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

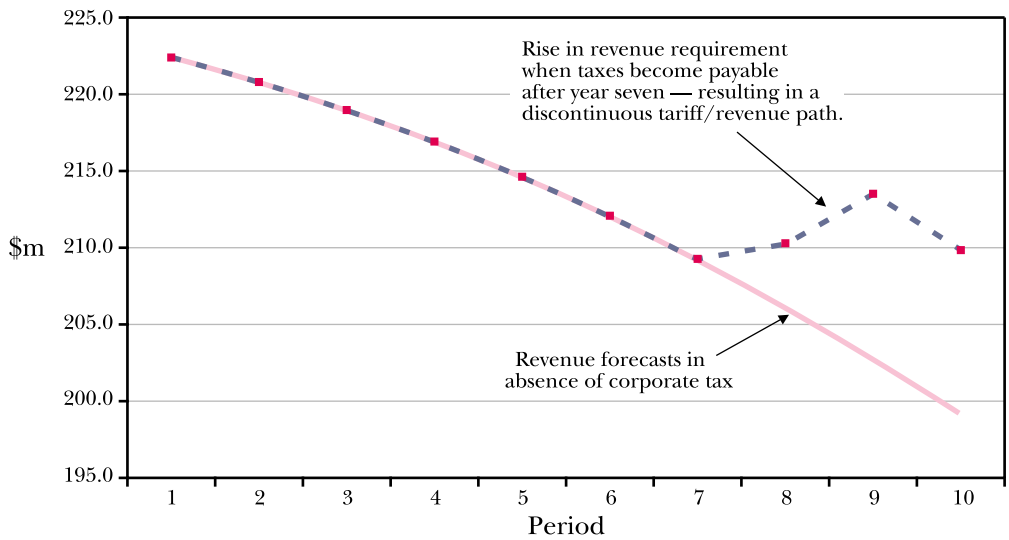
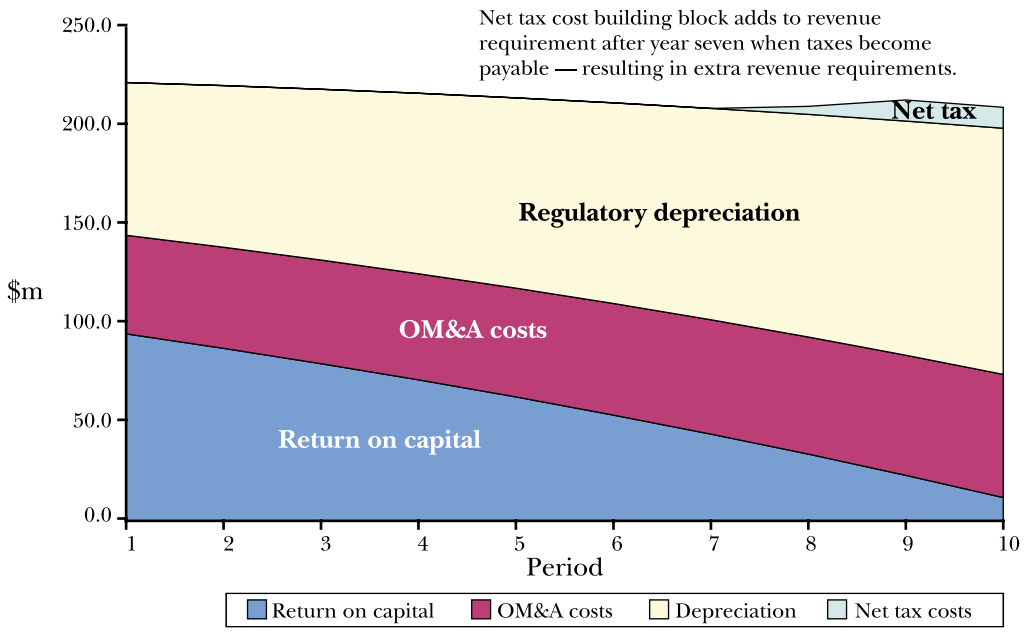


Chart 2 — Building Block cost components

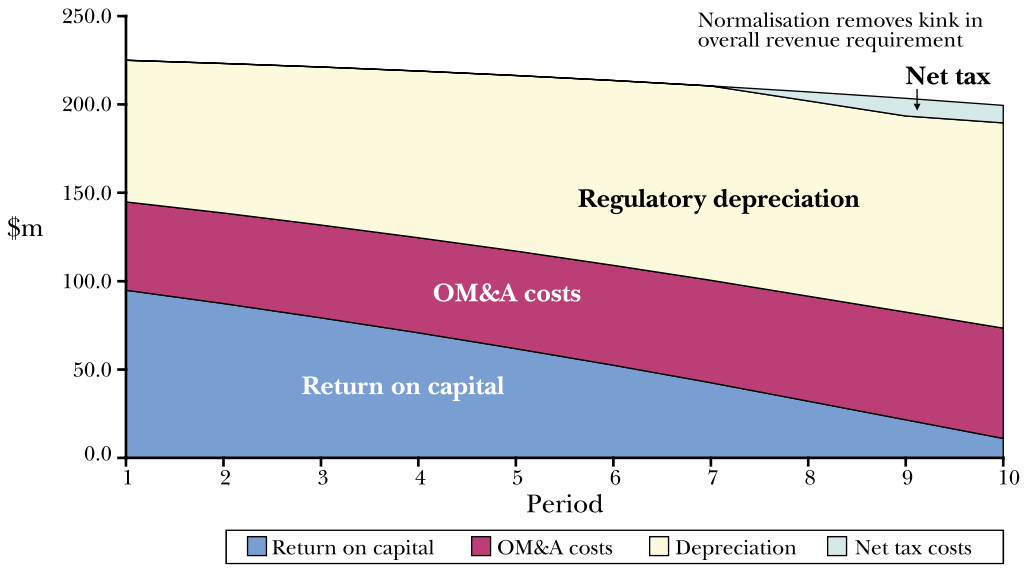


to the depreciation profile so that revenues in the building block approach are smoothed. This process involves three distinct stages to making the adjustments.

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

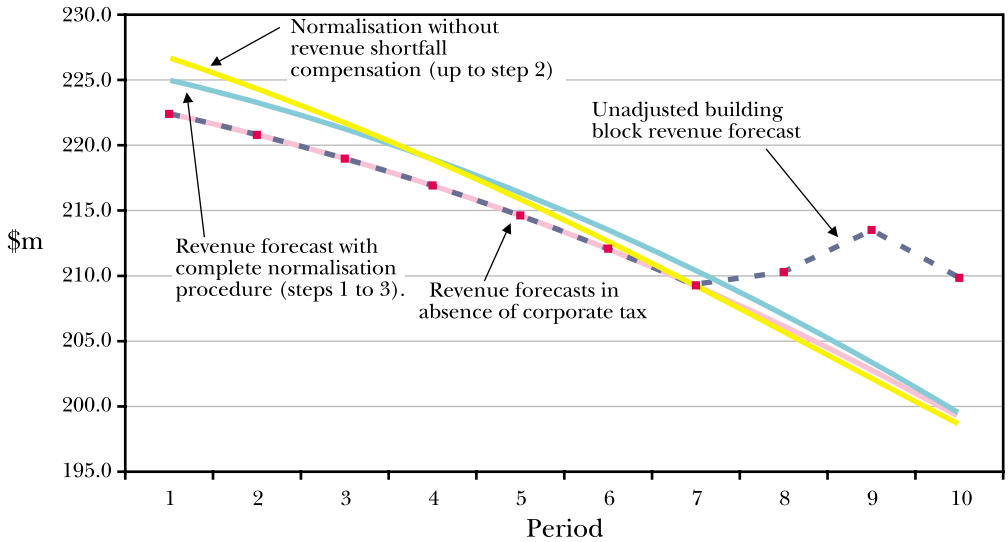
Net tax liability = tax payable less the value of associated imputation credits

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 =		2.50%	Specify Period 1,2 & 3 prices			4.00	-	-	
13						(Mechanism 3)			(Mechanism 1)						
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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