-	-	-	151.3	74.2	10.3	5.3
61	Unutilised deductions carried forward					36.3	72.3	107.6	139.3	167.2	191.0	59.2	-	-	-
62	Net Cash Flow to Debt	Td =	25.48%	5.22%	(600)	86.8	87.1	87.4	86.6	85.8	84.9	38.5	60.5	78.5	78.6
63	**Nominal Cash Flows to Assets**														
64	Cashflow to Asset			9.75%	(1,000)	172.4	169.5	166.4	163.1	159.4	155.5	151.3	150.9	152.6	147.4
65	Cashflow to Asset post tax			8.67%	(1,000)	172.4	169.5	166.4	163.1	159.4	155.5	151.3	134.5	109.9	104.8
66	Cashflow to Asset real			7.07%	(1,000)	168.2	161.4	154.6	147.7	140.9	134.1	127.3	123.8	122.2	115.1
67	Cashflow to Asset real post tax			6.01%	(1,000)	168.2	161.4	154.6	147.7	140.9	134.1	127.3	110.4	88.0	81.8
68	Check on Vanilla WACC cash flow(nom)			9.49%	(1,000)	172.4	169.5	166.4	163.1	159.4	155.5	151.3	146.8	141.9	136.7
69	Check on Vanilla WACC cash flow(real)			6.82%	(1,000)	168.2	161.4	154.6	147.7	140.9	134.1	127.3	120.5	113.6	106.8
70															
71															
72	**Further Dissection of Cash-Flows**														
73	**Return on Equity**														
74	Cashflow with imputation					83.8	81.5	79.1	76.4	73.6	70.6	67.4	64.0	60.4	56.6
75	add back Capex					-	-	-	-	-	-	-	-	-	-
76	less nominal depreciation of RAB					(77.5)	(82.0)	(86.7)	(91.5)	(96.6)	(101.8)	(107.3)	(112.9)	(118.8)	(124.9)
77	plus debt repayment					46.5	49.2	52.0	54.9	58.0	61.1	64.4	67.8	71.3	74.9
78	less net pretax allowance for tax					-	-	-	-	-	-	-	-	-	-
79	gives nominal return to equity					52.8	48.7	44.4	39.8	35.0	29.9	24.5	18.8	12.9	6.6
80	less inflation in equity component					10.0	9.2	8.4	7.5	6.6	5.7	4.6	3.6	2.4	1.2
81	gives real return to equity					42.8	39.5	36.0	32.3	28.4	24.2	19.9	15.3	10.4	5.3
82	%nominal ROE					13.21%	13.21%	13.21%	13.21%	13.21%	13.21%	13.21%	13.21%	13.21%	13.21%
83	%real ROE					10.45%	10.45%	10.45%	10.45%	10.45%	10.45%	10.45%	10.45%	10.45%	10.45%
84															
85	Equity at start of period					400.0	369.0	336.2	301.5	264.9	226.3	185.6	142.6	97.5	50.0
86	True Equity					400.0	369.0	336.2	301.5	264.9	226.3	185.6	142.6	97.5	50.0
87															
88	**5 year Analysis**														
89	**PERIOD**	**Parameter**		**IRR**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
90															
91	Revenue				-	222.4	220.8	219.0	216.9	214.6	212.1	209.3	210.3	213.5	209.8
92	less O&M				-	(50.0)	(51.3)	(52.5)	(53.8)	(55.2)	(56.6)	(58.0)	(59.4)	(60.9)	(62.4)
93	less interest					(42.1)	(38.8)	(35.4)	(31.7)	(27.9)	(23.8)	(19.5)	(15.0)	(10.3)	(5.3)
94	less tax				-	-	-	-	-	-	-	-	(16.3)	(42.7)	(42.6)
95	plus imputation credits				-	-	-	-	-	-	-	-	12.3	32.0	32.0
96	less capex				(1,000.0)	-	-	-	-	-					
97	less loan repayments				600.0	(46.5)	(49.2)	(52.0)	(54.9)	(58.0)	(61.1)	(64.4)	(67.8)	(71.3)	(74.9)
98	RAB residual value									226.3					
99	Post tax return on equity				(400.0)	83.8	81.5	79.1	76.4	299.9					
100	IRR			13.21%											
101	Target			13.21%											

Cash flow analysis is fundamental to all Commission regulatory decisions. First, it provides a comprehensive check on the validity of decisions to ensure that the outcomes are consistent with the assumptions forming the basis of the decision. For example, a key input assumption is the return of equity requirement based on financial markets analysis. The **Analysis** sheet is designed to check that the desired rate of return on equity can be expected from the regulated revenue stream.

The analysis is independent of the framework that gives rise to the revenues and costs. It may be applied to any forecasts of revenues and costs to assess returns available to the business. The analysis calculations form an integral part of all sheets that model mechanisms for establishing regulated revenues. They are also useful for assessing revenue and cost forecasts derived from ad hoc models or forecasts.

The analysis is described in conjunction with the cash flows resulting from the basic building block model but applies to any of the other modules contained in the PTRM.

The starting point for the cash flow analysis is the forecast revenue stream. From this must be deducted other cash flows and expenses faced by the firm to derive the net cash flows relevant to a particular entity. Generally all the cash flows are noted in nominal terms. Where appropriate net cash flows are reduced to real terms using the CPI deflator (row 8).

Some important cash flows are recorded in rows 47 to 49 for later use. These are:

- capital expenditures (row 47) values copied from the **Assets** sheet;
- interest expenses (row 48) copied from building block calculations; and
- net repayment of debt (row 49) calculated as the change in debt level from the beginning of this period to the commencement of the next. (Taken from line 13 of the **BldgBlk** sheet.)

Net cash flows available to equity holders

Net nominal pre-tax cash flows to equity holders (row 52) are represented by nominal revenues less:

- O&M expenditures;
- capital expenditures;
- interest payments; and
- any repayment of debt in the period. A contribution to capital expenditure funded by debt would normally result in a negative repayment.

Net nominal post-tax cash flow to equity holders (row 53) is obtained by further deducting the tax expense of the business (calculated in the revenue model).

This does not represent the net post-tax benefit to equity holders since it does not include the value of imputation credits. Row 54 adds back the value of imputation credits and represents the net post-tax benefits available to equity holders in each period.

Linked with each of these cash flows is the initial equity holding. This is represented as an initial equity outlay occurring at the end of period zero.

The IRR of the respective net cash flows over the life of the assets is calculated in column D. The key IRR is the net post-tax returns to equity holders inclusive of imputation credits (re), as that is conceptually the return indicated by the CAPM calculation. **It is critical that the CAPM-determined re be validated by the estimated cash flows (row 54) otherwise the regulatory framework is inconsistent with the regulatory assumptions.**

The corresponding real cash flows and the respective IRRs are calculated in rows 55 to 58.

The difference between the IRR applying to pre-tax and post-tax cash flows to equity allows the effective rate of tax (Te=1-rpost/rpre) to be calculated. This can then be used as an input to the formula-based WACC calculations. It is important to note that the formula-based WACC calculations will only provide an approximation of the actual WACC outcomes implied by the

cash flow calculations. In practice, Te is substantially below the corporate tax rate for assets amenable to accelerated depreciation.

Net cash flows necessary to service debt and the effective debt shield

The cost of debt is reduced by the value of the 'debt shield' (row 60) in reducing tax liabilities. Where the interest expense in a year reduces taxable income by a corresponding amount, the net cost of debt for investors is reduced by the corporate tax rate (T). However, where the taxable income is so low that the full interest deduction is not required to reduce tax liabilities to zero, the value of the debt shield benefit is deferred to a later period. This effect is analysed in rows 59 to 62. That part of interest expense used to defer tax is calculated in each period (row 60) and the unused part carried forward is embodied in the tax loss carried forward calculation (row 61). This allows the net cost to the firm of paying debt-holders, after taking account of the tax concession, to be calculated. The internal rate of return calculated (cell D62) represents the effective cost of debt, which is generally well below the nominal cost of debt based on current interest rates.

Where the available tax shield is fully utilised in every period, the effective cost of debt (rde) is reduced by a percentage equal to the corporate tax rate: rde = rd x (1-T). In this circumstance it could be said that the debt shield equates to the full corporate tax rate. When the tax shield is not fully utilised in every period, the effective debt cost is higher, corresponding to an effective debt shield (Td) being less than the corporate tax rate. The value of the debt shield can then be calculated by comparing the IRR from debt service cash flows with the nominal percentage for interest payment: Td=1-rde/rd. This is shown in cell C62. The number is relevant to the formula-based approximations to the WACC (calculated on the **WACC** sheet) in conjunction with the debt term in the formula. In practice Td is usually close to T.

Nominal cash flows to assets and calculation of WACCs

The cash flows to the different sources of capital (debt and equity) have been presented above, but the cash flows to the assets as a whole are of interest since these aggregate numbers characterise the nature of the regulated business.

The IRRs from these cash flows are the estimated WACCs expected from the application of the regulatory framework and have greater validity than any formula based approximations. They are summarised in the **WACC** sheet along with the formula based approximations. It should be noted that the WACC outcomes are calculated for reporting purposes only. They are not needed for setting revenues since the modelling already provides the requisite revenue forecasts needed to derive tariffs.

Once again, the revenue stream is the starting point. Pre-tax cash flows (row 64) involve deducting O&M and any ongoing capital expenditure. Post-tax cash flows are calculated by deducting estimated tax expenses. Again the corresponding real cash flows are calculated (rows 66 and 67) and the internal rates of return are calculated (cells D64 to D69).

The pre-tax cash flows to assets can be adjusted for the net tax costs after taking account of the value of imputation credits. This reveals the overall building block costs that must be covered before taking account of taxes. That is, it includes only those costs of capital implied in the calculation of the vanilla WACC. Unlike the other WACC calculations the vanilla WACC can be regarded as a regulatory input as it is based only on market-based regulatory parameters (re, rd and the assumed gearing ratio). Therefore it is expected that the IRR based on cash flows (cells D68 and D69) should validate the vanilla WACC input to the model in exactly the same way as the IRR of nominal cash flow to equity holders (cell D54) is required to match the value for CAPM determined re used as an input to the model.

Further dissection of cash flows

Rows 72 to 86 consider a further breakdown of net post-tax cash flow benefits available to equity holders (row 54). Elements separated out include contributions to capital expenditure, nominal depreciation of the regulatory asset base, debt repayments, and any net allowance for tax. This leaves that portion of cash flow in each period that might be identified as the nominal return on equity component (row 79). This may be checked against the equity holding at the start of each period (row 82) to derive the implied return on equity in that period. In a building block model this should confirm that the assumed return on equity is achieved in each period. Where the building block approach is not used (e.g. price path) the period by period returns may fluctuate; however, the whole of life return on equity would be confirmed. Similar calculations can be performed for real returns (rows 80, 81 and 83).

Where there is an allowance for tax in excess of liabilities in the period it is an extra component of return of capital that must be accounted for. If no extra debt is repaid then it must be a return of equity. Row 86 calculates the true value of residual equity under this assumption.

Five year analysis

Rows 88 to 101 provide an additional analysis of the cash flow to equity holders over a period of five years, the typical regulatory period. All earlier cash flow results were conducted over a time horizon equal to the remaining life of all the assets considered. The purpose of this section is to confirm that the desired re target remains over one regulatory period. Rows 91 to 99 are essentially an expansion of the calculations used to derive row 54 — that is, cash flow to equity holders inclusive of the value of imputation credits.

The only difference is that the residual value of remaining equity going into the next regulatory period (cell J98) is added to the cash flow in period five (cell J99). This represents the commercial value of equity in the asset at that time, and therefore needs to be included in assessing the five-year cash flow stream. The IRR estimate for the cash flows over the five years is calculated in cell D100 for validation against the target value input (cell D101).

Normalisation sheet

The **Normalisation** sheet provides a way of adjusting the depreciation profile to avoid revenue or price volatility in the face of rapid changes in the service provider's tax liabilities. This is achieved by adjusting depreciation to offset tax costs and making up the shortfall in accumulated depreciation by adding extra depreciation proportional to the RAB at row 20. The modified MAR is then calculated at row 28. The extra depreciation is sometimes referred to as the tax wedge since it effectively substitutes for the effect of taxes on revenues when they become payable.

Normalising the expected revenue stream

Normalisation involves smoothing tax payments over the life of the asset to avoid a sharp increase in the revenue requirement as taxes become payable. Without normalisation the revenue stream and therefore tariffs will initially be low as the firm takes advantage of available tax concessions (such as accelerated depreciation), and then higher as those concessions expire and tax liabilities become payable. This phenomenon is demonstrated in chart 1 — Revenue requirement (CH1-RevReq). Chart 2 — Building blocks (CH2-BldgBlks) shows the tax costs in comparison to other costs. The implied volatility in revenues and derived prices is considered undesirable.

To remove this volatility in revenues a normalisation process is used to make changes

Chart 1— Revenue requirement from Building Block model

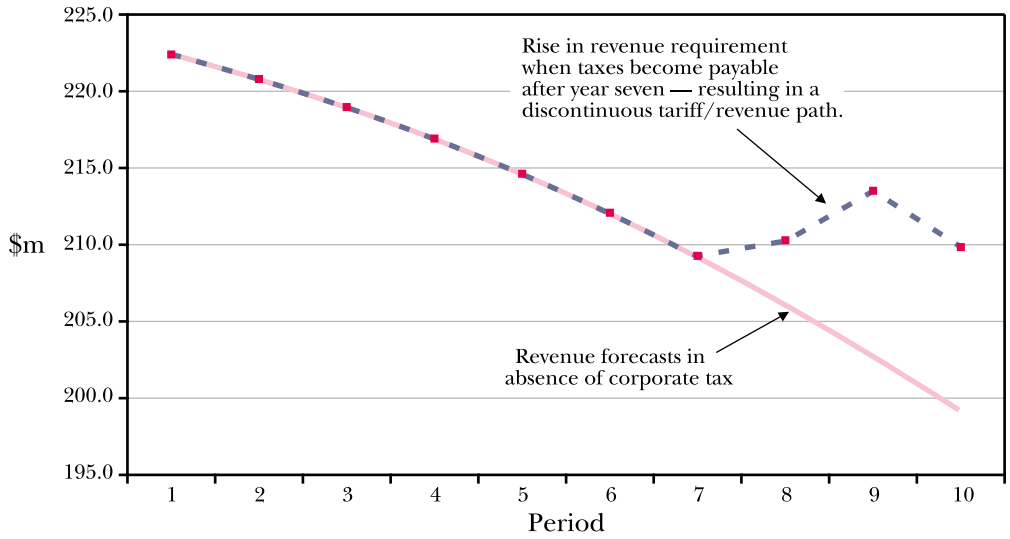
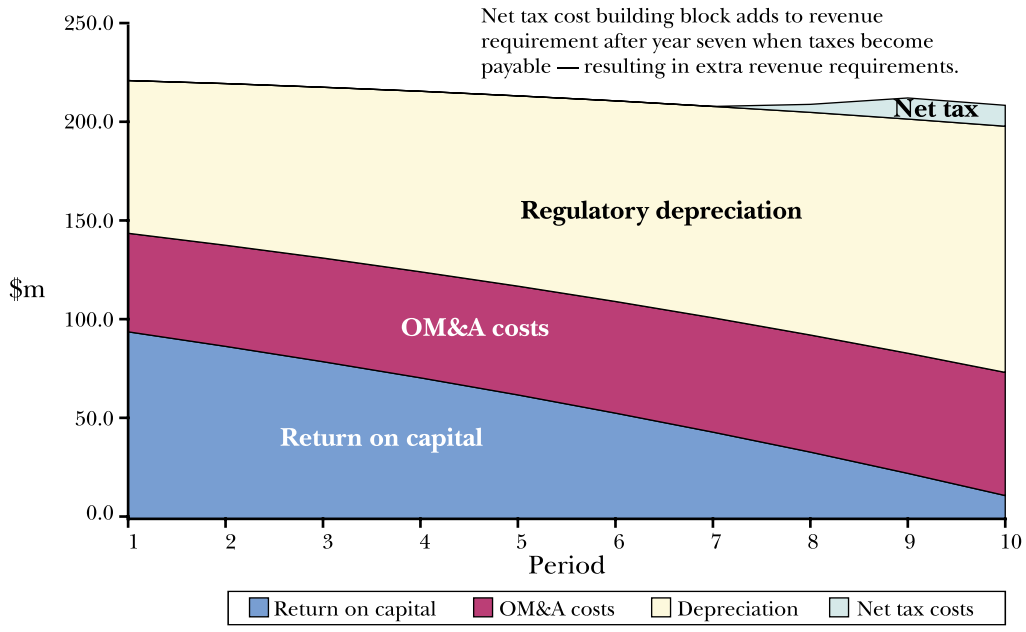


Chart 2 — Building Block cost components

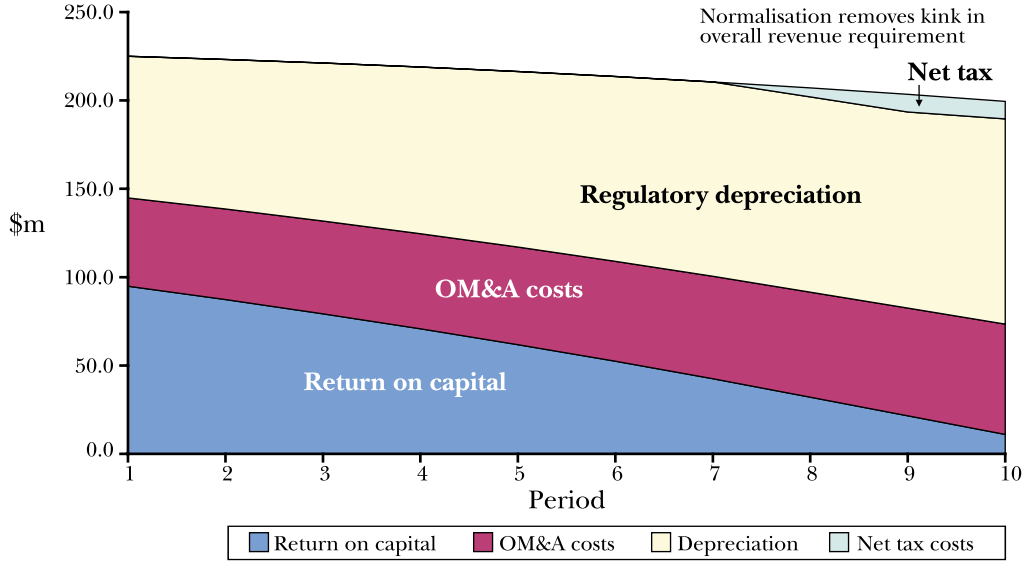


to the depreciation profile so that revenues in the building block approach are smoothed. This process involves three distinct stages to making the adjustments.

1. The allowance for depreciation is reduced by the amount of tax payable (over the regulatory period). This sculpting of the depreciation profile results in an overall revenue requirement similar to that illustrated in chart 3 — Normalised revenue (CH3-NormRev). Noting that at the end of the assets' expected life there will be a residual asset value equal to accumulated tax payments, highlights that this adjustment by itself is inadequate.

2. To ensure that depreciation does actually reduce the residual value of the RAB to zero at the end of its economic life, extra depreciation is added to the previous depreciation profile in proportion to the current value of the RAB. The actual proportion is calculated in the spreadsheet to achieve the zero RAB residual.

Chart 3 — Normalised revenue - Building Block components



The result of this is a smooth revenue profile in spite of volatility in tax payments. The normalisation process could end here. However, it is observed that the revenue profile actually falls below what would result if the corporate tax rate were zero. There is also a kink in the time profile of revenues when taxes become payable. These effects are to be expected given that the extra depreciation when no tax is payable leads to a faster write-off of the RAB value than observed in the unadjusted model and a slower rate when tax becomes payable. The lower value of the RAB over much of the assets' life means that the return on capital building block component is correspondingly higher at the start, and below at the end. While this remains perfectly consistent with providing a commercial return on the RAB it is not the complete adjustment.

3. The effect is remedied by making further adjustments to progressive depreciation to fill the perceived shortfall in revenues. This shortfall is equated to the cumulative impact of the extra depreciation over time multiplied by the rate of return and extra depreciation that would be applied to that value of the RAB. With the extra element of depreciation, the revenue profile is smoothed and runs an almost parallel path to the zero tax revenue path. The difference in these two paths can then be viewed as the premium in revenues needed to compensate for tax liabilities expected over the life of the assets — sometimes referred to as the tax wedge.

The extra depreciation allowance (tax wedge, is calculated (see row 20) as:

Extra depreciation = - Net tax liability + NF*RAB + (WACC + NF)*CED

Where each term in order corresponds to the adjustments noted in steps 1 to 3 above and:

NF = normalisation factor

RAB = nominal regulatory asset base

WACC = nominal vanilla WACC

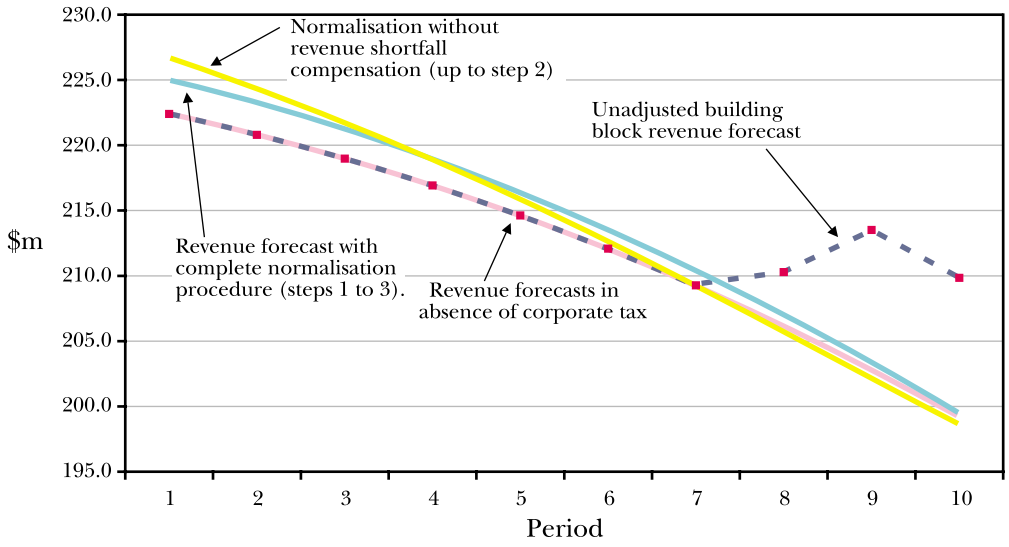
Net tax liability = tax payable less the value of associated imputation credits

CED = cumulative extra deprecation (recorded in row 14)

The module calculates the normalisation factor (NF) such that cumulative extra depreciation (CED) at the end of the asset life is equal to zero. The RAB value is progressively adjusted for the CED (row 11) so that flow-on effects are made to relevant parts of the building block model such as the return on equity and debt levels.

The effect of the tax wedge is easily observed graphically, and the NF estimate provides the corresponding tax wedge parameter. When added to the vanilla WACC it gives the pre-tax WACC consistent with the cash flow forecasts.

Chart 4 — Comparing revenue requirements before and after normalisation



Smoothing sheet

The first section of this sheet demonstrates how reference tariffs can be calculated from the MAR. Reference tariffs are calculated as the revenue requirement divided by forecast volume (row 18/row 24 = row 25).

The second section of this sheet converts the reference tariffs calculated above into a different series of tariffs that (while yielding the same NPV of revenue and post-tax cash flow over the regulatory period) follow a smooth path.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
2	**SMOOTHING PRICE PATH BASED ON BUILDING BLOCK MODEL**														
3	**Under the building block approach significant year to year variations in costs and/or forecast volumes can lead to undesirable**														
4	**volatility in calculated pricing designed to deliver the expected cost recovery.**														
5	**To avoid such volatility the pricing can be smoothed *within a regulatory period* while maintaining the key principle of cost recovery**														
6	**under the building block approach. This is done by allowing some cost revovery to be diverted to adjacent years within the regulatory period**														
7	**in such a way that the NPV of the post-tax revenues remains equal to the NPV of unadjusted costs. The CPI-X mechanisms for smoothing must be specified.**														
8	**Mechanism 1 - the starting price levels for period 1 (and 2,3 if desired) are specified and the accommodating X factor is calculated.**														
9	**Mechanism 2 - the price level and X factor is calculated to provide a smooth price transition to period 6.**														
10	**Mechanism 3 - the X factor is pre-specified and the accommodating price level is calculated.**														
11	**Suggestion: Experiment to find the X and price level combination that leads to smooth transition to pricing expected in the next regulatory period.**														
12	**Specify Price Mechanism (enter 1,2or3)**				**2**	Specify X factor = (Mechanism 3)		2.50%	Specify Period 1,2 & 3 prices (Mechanism 1)		4.00	-	-		
13															
14	**PERIOD**		**Start value**		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
15	Inflation assumption (CPI increase)					2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
16	CPI Index (end period)				100.0%	102.5%	105.1%	107.7%	110.4%	113.1%	116.0%	118.9%	121.8%	124.9%	128.0%
17															
18	**AGGREGATE REVENUE FORECAST($m)**				$841.47	222.40	220.80	218.97	216.92	214.63	212.08	209.28	210.29	213.52	209.84
19	O&M					50.00	51.25	52.53	53.84	55.19	56.57	57.98	59.43	60.92	62.44
20	Net Tax					-	-	-	-	-	-	-	4.08	10.68	10.66
21	Post-tax Cash Flow			NPV	$640.49	172.40	169.55	166.44	163.07	159.44	155.51	151.29	146.77	141.92	136.74
22															
23	Prices required to generate building block revenues														
24	Volume (PJ pa)					30	60	70	80	80	80	80	80	80	80
25	Unadjusted Prices ($/GJ)					7.41	3.68	3.13	2.71	2.68	2.65	2.62	2.63	2.67	2.62
26															
27															
28	Smoothed prices gererating NPV of revenues over the regulatory period (years 1 to 5)														
29	Volume (PJ pa)					30	60	70	80	80	80	80	80	80	80
30	Adusted Price ($/GJ)					4.40	3.98	3.59	3.25	2.93	2.65	2.62	2.63	2.67	2.62
31	Revenue ($m)			NPV	$841.47	132.1	238.7	251.6	259.8	234.7	212.1	209.3	210.3	213.5	209.8
32	O&M					50.00	51.25	52.53	53.84	55.19	56.57	57.98	59.43	60.92	62.44
33	Net Tax					-	-	-	-	-	-	-	4.08	10.68	10.66
34	Post-tax Cash Flow			NPV	$640.49	82.11	187.47	199.10	205.97	179.55	155.51	151.29	146.77	141.92	136.74
35															
36	Press to find smooth price path consistent with required NPV cost recovery.			**Period**		**1**	**2**	**3**	**4**	**5**					
37				**Smoothed Prices**		**4.40**	**3.98**	**3.59**	**3.25**	**2.93**					
38															
39				**X factor**		**11.86%**									

Setting tariffs and smoothing out annual fluctuations in tariffs

There are several ways that a service provider might wish to calculate reference tariffs from the maximum allowable revenue. This basic model assumes that the desired outcome is a single reference tariff. For simplicity of exposition it does not cover the situation where the service provider might wish, for instance, to implement multiple tariffs (e.g. zonal), a two-part tariff, or distance based tariffs.

It may be the case that the revenue resulting from the building block approach is not smooth over the access arrangement period (for example, as a result of capital expenditure). Where this is the case the Commission prefers to smooth the time profile of revenues by constraining it to follow a CPI-X path to prevent volatility in the reference tariff. Under this approach, revenues are increased annually by CPI-X where X is set such that the NPV of the smoothed revenue stream is equivalent to the NPV of the unsmoothed revenue stream. When the X is specified (cell H12), the level of the revenues is adjusted. Otherwise, revenue in the first (or last) year is left unchanged and the X adjusted to achieve the desired NPV equivalence.

It should be noted that this X factor relates purely to a price adjustment mechanism. It has little or nothing to do with actual productivity improvements in operations. This does not mean that the Commission ignores productivity improvements when assessing revenues. Rather, the preferred mechanism is to include any expectations of productivity gains directly into the forecasts of costs. To provide a reasonable basis for cost targets the Commission prefers to benchmark specific categories of costs for the asset being analysed. Such benchmarking may lead to estimates of rates of cost reduction or ‘best practice' cost benchmarks that a business should target over a feasible period.

Even where the building block revenue is smooth (as is the case in this simple example) and forecast volumes are not, then resulting reference tariffs will tend to be discontinuous over the access arrangement period. In this situation the Commission would also apply a similar approach to that discussed above but would focus on the level of tariffs rather than revenues. That is, a CPI-X formula would be applied annually to the reference tariff. In this case, when the X is specified the level of the tariffs is adjusted. Otherwise, tariffs in the first year (or last year if continuity with the next regulatory period is vital) are left unchanged and the X adjusted to achieve the desired NPV equivalence in expected revenues.

The advantage of the CPI-X path is that it provides an automatic adjustment mechanism to regulated revenues to compensate for errors in the forecast rate of inflation.

The **Smoothing** sheet applies this methodology to the smoothing of tariffs rather than revenues as that is probably the more common concern. The sheet could be easily modified to focus purely on revenues. One quick way of doing this would be to assume the same volume forecast in each year.

It is necessary to specify on the sheet (cell E12) which adjustment mechanism is to be used.

Value 1 — indicates that the first (and if desired 2nd and 3rd) period tariff is fixed and the X is selected to achieve the desired smoothed outcome (Note: specifying more than one period may require an extreme X value). [The starting tariff(s) must be specified in cell(s) L12 (L12 to O12).]

Value 2 — indicates that the tariff forecast at the beginning of the next regulatory period is set, while the tariff level and the X are selected to achieve the desired smooth transition to the tariff forecast at the beginning of the next regulatory period.

Value 3 — indicates that the X is pre-specified and the overall tariff level adjusted to achieve the desired NPV outcome. The X factor must be specified in cell H12.

An important consideration in selecting the mechanism and the initial value of the tariffs or the X will be the commercial viability of the tariffs and the need to avoid an undesirable price jump at the start of the next regulatory period.

Rows 14 to 16 record the standard period labels, inflation and CPI forecasts.

Rows 18 to 21 calculate the net post-tax cash-flow to the assets since this is the NPV value we wish to preserve in the interests of both the service provider and users. The NPV value of these cash flows is recorded in cell E21.

Rows 24 and 25 record forecast volumes and show the calculation of unadjusted average tariffs in each year.

Row 30 records the average tariffs that would emerge from the assumed price adjustment mechanism. And rows 31 to 34 record the new net post-tax cash flows. The NPV value is recorded in cell E34.

Pressing the lavender box calculates the parameters of the adjustment mechanism specified to achieve the NPV outcome desired. When this is done the values in cells E21 and E34 should be equal.

The smoothed prices for the regulatory period are recorded in row 37 and the accommodating X-factor recorded in cell F39.

Note: normalisation is used to adjust the revenue requirement to address the effects of tax depreciation being different to regulatory depreciation. The **Smoothing** sheet subsequently adjusts tariffs to mitigate the effects of such things as changing volumes and discontinuous O&M. This adjustment may be necessary in the case of a new pipeline or expanding pipeline system where demand is forecast to grow gradually or capital expansion is not met with immediate demand.

The approach to smoothing based on maintaining the NPV of building block revenues is illustrated as it has been proposed by a number of service providers. However, it should be noted that the preservation of the NPV of revenues will not necessarily preserve the NPV of equity returns. In other words, the smoothed return on equity expected over the period may differ from that indicated by the WACC assumptions. While the deviance is expected to be small in most cases, the smoothing procedure can be modified so that return on equity is preserved during the smoothing adjustment rather than the NPV of revenues. Essentially this means moving to the price path approach described in the next section which achieves smoothing similar to the approach here but specifically targets the return on equity while determining the path.

3. Advanced modules: price path

The Gas Code identifies the net present value (NPV) and the internal rate of return (IRR) approaches as alternatives to the building block (cost of service) approach for establishing regulated revenues and reference tariffs. Normally this is taken to mean that the service provider can select any reference tariff price path consistent with its marketing objectives, provided other criteria specified in the code are met. This module provides a mechanism for doing this based on the NPV or IRR criteria.

NPV and IRR

Under the NPV approach a price path is acceptable if expected revenues provide net cash flows to assets that equate to the initial value of the asset (or the contribution to the asset by the investor) when the cash flows are discounted by the appropriate rate of return.

The IRR approach is similar. A price path is acceptable if expected revenues provide net cash flows to the assets that, when included with the initial value of the asset (or the contribution to it by the investor), generate an appropriate rate of return. For example, the IRR for investor cash flows must equate to the rate of return expected by investors facing similar commercial risks.

These criteria are essentially the same. They are basically two sides of the same coin. That is, if the NPV criteria are satisfied, the IRR criteria will also be satisfied, and vice versa. This is a mathematical necessity since the NPV criteria using the benchmark commercial rates of return as the discount rate can only be satisfied if the cash flows themselves exhibit an IRR equal to those same benchmark rates of return.

The price path approach

The building block approach is consistent with the NPV and IRR approaches. However, the building block approach also generates a particular price path for revenues linked to the depreciation framework selected. This price path may not always meet the needs of a service provider in terms of market development or pricing efficiency.

While the building block model helps to develop the price path so it can meet these objectives while satisfying the IRR and NPV criteria, the NPV and IRR approaches provide greater flexibility to accommodate specific objectives of the service provider.

PricePath and **PPCashFlow** sheets

The module is developed over two Excel worksheets. The first (**PricePath**) allows the form of the price path to be determined, and the second (**PPCashFlow**) calculates the implied cash flows. A solution mechanism is included to adjust the price path parameters in such a way that the cash flow criteria (IRR and NPV) are satisfied.

The solution mechanism works within the building block framework by adjusting regulatory depreciation to accommodate a desired price path. In effect the three approaches can be regarded as compatible with the only difference being the way regulatory depreciation is determined. For instance, when early revenues do not cover costs, negative depreciation may be calculated and added to the value of the RAB to be recovered in later periods as the market grows. This was the approach used by the Commission in setting tariffs for the Central West Pipeline.[19]

The **PricePath** sheet incorporates two important price path approaches that should cater for most service providers' needs. Others may be designed, although some changes to the model may be required for the solution algorithm to work. Both price paths are based on CPI-X adjustments to tariffs over time. As previously mentioned, this provides an automatic mechanism for adjusting tariffs to take account of ongoing inflation and provides for the corresponding changes in rates of return observed in commercial markets.

[19] See section 3.4 of the Commission's final decision, *Access Arrangement by AGL Pipelines (NSW) Pty Ltd for the Central West Pipeline*, June 2000.

The price path mechanism needs to be specified in cell E12.

Value 1 — indicates that the initial price(s) is (are) specified and flexibility is provided by the X factor which is subsequently chosen so that the NPV/IRR criteria are satisfied. The initial prices in period 1 and possibly periods 2 to 5 are specified in cells L12 to O12. The value in period 1 must be specified. If one or more of the next few periods are left blank or set to zero the CPI-X adjustment mechanism will assign the price in those periods. [If there are multiple services to consider, the initial values may be hard coded in the respective price path rows e.g. cells F23 to J23, F28 to J28 etc.]

Value 2 — indicates that the X in the CPI-X adjustment mechanism may be specified in advance. This may be done, for example, to achieve a set rate of real price decrease. This value of X must be specified in cell H12. In this mechanism the overall level of prices is adjusted to satisfy the NPV/IRR criteria.

Multiple services may be accommodated but it is assumed that the same price adjustment mechanism will apply to each. It is also assumed that the same price path adjustment is sustained over the economic life of the assets involved. However, in practice the price path can be reconsidered at each regulatory review.

Rows 14 to 16 include the standard period labels, inflation and the CPI forecasts. Row 18 records the aggregate revenues that would occur given the price paths chosen and the volume forecasts. If multiple services are considered, the revenues from each must all be aggregated in this row, which is used in the cash flow analysis (**PPCashFlow** sheet).

In row 22 forecast demand for the service must be recorded over the life of the asset. The module assumes these volumes are insensitive to the price set for the services. However, it is a simple modification to make the volume forecasts sensitive to the prices calculated. The revenue associated with these volume forecasts and prices is calculated in row 24 and is aggregated with revenue from other services (row 18).

Rows 21 to 24 may be repeated for each service identified. Multiple part tariffs may also be accommodated by assuming that each part of the tariff is linked with a different service.

It should be noted that the X factor used in this context does not relate to actual productivity improvements in operations. As stated earlier the Commission captures forecast productivity directly by benchmarking different elements of cost that appear in the cash flow analysis.

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