COMMERCE COMMISSION NEW ZEALAND
Te Komihana Tauhokohoko

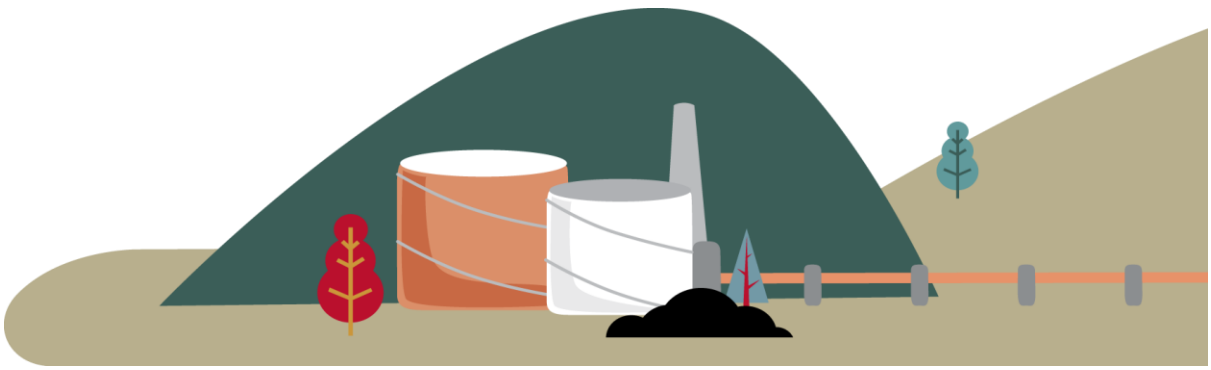
Project no. 15.01/14119

PUBLIC version

Default price-quality paths for gas pipeline services from 1 October 2017

Model specification for the 2017 GPB reset financial model

Date of publication: 1 July 2016



Contents

Purpose

1. The purpose of this document is to provide:

    1.1 the model specification against which the model will be constructed and peer reviewed;

    1.2 a record of the rationale for the analysis and decisions set out in this specification;

    1.3 the record of analysis, such as algebraic derivations, that are a bridge between the high level decisions made by the Commission and the line-by-line formulas in the model.

Introduction

2. This specification is being released along with the draft 2017 gas default price-quality path (DPP) reset financial model (early exposure draft model) and high level specification.

3. In this specification we first discuss the broader concepts in specifying the model and then consider more detailed aspects of the modelling. This document includes:

    3.1 a list (section starting at paragraph 53) of features in the draft model that are not present in the electricity distribution business (EDB) model;

    3.2 a brief description of the overall methodology of the EDB model;

    3.3 a discussion of each of the features that have been added to the EDB model to create the early exposure draft model;

    3.4 a model structure section with a sheet-by-sheet description of the model listing inputs, key calculations and outputs;

    3.5 a more detailed discussion of each listed feature, under the headings: timing issues, form of control, early base year and tax allowance.

4. The high level decisions to which the model is specified are set out in the high level specification, and not this specification.

5. No new material decisions have been assumed in building the model. However, some potential decisions have been provided for in that data inputs have been provided for those potential decisions to enable either the status quo or the potential decision to be reflected in the model calculations and outputs.

6. Those potential decisions are:

    6.1 a change in the form of control. The model can accommodate either a weighted average price cap or a total revenue cap for any of the regulated suppliers;

6.2 allowing an early base year for any of the suppliers;

6.3 adopting either a tax payable or a deferred tax approach to determining the tax allowance;

6.4 proposed amendments to the Input Methodologies, as contained in the Input Methodologies draft determinations released on 22 June 2016, have been followed in the preparation of this specification and the early exposure draft model (released June 2016).

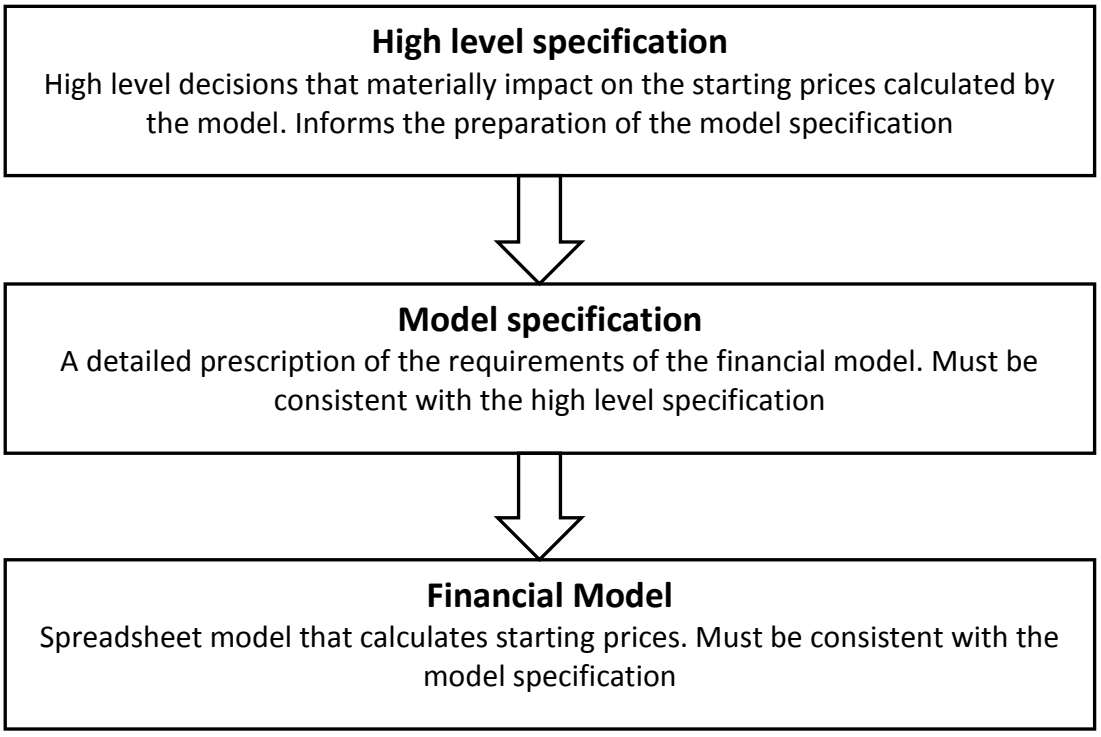
Interrelationship between the financial model, high level specification and model specification

7. This model specification, the high level specification, and the financial model have been released in the week ending 1 July 2016. Releasing model specifications is a new process for us, and we would appreciate stakeholders' views on these documents.

8. The purpose of the financial model is to determine the starting prices in the 2017 gas DPP reset for the gas pipeline services that are regulated under Part 4 of the Commerce Act.

9. The high level specification records the decisions that materially impact on the calculation of the starting prices in the model. The high level specification informs the preparation of the model specification.

10. This model specification provides a more detailed prescription of the model requirements.



Naming the suppliers

11. As noted in the high level specification, the early exposure draft model is to calculate the price path for six gas networks. Those networks, and the names to be used as column headers in tables in the early exposure draft model, are as follows:

Network	**Short name as column heading**
GasNet distribution	GasNet
Powerco distribution	Powerco
Auckland distribution networks, continued ownership by Vector	Vector
First Gas non-Auckland distribution network	1st Gas non-Auck
First Gas transmission, previously owned by Vector	1st Gas trans Vct
First Gas transmission, previously owned by Maui Development Ltd (MDL)	1st Gas trans MDL

Form of control

12. Currently the gas distribution businesses are subject to a weighted average price cap and gas transmission businesses to a total revenue cap. This could change as part of the Input Methodologies (IM) review. Another potential change is to the use of forecast current quantities in the specification of price, rather than lagged quantities.

13. Our IM draft decision is that gas distribution businesses (GDBs) will be subject to a weighted average price cap with lagged quantities and gas transmission businesses (GTBs) will be subject to a revenue cap with forecast quantities, with an associated wash-up.

14. The maximum allowable revenue roll-forward formula in the early exposure draft model reflects this IM review draft decision. In practice, this does not require a change from that in the 2013 GPB DPP model. The form of control can be specified in the draft model supplier-specific input data as being either a:

- weighted average price cap with lagged quantities, or
- total revenue cap with forecast quantities.

Implementing the financial capital maintenance principle

15. Implementing the financial capital maintenance principle set out in the high level specification is based on applying the following formula from that specification: [1]

Opening RIV = Present value of cash flows + Present value of closing RIV, where:

- RIV = Regulated Investment Value = Regulated asset base (RAB) + deferred tax balance;
- Present values and opening value are as at the start of the building blocks allowable revenue (BBAR) period;[2]
- The discount rate used in the present value calculations is the 67th percentile of the vanilla weighted average cost of capital (WACC).

16. This formula is applied for one BBAR period at a time, so the opening and closing values are as at the start and end of the BBAR period respectively, while the cash flows are those that occur during the BBAR period.

17. Appendices A and B of this specification are an algebraic derivation of a number of formulas that are used in this specification. The starting point for much of this derivation is the formula above. For example, the first step in each attachment is to derive the following formula from the one above.[3]

$RAB_0 + DT_0 = PV_{start}(Cash\ flows) + (RAB_1 + DT_1)/(1 + WACC)^{n/365}$ *where:*

- RAB_0 *and* RAB_1 are the RAB at the start and end of the BBAR period respectively;
- DT_0 *and* DT_1 are the deferred tax balance at the start and end of the BBAR period respectively;
- $PV_{start}(Cash\ flows)$ is the present value, as at the start of the BBAR period, of the cash flows during the BBAR period;
- n is the number of days in the BBAR period.

18. This formula is then used in Appendix A to develop a formula for the BBAR for each BBAR period.

19. The timing of the cash flows is a key part of determining the present values, and is discussed in this specification under the heading “Timing Issues”.

[1] See the high level specification for a definition of each of these terms and further context.
[2] For a definition and discussion of BBAR period, see the ‘Definitions’ section of the high level specification.
[3] See Appendix A for a derivation of this formula and a definition of each of these terms used.

The role of the input methodologies

20. The input methodologies that have the most impact on specifying the financial model are the Part 3 input methodologies for specification of price and the Part 4 input methodologies for asset valuation and tax.

Timing issues

Year-end alignment

21. The year-ends used for information disclosure by the gas pipeline businesses (GPBs) are different between the six networks, being:

- December year-end for the former MDL network;
- June year-end for the former Vector transmission network;
- June year-end for the former Vector distribution non-Auckland network;
- June year-end for the Vector Auckland distribution networks;
- June year-end for the GasNet network;
- September year-end for Powerco.

22. Except for the Powerco network, these year-ends do not align with the 30 September year-end on which the next five-year regulatory period is likely to be based, ie, 1 October 2017 to 30 September 2022.

23. This lack of alignment leads to significant additional complexity in the GPB modelling, as described below.

Draft model approach to BBAR periods

24. For the early exposure draft model, part of the BBAR modelling is for each 12 month disclosure year (as that term is defined in the IMs) that falls entirely within the regulatory period. That modelling of itself potentially leaves a part year at the start and another part year at the end of the regulatory period that are not covered by such 12 month BBAR calculation.

25. To cover these part years we have further assumed that any such part year will also have a BBAR calculation. We define “BBAR period” to refer to each such part year or full year. The model shall calculate a BBAR for each BBAR period.

Timing assumptions for full years

26. Operating expenditure, asset commissioning, tax cash flow, other regulatory income and tax payable cash flows will occur on average at the middle of the BBAR year, ie, 182 days before year-end.

27. Term credit spread differential (TCSD) cash flows occur at year-end.

28. Revenue cash flows occur monthly on the 20th of the month following the provision of the service, with the 12 monthly cash flows being equal to each other. This is modelled as a present value equivalent single annual amount equal to the sum of the 12 monthly amounts and occurring 148 days prior to year-end.

Timing assumptions for part year [4]

29. Opex, asset commissioning, tax cash flow, and other regulatory income will occur on average at the middle of the BBAR period.

30. TCSD cash flows occur at BBAR period-end.

31. Tax cash flows (ie, tax payable amounts) occur at the middle of the BBAR period.

32. Revenue cash flows occur 34 days after the mid-BBAR-period cash flows.[5]

Pro-rata reduction of full year amounts for BBAR periods that are a part year

33. As required by the policy specification, data that is initially available to the model only on a full-year basis which is required for a BBAR period that is a part year shall be adjusted on a pro-rata basis.

34. This pro-rata calculation shall be performed for each of:

- Value of commissioned assets
- Term credit spread differential
- Revaluation
- Operating expenditure
- Increase in deferred tax
- Other regulated income
- Depreciation
- Regulatory tax adjustments
- Tax depreciation
- Notional deductible interest.

[4] The timings set out in this section also work for BBAR periods that are a full year.

[5] This value of 34 days is very close to the time period between the middle of one month to the 20th of the following month. It is also equivalent to the timing assumptions for full years, ie, 182 days before year-end for mid-year amounts and 148 days before year-end for revenues, noting that 182 – 148 = 34.

Linear interpolation of balance amounts

35. As required by the policy specification, data that is initially available to the model only as at the end-of-disclosure-years, and is required as at the beginning and end of the regulatory period, shall be determined by linear interpolation. Accordingly:

    35.1 opening values of RAB and deferred tax shall be calculated as at the start of the regulatory period by linear interpolation;

    35.2 closing values of RAB and deferred tax shall be calculated as at the end of the regulatory period by linear interpolation.

Early base year

36. An early base year, if used at all, is only likely to be used for Powerco for the final decision, but could be used for other businesses for the draft decision. Whether an early base year is to be used may not be made until late in the process. The option has been built into the model to allow the choice to be made via a business-specific input data item.

Tax allowance

37. Gas transmission businesses have had tax allowance calculated on a tax payable basis, which was not a feature of the EDB model. It was however a feature of the 2013 gas reset model.

38. The model provides the flexibility to choose the tax approach for each of the six businesses via a business-specific data input.

Tax losses

39. In all DPP financial models to date we have assumed that tax losses will not arise in the BBAR calculations and have not provided for them in those models. A test for tax losses has been applied with #N/A error values being deliberately generated in the unlikely event of a tax loss.

40. For the early exposure draft model, we have again made the assumption for modelling purposes that tax losses will not arise. The model shall adopt the simple approach of not providing for them, except for a test that if the model indicates a tax loss, the error value #N/A will be adopted by the model as the tax allowance. This error value would then propagate through BBAR and maximum allowable revenue (MAR) values through to the outputs as a very clear signal that the assumption is incorrect.

41. Tax loss calculations would add unnecessary complexity to the model, and be unlikely to be required.

42. We have considered the possibility of the purchase of gas pipeline assets by First Gas Ltd resulting in significantly different tax asset values. This could in turn lead to tax

losses. For good but somewhat complex reasons, we do not consider that this will arise. This will be checked when the relevant input data is first available.

How the model is specified

43. This document specifies most of the calculation methodology required.

44. In addition to this specification, for some of the lines in the model, the "Notes" sheet within the model describes the methodology used and in some cases its rationale. The methodology in the Notes sheet is generally intuitive and is more of an "as-built" description rather than a specified methodology. References to the numbering of each item in the Notes sheet is indicated in column L in the RAB and Tax sheets and column M in the other model sheets. That column has a column heading in Row 1 of "Spec ref".

45. The "Spec ref" column provides a number of references as follows:

    45.1 where the column contains a simple number, then it is a reference to the Notes sheet as described above;

    45.2 where the column contains "simple ref" the row is a simple repetition of another row further up the sheet;

    45.3 where the column contains the name of another sheet, then it is in a row in the inputs section of a sheet. This data linkage between sheets will be from the Outputs section of the precedent sheet.

The gas pipeline businesses financial model "as built"

We set out in this section how the early exposure draft model has been built.

GPB model from EDB model

46. The early exposure draft model has been developed from a copy of the 2015 EDB DPP reset financial model (EDB model), adapted as necessary to reflect the requirements of the GPB DPP reset.

47. In the section immediately below we set out the approach to determining BBAR values in the EDB model. Apart from the references to the year-end timings applied to EDBs, all of the features described have been repeated in the GPB model. We then discuss the additional features that form part of the GPB model.

EDB BBAR approach to BBAR calculations

48. For the EDB model, we calculated a BBAR for each of the five BBAR periods that made up the regulatory period and then calculated the present value of the combined BBARs as at the start of the regulatory period. Each of the five BBAR periods comprised a disclosure year ending 31 March.

49. This present value of allowable revenue for the entire regulatory period was used to determine a price path that also had the same present value, with the starting price for that price path being adjusted to achieve this present value equivalence.

50. An exception to this present value equivalence can arise if an "additional allowance" is provided for. This additional allowance is an input data item, and reflects an allowance to potentially reduce the likelihood of the supplier applying for a CPP.

51. The price path comprised a set of five MARs with each of these having a 31 March year-end.

52. The calculation of the BBAR for each of the BBAR periods requires each of the building blocks (return on capital, return of capital, operating expenditure, tax allowance and other regulated income) for a BBAR period to be adjusted with a discounting calculation to ensure each building block was expressed as at the same date. This common date was chosen to be the end of each respective BBAR period.

Additional features in the early exposure draft model

53. The early exposure draft model contains the following features which are not present in the EDB model:

    53.1 **Timing:** The year-end date for information disclosure and BBAR periods being different from the year-end on which the regulatory period is based, and those information disclosure year-end dates being different between the five gas pipeline businesses.

    53.2 **Form of control:** some businesses are subject to a total revenue cap rather than a weighted average price cap. There is also a possibility that a revenue cap will be in terms of forecast quantities, rather than the lagged quantities that have been used to date. In practice however, the use of current quantities versus lagged quantities makes no change in the modelling for a total revenue cap.

    53.3 **Early base year:** The model provides, for each business, the option of an "early base year". This applies particularly to Powerco, which is the only GPB with a September year-end for information disclosure. Powerco's date means that if the usual approach to choosing the dates of the base year for data input to the financial model were to apply, there would be only two months between the Commission receiving Powerco's information and publishing starting prices. Making the base year 12 months earlier than the usual approach may be required and involves having a process to roll-forward RAB values, tax book values, etc, for an additional year.

    53.4 **Tax allowance:** Some businesses have their tax allowance based on a tax payable rather than a deferred tax approach.

Sheet-by-sheet description of the model

Inputs

54. All the inputs required to run the model are entered via the inputs sheet. They are a mixture of supplier-specific and industry-wide inputs.

Industry-wide inputs

- First BBAR year
- Forecast changes in Consumer Price Index (CPI) used for revaluations, March year-ends
- Forecast changes in CPI used for revaluations, June year-ends
- Forecast changes in CPI used for revaluations, September year-ends
- Forecast changes in CPI used for revaluations, December year-ends
- Forecast changes in the CPI element of the price path
- Corporate tax rate
- Days in a year
- Days from mid-year to year-end
- Days from revenue date to year-end
- Day prior to start of the regulatory period
- Vanilla WACC (67th percentile)
- Cost of debt
- Leverage
- Remaining asset life for additional assets
- Industry-wide X-factor

Supplier-specific inputs

- Early base year adopted?
- Last day in the standard base year
- Tax payable (payable) or deferred tax (deferred)
- Total revenue cap (TRC) or weighted avg price cap (WAPC)
- Opening RAB
- Total depreciation
- Closing RAB
- Opening RAB excluding revaluations
- Adjusted depreciation
- Tax depreciation
- Opening regulatory tax asset value
- Amortisation of initial differences in asset values
- Term credit spread differential allowance
- Opening deferred tax balance
- Additional allowance in 30 Sep 17 present value (PV) terms
- Alternative X-factor
- Operating expenditure
- Constant price revenue growth (CPRG)
- Value of commissioned assets
- Value of disposed assets

- Other regulated income

GPB data

55. This sheet has functionality to select a specific supplier. The sheet then extracts all input data for the selected supplier from the Inputs sheet. The purpose of this sheet is to organise the data in a supplier-specific way to be used in subsequent tabs. All sheets after the "GPB data" sheet relate to the supplier selected in this sheet.

Timing

56. This sheet derives the three timing factors TF_{mid} TF_{tax} and TF_{rev}.

Inputs

- Days from mid-year to year-end
- Days from revenue date to year-end
- Vanilla WACC (67th percentile)
- Last day in the standard base year
- Day prior to start of the regulatory period

Calculations

57. All calculations in the timing sheet are discussed in the "Timing Issues" section of this specification and the "Timing factors" sections of Attachments A and B.

Outputs

The outputs from the Timing sheet are:

- TF_{rev} for MAR calculations
- Number of days in the BBAR period
- Proportion of building blocks year that is in PV period
- TF_{mid} – Used to convert mid-period cash flows to mid-period cash flows in BBAR year-end terms
- TF_{tax} – Used to convert tax date terms to period – end terms
- TF_{rev} – Used to align with revenue date terms

RAB

58. This sheet sets out asset schedule calculations for each BBAR year. The outputs of the RAB sheet are inputs to the calculation of the return on capital, return of capital (depreciation), revaluations and tax allowance as part of the BBAR for each BBAR period.

Inputs

The key inputs are:

- The opening and closing RAB value in the base year
- Total depreciation in the base year

- Value of disposed assets
- Value of commissioned assets
- Remaining asset life for additional assets
- Forecast change in the CPI used for revaluations

Calculations

59. The methodologies for the calculations in this sheet are set out in the Input Methodologies.[6]

Outputs

The outputs of the RAB sheet are:

- Aggregate opening RAB value
- Total revaluation
- Total depreciation
- Aggregate closing RAB value

Tax

60. The tax sheet calculates a number of tax related parameters, but does not calculate the tax allowance itself. That calculation requires the BBAR revenue, which is not calculated until the BBAR sheet.

61. The sheet includes calculation of "adjusted depreciation" which essentially requires repeating the asset schedule calculations in the RAB sheet, but with no revaluations being accounted for.[7]

Inputs

- Corporate tax rate
- Value of commissioned assets
- Remaining asset life for additional assets
- Amortisation of initial differences in asset values
- Value of disposed assets
- Opening RAB excluding revaluations
- Adjusted depreciation
- Tax depreciation
- Opening regulatory tax asset value
- Opening deferred tax balance
- Cost of debt
- Leverage
- Remaining asset life for existing assets
- Total depreciation

[6] Subpart 2 of Part 4 of the GDB IM and Subpart 2 of Part 4 of the GTB IM.

[7] See the definition of "adjusted depreciation" in the Interpretation section (1.1.4) of the relevant input methodology.

- Term credit spread differential allowance
- Opening investment value

Calculations

62. The methodologies for the calculations in this sheet are set out in the Input methodologies.[8]

Outputs

The outputs of the tax sheet are:

- Opening deferred tax
- Closing deferred tax
- Regulatory tax adjustments
- Tax depreciation
- Notional deductible interest

BBAR

63. The key output of this sheet is the total of the present values of the BBAR of each BBAR period. The building blocks include revaluation, return of capital (depreciation), return on capital, operating expenditure allowance and tax allowance.

Inputs

- Vanilla WACC (67th percentile)
- Term credit spread differential allowance
- Corporate tax rate
- Other regulated income
- Value of commissioned assets
- Operating expenditure
- Day prior to start of the regulatory period
- TF_{mid}
- TF_{tax}
- TF_{rev}
- Aggregate opening RAB value
- Closing RAB, 6th BBAR year
- Total revaluation
- Total depreciation
- Opening deferred tax
- Closing deferred tax
- Regulatory tax adjustments
- Tax depreciation
- Notional deductible interest
- Proportion of BBAR year in the regulatory period
- Number of BBAR days in the BBAR period

[8] Subpart 3 of Part 4 of the GDB IM and Subpart 3 of Part 4 of the GTB IM.

Calculations

64. The BBAR sheet performs a number of key calculations being:

64.1 calculating amounts relating to each BBAR period from data for the full BBAR year, using a pro-rata calculation;

64.2 calculating asset balance amounts for RAB and deferred tax as at the start and end of the regulatory period by linear interpolation;

64.3 directly calculating values for each building block, other than the tax allowance, from the information referred to in the previous two list items;

64.4 calculating the BBAR value using a formula derived in the attached derivations, that formula being one that breaks the circularity problem of not being able to readily calculate either the BBAR without first knowing the tax allowance and not being able to readily calculate the tax allowance without first knowing the BBAR;

64.5 calculating the tax allowance building block, using the BBAR value calculated per the previous list item;

64.6 calculating the BBAR using a simple direct formula that uses the tax allowance amount per the previous list item, and performing a check that this is identical to the BBAR first calculated

65. The calculation of the BBAR and tax allowance is set up twice in the BBAR sheet: once for calculations according to the deferred tax approach and once for the tax payable approach. The block of calculations not being used in relation to the selected supplier is greyed-out (using conditional formatting) to indicate that it is not applicable.

66. The key output of total present value of the BBARs is used in the MAR sheet, where the allowed revenue in the first year of the regulatory period is adjusted to achieve present value equivalence between the BBARs and the MARs.

Outputs

- Present value of BBAR as at the start of the regulatory period
- Opening investment value at start of regulatory period
- Closing investment value at end of regulatory period
- Term credit spread differential allowance, full BBAR years
- BBAR before tax in revenue date terms
- Opening investment value (full BBAR year values)

Rev

67. This worksheet calculates a normalised profile of the MAR values.

Inputs

- Constant price revenue growth
- Industry-wide X-factor
- Alternative X-factor
- Forecast changes in the CPI element of the price path
- Total revenue cap (TRC) or weighted average price cap (WAPC)

Calculation

68. This worksheet calculates the growth in MAR, taking account of:

- CPI-X adjustments
- X value of either an industry-wide X or an alternative X
- Growth in quantities of services supplied, which is forecast as CPRG
- Whether a weighted average price cap or a total revenue cap is to apply

Output

- Indexed maximum allowable revenue before tax—industry-wide X-factor
- Indexed maximum allowable revenue before tax—applicable X-factor

MAR

69. This worksheet calculates a time series of MAR values, such that the profile of the series is the same as the normalised MAR profile from the Rev sheet, with that profile being scaled to achieve present value equivalence between the BBAR series and the MAR series. The MAR series is the MAR for each year of the regulatory period including year 1 (starting price).

Inputs

- Industry-wide X-factor
- Additional allowance in 30 Sep 2017 PV terms
- Alternative X-factor
- Vanilla WACC (67th percentile)
- TF_{rev}
- Constant price revenue growth 2016
- Constant price revenue growth 2017

- PV at 30 Sep 2017 of BBAR before tax over the regulatory period
- Indexed maximum allowable revenue before tax—industry-wide X-factor
- Indexed maximum allowable revenue before tax—applicable X-factor
- Form of control

Calculations

70. The key output of the sheet is the time series of MAR before tax in revenue date terms.

71. The scaling factor used to convert the normalised MAR profile to the MAR time series is:

Present value of BBAR, including any additional allowance ÷ present value of the normalised MAR profile

72. The sheet also calculates Delta D (ΔD) which is used for GDBs. The draft IM decision is for GDBs to continue on a weighted average price cap with lagged quantities. ΔD is effectively the conversion factor to determine a notional revenue (ie, using lagged quantities) from a revenue (ie, using current quantities). It is calculated as 1+CPRG for the first year of the regulatory period multiplied by 1+CPRG for the previous year.

Outputs

- MAR before tax in revenue date terms for industry-wide X-factor
- MAR before tax in revenue date terms for applicable X-factor
- Starting price for industry-wide X-factor
- Starting price for applicable X-factor
- PV at 30-Sep-17 of MAR before tax over the regulatory period (applicable X)
- ΔD
- ANR 2016 (applicable X-factor)

Outputs

73. This worksheet uses Excel's data table facility to display the calculated results for all suppliers.

Outputs

- PV at 30 September 2017 of BBAR
- Starting price for industry-wide X-factor
- Starting price for applicable X-factor
- PV at 30 September 2017 of MAR (applicable X)

- MAR (industry-wide X-factor) pricing years commencing 2017 to 2021
- MAR (applicable X-factor) pricing years commencing 2017 to 2021
- BBAR before tax, BBAR periods commencing 2017 to 2022
- ΔD
- ANR 2016 (applicable X-factor).

Attachment A - Derivation of the building blocks allowable revenue formula for gas distribution businesses (deferred tax approach)

1. This attachment derives a formula for the building blocks allowable revenue before tax (BBAR). This is the annual revenue requirement of a gas distribution business subject to a default price path where a deferred tax approach is used for the determination of the tax allowance. The formula accommodates given cash flow timing assumptions, the opening RAB at the start of the BBAR period, the operating expenditure, change in the deferred tax balance in the BBAR period and a number of other variables.

2. This derivation relates to just one year or part year in a regulatory period (ie, a BBAR period), not on a multi-year regulatory period as a whole. It is intended that the formulas derived would be applied to determine the building blocks revenue for each BBAR period, which would then be "smoothed" to form a CPI minus X price path.

3. This note first covers preliminary matters before setting out the derivation proper. The preliminary matters are defining variables, discussion of timing factors (used with respect to intra-period cash flow timing) and setting out the set of fundamental equations on which the derivation is based.

Variable definitions

Input variables[9]

RAB_0	RAB at start of the BBAR period
DT_0	Deferred tax asset value at the start of the BBAR period
DT_1	Deferred tax asset value at the end of the BBAR period
WACC	Weighted average cost of capital for a 12 month period (used as the discount rate)
p	Proportion of a whole year being referred to, ie number of months in the BBAR period divided by 12
O	Operating expenditure, net of pass through costs and recoverable costs
D	Regulatory depreciation
D_{tax}	Tax depreciation
TCSD	Term credit spread differential allowance
NDI	Notional deductible interest (which includes TCSD)
Reval	Revaluation
VCA	Value of commissioned assets
t	Corporate tax rate
RTA	Regulatory tax adjustments
ΔDT	Increase in deferred tax asset value during the BBAR period
Dispos	Sum of the opening RAB value of assets disposed of during the BBAR period
ORI	Other regulated income

[9] These "Input Variables" are inputs to this derivation, not necessarily inputs to a spreadsheet model. For example, they include regulatory depreciation which is treated as a given input in this derivation, but it will be calculated from other parameters in the spreadsheet model.

Derived values (ie, formulas are provided in this derivation)

RAB_1	RAB at end of the BBAR period
DT_1	Deferred tax asset value at the end of the BBAR period
TP	Tax payable
TA	Tax allowance
Rev	Revenue requirement from prices for the BBAR period, ie, building blocks revenue before tax[10]
RIV	Regulatory investment value
$WACC_p$	Weighted average cost of capital over the BBAR period, ie, WACC adjusted for the BBAR period comprising only a proportion (p) of a whole year

Present value functions

$PV_{start}()$	Present value as at the start of the BBAR period
$PV_{end}()$	Present value as at the end of the BBAR period

Timing factors

4. A Timing Factor (TF) reflects the BBAR period-end value of a cash flow that occurs part-way through a BBAR period. For example, operating expenditure, tax payments and interest payments are assumed to occur at mid-BBAR period, so half a period of discounting at WACC is required to determine the equivalent value at BBAR period-end.

5. The particular timing assumptions are set out in the "Timing assumptions for part years" section above.

6. Opex, asset commissioning, tax cash flow, other regulatory income will occur on average at the middle of the BBAR period.

7. TCSD cash flows occur at mid-BBAR period.

8. Revenue cash flows occur 34 days after the mid-BBAR period cash flows.

9. For example, for a full year of 365 days, there are 182 days between mid-year and year-end, so the timing factor for mid-year cash flows would have the value:

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

10. The corresponding timing factor for revenues reflects cash flows 34 days later than mid-year, ie, 182-34 = 148 days before year-end, so that

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

[10] This is the revenue amount received on the revenue date during the year, not an amount expressed in year-end terms.

11. These TF values are applied when calculating, for a cash flow that occurs during a BBAR period, the present value equivalent amount at BBAR period-end. We define the function $PV_{end}()$ above as this equivalent amount. For example:

$$PV_{end}(Rev) = Rev * TF_{rev}$$

12. The $PV_{end}()$ function can be applied in a similar fashion for each of the other cash flows and other lengths of BBAR periods.

Proceeds of sale of disposed assets and costs of disposal

13. It would be possible to model the cash flows associated with the proceeds of sale of disposed assets and the costs of disposal. However for the purpose of this derivation, no amounts of sales proceeds or costs of disposal have been modelled, which is consistent with the approach used in the 2010 input methodologies for customised price paths.

Equations on which this derivation is based

14. The equations which form the basis of this derivation are as follows:

WACC adjusted for a proportion of a year

15. When only a proportion of a whole year is being referred to, the discounting of values between the start and end of the BBAR period will be by the factor $(1 + WACC)^p$ where p is the proportion of a whole year that comprises the BBAR period.

16. We define $WACC_p$ to be a WACC value applicable to a BBAR period, such that

$$(1 + WACC_p) = (1 + WACC)^p$$

ie,
$$WACC_p = (1 + WACC)^p - 1 \qquad 1$$

Period-end present values, relative to period-start

17. The present value of a set of cash flows as at the end of the BBAR period is $(1 + WACC)^p$ multiplied by the present value at the start of the BBAR period:

$$PV_{end}(\text{Cash flows}) = PV_{start}(\text{Cash flows}) * (1+ WACC)^p$$

ie,
$$PV_{end}(\text{Cash flows}) = PV_{start}(\text{Cash flows}) * (1+ WACC_p) \qquad 2$$

Financial capital maintenance

18. The following equation expresses the NPV = 0 approach of having the opening total value[11] of the assets equal to the sum of

- the present value of cash flows over a BBAR period plus

[11] This total opening value includes the value of the deferred tax asset

- the discounted total asset value at the end of that BBAR period.

$$RAB_0 + DT_0 = PV_{start}(\text{Cash flows}) + (RAB_1 + DT_1)/(1 + WACC_p) \quad 3$$

19. When applying this equation, the commissioning of an asset or the disposal of an asset is treated as if it generates a cash flow on the basis that at the time of asset commissioning, the supplier is treated as having to have paid the "value of commissioned asset", which includes an allowance for finance during construction.

RAB roll-forward equation

20. The roll-forward of the RAB from one period to the next is given by: [12]

$$RAB_1 = RAB_0 + VCA - D + Reval - Dispos \quad 4$$

Tax allowance

21. The tax allowance, in the absence of tax losses, is given by: [13]

$$TA = (Rev + ORI - O - D + RTA) * t \quad 5$$

Deferred tax balance roll-forward

22. The roll-forward of the deferred tax balance from one period to the next is given by:

$$DT_1 = DT_0 + \Delta DT \quad 6$$

Tax payable

23. The formula for tax payable is as follows:

$$TP = TA + \Delta DT \quad 7$$

Derivation

24. The derivation of a non-circular formula for the annual revenue requirement is set out below, based on the six equations above (Equations 1 to 7).

25. Equation 3 multiplied by $(1 + WACC_p)$ becomes, after applying Equation 2:

$$(RAB_0 + DT_0) * (1 + WACC_P) = PV_{end}(\text{Cash flows}) + RAB_1 + DT_1$$

26. Subtracting $(RAB_0 + DT_0)$ from each side of this equation gives:

$$(RAB_0 + DT_0) * WACC_p = PV_{end}(\text{Cash flows}) + RAB_1 - RAB_0 + DT_1 - DT_0$$

[12] This RAB roll-forward equation is consistent with the RAB roll-forward approach in Paragraph 4.2.1 of the GDB IM.

[13] This tax allowance equation is consistent with the tax allowance approach in clause 4.3.1 of the GDB IM.

27. Recognising that the cash flows comprise Rev, O, VCA, TCSD, TP and ORI, and applying Equation 6 gives:

$$(RAB_0 + DT_0) * WACC_p = PV_{end}(Rev, O, VCA, TCSD, TP \text{ and } ORI) +$$

$$RAB_1 - RAB_0 + \Delta DT$$

28. Equation 4 indicates that $RAB_1 - RAB_0 = VCA - D + Reval - Dispos$, and applying this to the equation above gives:

$$(RAB_0 + DT_0) * WACC_p = PV_{end}(Rev, O, VCA, TCSD, TP \text{ and } ORI) +$$

$$VCA - D + Reval - Dispos + \Delta DT$$

29. Expanding the $PV_{end}()$ function in this equation using the timing factors gives:

$$(RAB_0 + DT_0) * WACC_p = Rev*TF_{rev} - O*TF_{mid} - VCA*TF_{mid} - TCSD - TP*TF_{tax} +$$

$$ORI*TF_{mid} + VCA - D + Reval - Dispos + \Delta DT \qquad 8$$

30. We define the variable, Regulatory Investment Value (RIV) as follows:

$$RIV = RAB_0 + DT_0$$

31. Substituting, in Equation 7, the variable RIV for $RAB_0 + DT_0$ and substituting the right-hand-side of Equation 5 for TP gives:

$$RIV * WACC_p = Rev*TF_{rev} - O*TF_{mid} - VCA*TF_{VCA} - TCSD -$$
$$(TA + \Delta DT) *TF_{tax} + ORI*TF_{mid} + VCA - D + Reval - Dispos + \Delta DT \qquad 9$$

32. The BBAR before tax in BBAR period-end terms is the term $Rev*TF_{rev}$ in the Equation 9 above. Rearranging the equation so that its left-hand-side is $Rev*TF_{rev}$ is the first step in deriving the equation used in the financial model as the "BBAR before tax in BBAR period-end terms, direct simple calculation".

33. Rearranging this Equation 9 gives:

$$Rev * TF_{rev} = RIV * WACC_p + VCA*(TF_{VCA} – 1) +TCSD - Reval +$$

$$Dispos + D + O * TF_{mid} + (TA + \Delta DT) * TF_{tax} - ORI * TF_{mid} - \Delta DT \qquad 10$$

34. We define "Return on capital" as the first line on the right-hand-side of Equation 10 above, ie,

$$\text{Return on capital} = RIV * WACC_p + VCA*(TF_{VCA} – 1) +TCSD – Reval \qquad 11$$

35. Substituting that first line in Equation 10 with "Return on capital" gives the following equation, which is used in the financial model for the "BBAR before tax in BBAR period-end terms, direct simple calculation".

$$Rev*TF_{rev} = \text{Return on capital} + Dispos + D + O * TF_{mid} +$$

$$(TA + \Delta DT) * TF_{tax} - ORI * TF_{mid} - \Delta DT \qquad 12$$

36. The expression for TA in Equation 5 is:

$$TA = (Rev + ORI - O - D + RTA) * t$$

37. Substituting the right-hand-side of this expression for TA in Equation 8 gives:

$$Rev*TF_{rev} = \text{Return on capital} + Dispos + D + O * TF_{mid} +$$

$$((Rev + ORI - O - D + RTA) * t + \Delta DT) * TF_{tax} - ORI * TF_{mid} - \Delta DT \qquad 13$$

38. Collecting terms in Rev to the left-hand-side gives:

$$Rev*(TF_{rev} - t * TF_{tax}) = \text{Return on capital} + Dispos + D + O * TF_{mid} +$$

$$((ORI - O - D + RTA) * t + \Delta DT) * TF_{tax} - ORI * TF_{mid} - \Delta DT$$

39. Dividing both sides of this equation by $(TF_{rev} - t * TF_{tax})$ gives:

$$Rev = \big(\text{Return on capital} + Dispos + D + O * TF_{mid} +$$

$$((ORI - O - D + RTA) * t + \Delta DT) * TF_{tax} - ORI * TF_{mid} - \Delta DT\big) / (TF_{rev} - t * TF_{tax})$$

40. Collecting terms in O together, collecting terms in D together, collecting terms in ORI together and collecting terms in ΔDT together gives:

$$Rev = \big(\text{Return on capital} + Dispos + D - D * t * TF_{tax} + O*TF_{mid} - O * t * TF_{tax}$$
$$- ORI * (TF_{mid} - t * TF_{tax}) + \Delta DT *TF_{tax} - \Delta DT + RTA * t *TF_{tax}$$
$$- VCA - Reval + Dispos\big)/(TF_{rev} - t * TF_{tax})$$

41. Taking out the common factors VCA, O, D and ΔDT gives, after some re-ordering:

$$Rev = \big(\text{Return on capital}$$
$$+ D * (1 - t * TF_{tax}) + Dispos$$
$$+ O * (TF_{mid} - t * TF_{tax})$$
$$- ORI * (TF_{mid} - t * TF_{tax})$$
$$+ \Delta DT * (TF_{tax} - 1)$$
$$+ RTA * t *TF_{tax}\big)/(TF_{rev} - t * TF_{tax}) \qquad 14$$

Attachment B - Derivation of the building blocks allowable revenue formula for gas transmission businesses (tax payable approach)

1. This attachment derives a formula for the building blocks allowable revenue before tax (BBAR). This is the annual revenue requirement of a gas transmission business subject to a default price path where a tax payable approach is used for the determination of the tax allowance. The formula accommodates given cash flow timing assumptions, the opening RAB at the start of the BBAR period, the operating expenditure, tax temporary differences and a number of other variables.

2. This derivation relates to just one year or part year in a regulatory period (ie, a BBAR period), not on a multi-year regulatory period as a whole. It is intended that the formulas derived would be applied to determine the building blocks revenue for each BBAR period, which would then be "smoothed" to form a CPI minus X price path.

3. This note first covers preliminary matters before setting out the derivation proper. The preliminary matters are defining variables, discussion of timing factors (used with respect to intra-period cash flow timing) and setting out the set of fundamental equations on which the derivation is based.

Variable definitions

Input variables[14]

RAB_0	RAB at start of the BBAR period
WACC	Weighted average cost of capital for a 12 month period (used as the discount rate)
p	Proportion of a whole year being referred to, ie number of months in the BBAR period divided by 12
O	Operating expenditure, net of pass through costs and recoverable costs
D	Regulatory depreciation
TCSD	Term credit spread differential allowance
NDI	Notional deductible interest (which includes TCSD)
TD	Depreciation temporary differences
Reval	Revaluation
VCA	Value of commissioned assets
t	Corporate tax rate
Dispos	Sum of the opening RAB value of assets disposed of during the BBAR period
ORI	Other regulated income

Derived values (ie, formulas are provided in this derivation)

RAB_1	RAB at end of the BBAR period

[14] These "Input Variables" are inputs to this derivation, not necessarily inputs to a spreadsheet model. For example, they include regulatory depreciation which is treated as a given input in this derivation, but it will be calculated from other parameters in the spreadsheet model.

TP	Tax payable
TA	Tax allowance
Rev	Revenue requirement from prices for the BBAR period, ie, building blocks revenue before tax[15]
RIV	Regulatory investment value
$WACC_p$	Weighted average cost of capital over the BBAR period, ie, WACC adjusted for the BBAR period comprising only a proportion (p) of a whole year

Present value functions

$PV_{start}()$	Present value as at the start of the BBAR period
$PV_{end}()$	Present value as at the end of the BBAR period

Timing factors

4. A Timing Factor (TF) reflects the BBAR period-end value of a cash flow that occurs part-way through a BBAR period. For example, operating expenditure, tax payments and interest payments are assumed to occur at mid-BBAR period, so half a BBAR period of discounting at WACC is required to determine the equivalent value at BBAR period-end.

5. The particular timing assumptions are set out in the "Timing assumptions for part years" section above.

6. Opex, asset commissioning, tax cash flow, other regulatory income will occur on average at the middle of the BBAR period.

7. TCSD cash flows occur at mid-BBAR period.

8. Revenue cash flows occur 34 days after the mid-BBAR period cash flows.

9. For example, for a full year of 365 days, there are 182 days between mid-year and year-end, so we the timing factor for mid-year cash flows would have the value:

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

10. The corresponding timing factor for revenues reflects cash flows 34 days later than mid-year, i.e. 182-34 = 148 days before year-end, so that

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

11. These TF values are applied when calculating, for a cash flow that occurs during a BBAR period, the present value equivalent amount at BBAR period-end. We define the function $PV_{end}()$ above as this equivalent amount. For example:

$$PV_{end}(Rev) = Rev * TF_{rev}$$

[15] This is the revenue amount received on the revenue date during the year, not an amount expressed in year-end terms.

12. The $PV_{end}()$ function can be applied in a similar fashion for each of the other cash flows and other lengths of BBAR periods.

Proceeds of sale of disposed assets and costs of disposal

13. It would be possible to model the cash flows associated with the proceeds of sale of disposed assets and the costs of disposal. However for the purpose of this derivation, no amounts of sales proceeds or costs of disposal have been modelled, which is consistent with the approach used in the 2010 input methodologies for customised price paths.

Equations on which this derivation is based

14. The equations which form the basis of this derivation are as follows:

WACC adjusted for a proportion of a year

15. When only a proportion of a whole year is being referred to, the discounting of values between the start and end of the BBAR period will be by the factor $(1 + WACC)^p$ where p is the proportion of a whole year that comprises the BBAR period.

16. We define $WACC_p$ to be a WACC value applicable to a BBAR period, such that:

$$(1 + WACC_p) = (1 + WACC)^p$$

ie,
$$WACC_p = (1 + WACC)^p - 1 \qquad 15$$

Period-end present values, relative to period-start

17. The present value of a set of cash flows as at the end of the BBAR period is $(1 + WACC)^p$ multiplied by the present value at the start of the BBAR period:

$$PV_{end}(\text{Cash flows}) = PV_{start}(\text{Cash flows}) * (1+ WACC)^p$$

ie,
$$PV_{end}(\text{Cash flows}) = PV_{start}(\text{Cash flows}) * (1+ WACC_p) \qquad 16$$

Financial capital maintenance

18. The following equation expresses the NPV = 0 approach of having the opening total value[16] of the assets equal to the sum of:

- the present value of cash flows over a BBAR period plus
- the discounted total asset value at the end of that BBAR period

$$RAB_0 = PV_{start}(\text{Cash flows}) + RAB_1/(1 + WACC_p) \qquad 17$$

[16] This total opening value includes the value of the deferred tax asset.

19. When applying this equation, the commissioning of an asset or the disposal of an asset is treated as if it generates a cash flow on the basis that at the time of asset commissioning, the supplier is treated as having to have paid the "value of commissioned asset", which includes an allowance for finance during construction.

RAB roll-forward equation

20. The roll-forward of the RAB from one period to the next is given by:

$$RAB_1 = RAB_0 + VCA - D + Reval - Dispos \quad 18$$

Tax allowance

21. The tax allowance, in the absence of tax losses, is given by: [17]

$$TA = (Rev + ORI - O - D + TD - NDI) * t \quad 19$$

Tax payable

22. For the tax payable approach, the tax payable amount is equal to the tax allowance:

$$TP = TA \quad 20$$

Derivation

23. The derivation of a non-circular formula for the annual revenue requirement is set out below, based on the six equations above (Equations 15 to 20).

24. Equation 17 multiplied by $(1 + WACC_p)$ becomes, after applying Equation 16:

$$RAB_0 * (1 + WACC_p) = PV_{end}(\text{Cash flows}) + RAB_1$$

25. Subtracting RAB_0 from each side of this equation gives:

$$RAB_0 * WACC_p = PV_{end}(\text{Cash flows}) + RAB_1 - RAB_0$$

26. Recognising that the cash flows comprise Rev, O, VCA, TCSD, TP and ORI gives:

$$RAB_0 * WACC_p = PV_{end}(\text{Rev, O, VCA, TCSD, TP and ORI}) + RAB_1 - RAB_0$$

27. Equation 18 indicates that $RAB_1 - RAB_0 = VCA - D + Reval - Dispos$, and applying this to the equation above gives:

$$RAB_0 * WACC_p = PV_{end}(\text{Rev, O, VCA, TCSD, TP and ORI}) + VCA - D + Reval - Dispos$$

28. Expanding the $PV_{end}()$ function above using the timing factors gives:

[17] This tax allowance equation is consistent with the tax allowance approach in 4.3.1 of the GTB IM.

$$RAB_0 * WACC_p = Rev * TF_{rev} - O*TF_{mid} – VCA * TF_{mid} – TCSD – TP * TF_{tax} + ORI*TF_{mid} + VCA - D + Reval - Dispos \quad 21$$

29. The BBAR before tax in BBAR period-end terms is the term $Rev*TF_{rev}$ in Equation 21 above. Rearranging the equation so that its left-hand-side is $Rev*TF_{rev}$ is the first step in deriving the equation used in the financial model as the "BBAR before tax in BBAR period-end terms, direct simple calculation".

30. Rearranging this Equation 21 gives:

$$Rev*TF_{rev} = RAB_0 * WACC_p + VCA*(TF_{VCA} - 1) + TCSD - Reval + D + Dispos + O*TF_{mid} + TP*TF_{tax} - ORI*TF_{mid} \quad 22$$

31. We define "Return on capital" as the first line on the right-hand-side of Equation 10 above, ie,

$$\text{Return on capital} = RAB_0 * WACC_p + VCA*(TF_{VCA} – 1) +TCSD – Reval \quad 23$$

32. Substituting that first line in Equation 22 with "Return on capital" gives the following equation, which is used in the financial model for the "BBAR before tax in BBAR period-end terms, direct simple calculation".

$$Rev*TF_{rev} = \text{Return on capital} + D + Dispos + O*TF_{mid} + TP*TF_{tax} - ORI*TF_{mid} \quad 24$$

33. The expression for TA in Equation 19 is:

$$TA = (Rev + ORI - O - D + TD - NDI) * t$$

34. Substituting the right-hand-side of this expression for TP (which is equal to TA per Equation 20) in Equation 24 gives:

$$Rev*TF_{rev} = \text{Return on capital} + D + Dispos + O*TF_{mid} + (Rev + ORI - O - D + TD - NDI) * t *TF_{tax} - ORI*TF_{mid} \quad 25$$

35. Collecting terms in Rev to the left-hand-side gives:

$$Rev*(TF_{rev} - t * TF_{tax}) = \text{Return on capital} + D + Dispos + O * TF_{mid} + (ORI - O - D + TD - NDI) * t *TF_{tax} – ORI * TF_{mid}$$

36. Dividing both sides of this equation by $(TF_{rev} - t * TF_{tax})$ gives:

$$Rev = (\text{Return on capital} + D + Dispos + O * TF_{mid} + +(ORI - O - D + TD - NDI) * t *TF_{tax} - ORI*TF_{mid}) / (TF_{rev} - t * TF_{tax})$$

37. Collecting terms in O together, collecting terms in D together and collecting terms in ORI together gives:

$$\text{Rev} = (\text{Return on capital} + D - D * t * TF_{tax} + \text{Dispos} + O*TF_{mid} - O * t * TF_{tax} - ORI * TF_{mid} + ORI * t *TF_{tax} + (TD - NDI) * t * TF_{tax}) / (TF_{rev} - t * TF_{tax})$$

38. Taking out the common factors O, D and ORI gives, after some re-ordering:

$$\text{Rev} = (\text{Return on capital} + D * (1 - t * TF_{tax}) + \text{Dispos} + O * (TF_{mid} - t * TF_{tax}) - ORI * (TF_{mid} - t * TF_{tax}) + (TD - NDI) * t * TF_{tax}) / (TF_{rev} - t * TF_{tax}) \quad 26$$