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think through the future

TransGrid

Capital Accumulation Model (CAM)

CAM Functional Specification

October 2012

Table of Contents

List of Figures

List of Appendices

1 Introduction

TransGrid engaged Evans & Peck to extend the capabilities of TransGrid's Capital Accumulation Model (CAM). The CAM was originally developed in 2008, and was subsequently modified in 2009 and 2010.

The key modifications required in this latest revision of the CAM were to extend the date range of the CAM to reflect the upcoming Regulatory Control Period, provide the ability to have real or nominal reporting, maintain the ability to use scenarios, and to modify and extend the project categories and project components. For the full list of modifications refer to Appendix C.

2 Purpose

The purpose of this Functional Specification is to provide a high-level overview of the key design decisions and the structure and operation of the Capital Accumulation Model, to assist TransGrid staff to understand the model.

3 Definitions

Key abbreviations used in this document include the following:

Abbreviation	Definition
AER	Australian Energy Regulator
ATOM	AER Template Output Model (second part of the CAM)
CAM	Capital Accumulation Model

4 Model Structure

A graphical overview of the Capital Accumulation Model (CAM) structure is shown in Figure 1 below, with a more detailed breakdown provided in Appendix A.

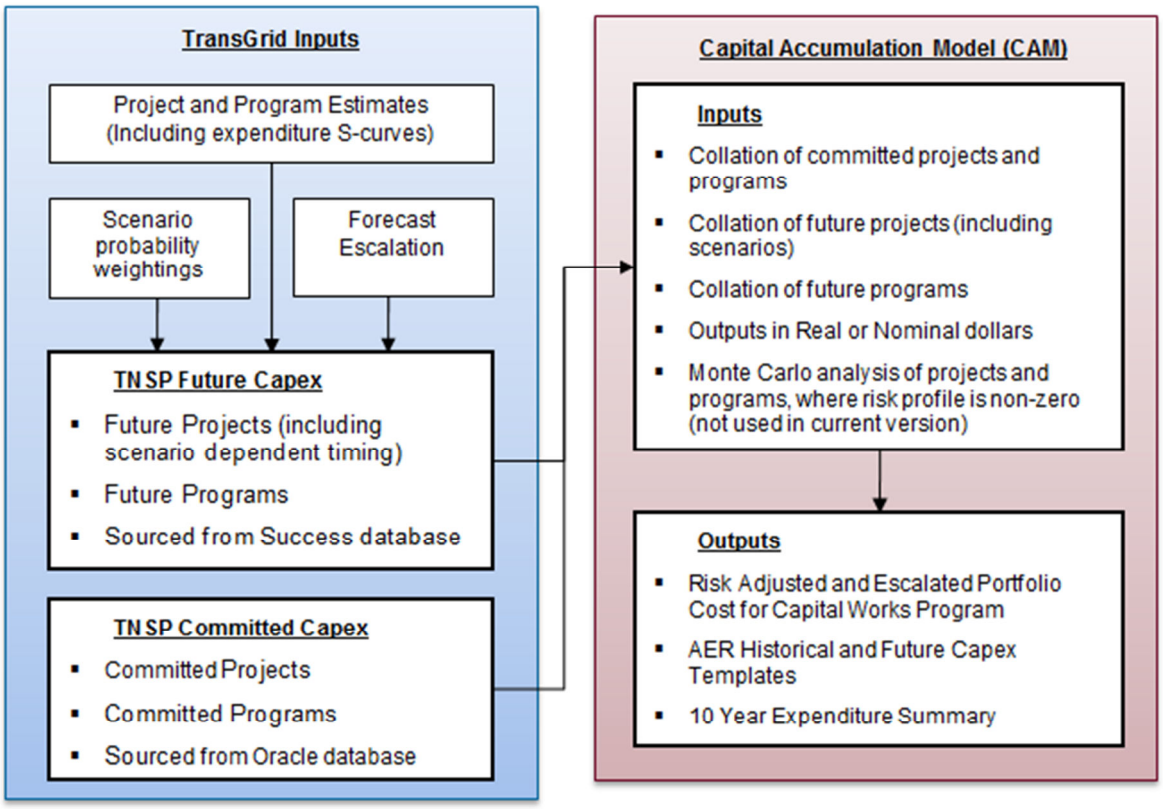


Figure 1: CAM Structure

The complete CAM consists of both the **CAM** and the **AER Template Output Model (ATOM)**, as described below[1]:

(1) **Capital Accumulation Model (CAM):** The CAM is self-contained and includes:

- **Inputs**: committed projects and programs, future projects and programs, regulatory asset class breakdown, project component breakdown, scenario probabilities, escalation and CPI inputs, and risk inputs.
- **Calculations**: Escalation calculations (including real/nominal output switch), weighted-average scenario calculations,
- **Outputs**: single scenario output, committed project and program output, future project and program output, and a combined future/committed projects and program output sheet.

(2) AER Template Output Model (ATOM): The AER Template Output Model (ATOM) provides AER template outputs and is linked to the CAM.

[1] To refresh the links in the AER Template Output Model, (ATOM) save both the CAM and the ATOM in the same directory and open the ATOM only after opening the Input model.

5 Inputs

The input data for the CAM is entered into the following sheets:

- ***Input_Fixed***
  - Scenario Weightings
  - Escalation multipliers (CPI & Commodity)
  - Regulatory Asset Classes
  - Project Component List
- ***Input Risk & Exp Profile***
  - Risk and expenditure profiles
- ***Input_Projects_Committed***
  - Committed projects list
  - Scenario-independent
  - Forecast capex spend
- ***Input_Programs_Committed***
  - Committed programs list
  - Scenario-independent
  - Forecast capex spend
- ***Input_Projects_Future***
  - Future projects list
  - Scenario commissioning dates
  - Expenditure S-curve
  - Project risk profiles
- ***Input_Programs_Future***
  - Future programs list
  - Scenario-independent
  - Forecast capex spend
  - Program risk profiles

5.1 Escalation

The escalation methodology applied in the CAM is shown in Figure 2, and applies to Real and Nominal outputs. CPI is used to escalate estimates up to the current year, and either commodity escalation (for real outputs) or CPI and commodity escalation (for nominal outputs) is used after the current (reporting) year to obtain the expenditure in any given future year.

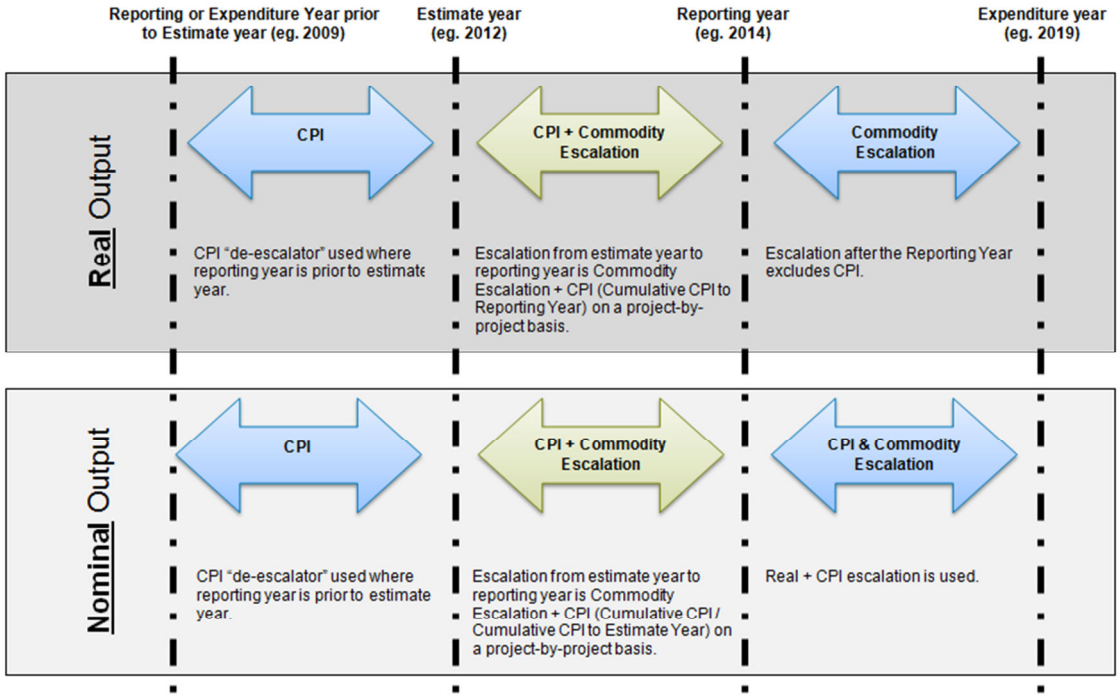


Figure 2: Escalation Summary Diagram

Escalation data is entered into the model on the fixed input worksheet in the fields shown in Figure 3.

CPI Calculations

Financial Year:	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
CPI Index Date	Mar-09	Mar-10	Jun-11													
Value (ABS - 8 cities)	166.2	171.0														
CPI (Actual, %)		2.89%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Forecast CPI			2.75%	2.75%	3.00%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
CPI (forecast + actual)		2.89%	2.75%	2.75%	3.00%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Cumulative CPI	100.0%	102.9%	105.7%	108.6%	111.9%	114.7%	117.5%	120.5%	123.5%	126.6%	129.8%	133.0%	136.3%	139.7%	143.2%	146.8%
Cumulative CPI to Report Year 2014	114.7%	111.5%	108.5%	105.6%	102.5%	100.0%	97.6%	95.2%	92.9%	90.6%	88.4%	86.2%	84.1%	82.1%	80.1%	78.1%

Annual Escalation (Real Commodity escalation, no CPI escalation)

Financial Year:	CPI Only	Inflation	EGW Wages	Wages General	Aluminium	Copper	Steel	Land urban	Land rural	Construction	Crude oil	NOT USED	NOT USED	NOT USED
2010	0.0%	2.7%	1.6%	1.9%	-0.9%	3.8%	3.4%	0.7%	4.5%	-1.0%	-2.2%	0.0%	0.0%	0.0%
2011	0.0%	2.8%	1.1%	0.4%	2.4%	12.4%	6.6%	-8.0%	3.0%	-0.5%	-5.8%	0.0%	0.0%	0.0%
2012	0.0%	2.8%	2.4%	2.9%	-12.7%	-10.6%	-5.3%	4.0%	3.0%	-1.8%	-0.2%	0.0%	0.0%	0.0%
2013	0.0%	3.0%	0.9%	2.4%	6.6%	4.2%	6.4%	10.0%	7.0%	0.6%	1.8%	0.0%	0.0%	0.0%
2014	0.0%	2.5%	0.9%	2.3%	7.2%	1.5%	3.8%	11.0%	10.0%	-0.3%	1.8%	0.0%	0.0%	0.0%
2015	0.0%	2.5%	1.1%	1.5%	7.0%	-4.9%	3.6%	11.0%	10.0%	0.1%	1.5%	0.0%	0.0%	0.0%
2016	0.0%	2.5%	0.6%	1.0%	1.7%	-3.7%	-2.6%	11.0%	9.0%	0.6%	1.2%	0.0%	0.0%	0.0%
2017	0.0%	2.5%	0.7%	1.2%	1.9%	-2.7%	1.2%	8.0%	7.0%	0.9%	0.9%	0.0%	0.0%	0.0%
2018	0.0%	2.5%	0.4%	1.3%	6.0%	-6.3%	0.0%	11.5%	10.3%	1.1%	3.4%	0.0%	0.0%	0.0%
2019	0.0%	2.5%	0.3%	1.3%	7.0%	-7.8%	-0.5%	15.8%	11.0%	1.5%	4.2%	0.0%	0.0%	0.0%
2020	0.0%	2.5%	0.1%	1.2%	8.0%	-9.2%	-1.0%	17.7%	11.8%	1.8%	5.0%	0.0%	0.0%	0.0%
2021	0.0%	2.5%	0.0%	1.1%	8.9%	-10.7%	-1.4%	19.6%	12.5%	2.2%	5.8%	0.0%	0.0%	0.0%
2022	0.0%	2.5%	-0.2%	1.0%	9.9%	-12.1%	-1.9%	21.5%	13.2%	2.5%	6.6%	0.0%	0.0%	0.0%
2023	0.0%	2.5%	-0.4%	0.9%	10.9%	-13.6%	-2.4%	23.4%	14.0%	2.9%	7.4%	0.0%	0.0%	0.0%
2024	0.0%	2.5%	-0.5%	0.9%	11.9%	-15.0%	-2.9%	25.3%	14.7%	3.2%	8.2%	0.0%	0.0%	0.0%

Cumulative Escalation (Real Commodity escalation, no CPI escalation)

2009	100.0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2010	100.0%	102.7%	101.6%	101.9%	99.1%	103.8%	103.4%	100.7%	104.5%	99.0%	97.8%	100.0%	100.0%	100.0%
2011	100.0%	105.5%	102.7%	102.3%	101.4%	116.7%	110.2%	92.6%	107.7%	98.5%	92.1%	100.0%	100.0%	100.0%
2012	100.0%	108.4%	105.2%	105.3%	88.5%	104.3%	104.4%	96.3%	110.9%	96.7%	91.9%	100.0%	100.0%	100.0%
2013	100.0%	111.7%	106.1%	107.8%	94.4%	108.7%	111.1%	106.0%	118.7%	97.3%	93.6%	100.0%	100.0%	100.0%
2014	100.0%	114.5%	107.1%	110.3%	101.2%	110.3%	115.3%	117.6%	130.5%	97.0%	95.2%	100.0%	100.0%	100.0%
2015	100.0%	117.4%	108.2%	112.0%	108.3%	104.9%	119.4%	130.6%	143.6%	97.1%	96.7%	100.0%	100.0%	100.0%
2016	100.0%	120.3%	108.9%	113.1%	110.1%	101.0%	116.3%	144.9%	156.5%	97.7%	97.8%	100.0%	100.0%	100.0%
2017	100.0%	123.3%	109.7%	114.4%	112.2%	98.3%	117.7%	156.5%	167.5%	98.6%	98.7%	100.0%	100.0%	100.0%
2018	100.0%	126.4%	110.1%	115.9%	118.9%	92.1%	117.7%	174.5%	184.7%	99.6%	102.1%	100.0%	100.0%	100.0%
2019	100.0%	129.5%	110.4%	117.4%	127.3%	84.9%	117.1%	202.1%	205.0%	101.1%	106.4%	100.0%	100.0%	100.0%
2020	100.0%	132.8%	110.5%	118.8%	137.4%	77.1%	116.0%	237.9%	229.2%	103.0%	111.7%	100.0%	100.0%	100.0%
2021	100.0%	136.1%	110.5%	120.1%	149.7%	68.9%	114.4%	284.5%	257.9%	105.2%	118.2%	100.0%	100.0%	100.0%
2022	100.0%	139.5%	110.3%	121.3%	164.5%	60.5%	112.2%	345.6%	291.9%	107.8%	125.9%	100.0%	100.0%	100.0%
2023	100.0%	143.0%	109.9%	122.4%	182.4%	52.3%	109.5%	426.5%	332.8%	111.0%	135.3%	100.0%	100.0%	100.0%
2024	100.0%	146.6%	109.3%	123.5%	204.1%	44.5%	106.3%	534.4%	381.7%	114.5%	146.4%	100.0%	100.0%	100.0%

Figure 3: Escalation data inputs

The cumulative CPI is calculated using the following:

$$CPI_{Cum} = CPI_{Cum\ Previous\ Year} \times (1 + \{CPI_{Actual}; CPI_{Forecast}\})$$

Note: Either *CPI Actual* or *CPI Forecast* will be used in the calculation (this depends on which has been entered into the model for the year in question)

The cumulative CPI to the Reporting Year is calculated using the following:

$$CPI_{Cum\ to\ Reporting\ year} = CPI_{Cum\ in\ Report\ Year} / CPI_{Cum\ Assessed\ year}$$

Cumulative Commodity Escalation is calculated using the following:

$$Commodity\ Esc_{Cum} = Commodity\ Esc_{Cum\ Previous\ Year} \times \left(1 + Commodity\ Esc_{Annual\ assessd\ year}\right)$$

5.2 Scenarios

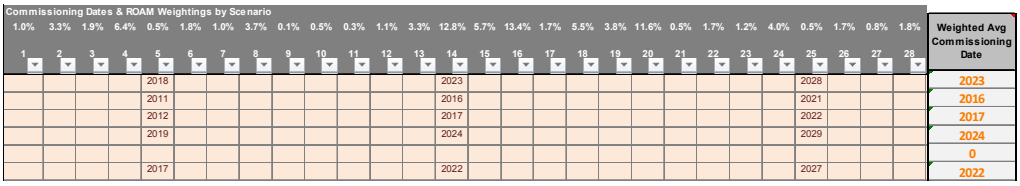
For main grid projects, TransGrid has adopted the approach of assessing project requirements with a scenario-based approach, weighting scenarios based on their likelihood of occurrence.

The CAM provides for up to 40 individual scenarios, with future projects able to be assigned different required dates ("needs dates") under each scenario. To provide for the different project dates for each scenario, an expenditure S-curve is required to be entered into the CAM for each project based on the expected expenditure profile for each project. These scenarios are to be developed considering future uncertainties such as economic growth. Examples of the input data required for the Scenarios are shown in Figure 4 and Figure 5.

Scenarios

Scenario	Weighting	Description
1	1.0%	L10 * BAU * BAU * BAU
2	3.3%	L10 * BAU * BAU * CO2 Tax
3	1.9%	L10 * BAU * Limited * BAU
4	6.4%	L10 * BAU * Limited * CO2 Tax
5	0.5%	L10 * QNI * BAU * BAU
6	1.8%	L10 * QNI * BAU * CO2 Tax
7	1.0%	L10 * QNI * Limited * BAU
8	3.7%	L10 * QNI * Limited * CO2 Tax
9	0.1%	L10 * Snow y-NSW * BAU * BAU
10	0.5%	L10 * Snow y-NSW * BAU * CO2 Tax
11	0.3%	L10 * Snow y-NSW * Limited * BAU
12	1.1%	L10 * Snow y-NSW * Limited * CO2 Tax
13	3.3%	M10 * BAU * BAU * BAU
14	12.8%	M10 * BAU * BAU * CO2 Tax
15	5.7%	M10 * BAU * Limited * BAU
16	13.4%	M10 * BAU * Limited * CO2 Tax
17	1.7%	M10 * QNI * BAU * BAU
18	5.5%	M10 * QNI * BAU * CO2 Tax
19	3.8%	M10 * QNI * Limited * BAU
20	11.6%	M10 * QNI * Limited * CO2 Tax
21	0.5%	M10 * Snow y-NSW * BAU * BAU
22	1.7%	M10 * Snow y-NSW * BAU * CO2 Tax
23	1.2%	M10 * Snow y-NSW * Limited * BAU
24	4.0%	M10 * Snow y-NSW * Limited * CO2 Tax
25	0.5%	H10 * BAU * BAU * BAU
26	1.7%	H10 * BAU * BAU * CO2 Tax
27	0.8%	H10 * BAU * Limited * BAU
28	1.8%	H10 * BAU * Limited * CO2 Tax
29	0.3%	H10 * QNI * BAU * BAU
30	0.9%	H10 * QNI * BAU * CO2 Tax
31	0.5%	H10 * QNI * Limited * BAU
32	1.5%	H10 * QNI * Limited * CO2 Tax
33	0.1%	H10 * Snow y-NSW * BAU * BAU
34	0.3%	H10 * Snow y-NSW * BAU * CO2 Tax
35	0.1%	H10 * Snow y-NSW * Limited * BAU
36	0.6%	H10 * Snow y-NSW * Limited * CO2 Tax
37	1.0%	test
38	1.0%	test
39	1.0%	test
40	1.0%	test
Total Scenario Weights	**100.0%**	

Figure 4: Example of Scenarios Input Weightings (from the "Input Fixed" Worksheet)



Commissioning Dates & ROAM Weightings by Scenario																												Weighted Avg Commissioning Date
1.0%	3.3%	1.9%	6.4%	0.5%	1.8%	1.0%	3.7%	0.1%	0.5%	0.3%	1.1%	3.3%	12.8%	5.7%	13.4%	1.7%	5.5%	3.8%	11.6%	0.5%	1.7%	1.2%	4.0%	0.5%	1.7%	0.8%	1.8%	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
				2018									2023											2028				2023
				2011									2016											2021				2016
				2012									2017											2022				2017
				2019									2024											2029				2024
																												0
				2017									2022											2027				2022

Figure 5: Example of Data entered to calculate Commission dates

The output of individual scenarios can be seen on the *Output_Single_Scenario* refer to Section 6.6. The calculations for individual scenarios can be seen on the *Scenario Wgtd* worksheet. A summary of the all the scenarios is shown on the C*alc_Scenario Capex* worksheet.

5.3 Regulatory Asset Classes

Regulatory Asset Classes defines the asset classes used in the model for the breakdown of expenditure in Projects and Programs. Up to 25 different classes can be entered into the model, along with a short description of the class. An example of Regulatory Asset Classes input data is shown in Figure 6.

Regulatory Asset Classes		
Item	Name	Description
RAC - TL	TL	Transmission Lines
RAC - Subs	Subs.	Substations
RAC - Sec.	Sec.	Secondary Systems
RAC - Comms.	Comms.	Communications
RAC - Land	Land	Land and Easements
RAC - Cables	Cables	Underground Cables
RAC - MP & MV	MP & MV	Minor Plant, Motor Vehicles & Mobile Plant
RAC - TL Life Ext.	TL Life Ext.	Transmission Line Life Extension
RAC - Bus IT	Bus. IT	Business & Information Technology
RAC -	Not required	Not required

Figure 6: Example Data entered for Regulatory Asset Classes

5.4 Project Components

Project Components defines the categories for the real commodity escalation. Names entered in the Project Component are used in the model for the breakdown of expenditure in Projects and Programs. For each of the Projects and Programs the dollars required for each component are required to be entered. An example of Project Components input data is shown in Figure 7.

Project Components		
Description	Name	Description
Project Component 1	CPI Only	Inflation Amount to be escalated by CPI (no commodity esc.)
Project Component 2	EGW Wages	Electricity Gas and Water Wages
Project Component 3	Wages General	General Wages
Project Component 4	Property	Land And Easements
Project Component 5	Copper	Copper
Project Component 6	Aluminium	Aluminium
Project Component 7	Steel	Steel
Project Component 8	Oil	Oil
Project Component 9	Construction	Construction
Project Component 10	Not Used	Not Used
Project Component 11	Not Used	Not Used
Project Component 12	Not Used	Not Used
Project Component 13	Not Used	Not Used
Project Component 14	Not Used	Not Used

Figure 7: Example Data entered for Project components

5.5 Capex by Project Category

Capex by Project Category is used to define whether the project or program is Network or Non network related. The Project Category, Grouping and whether the category is network or non-network are defined Input_Fixed Spread sheet. The Network or Non- Network status of a project is used to sort projects and programs in the output spreadsheet. An example of Project Category input data is shown in Figure 8.

Capex by Project Category		
Category	Grouping	Network or Non-Network
PS Augmentation	Load Driven	Network
PS Connections	Non-Load Driven	Network
PS Easements	Load Driven	Network
PS Replacement	Non-Load Driven	Network
PS Network Asset Replacement	Non-Load Driven	Network
PS Network-Other	Non-Load Driven	Network
PS Security/Compliance	Non-Load Driven	Network
PS Information Technology	Business IT	Non-Network
PS Facilities	Support the Business	Non-Network
PS Motor Vehicles	Support the Business	Non-Network
PS Market Benefits	Non-Load Driven	Network

Figure 8: Example Data entered for Capex by Project Category

5.6 Risk

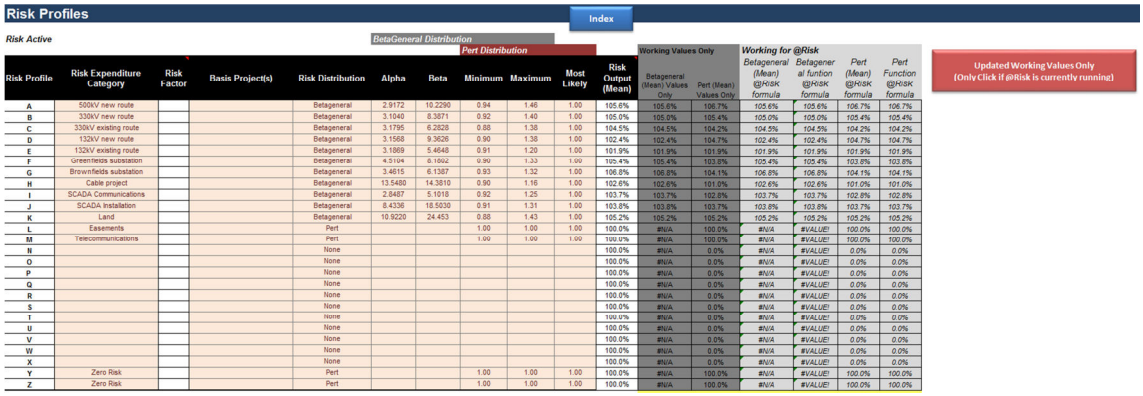
The risk component in this version of the CAM has had its functionality reduced compared to previous versions. In this version the Monte Carlo simulation has been disabled in the model, as requested by TransGrid, but the ability to reinstate this component in the future exists.

The risk component is limited to scaling the results based on the mean of a distribution. The scaling values are assigned to projects / programs based on the assigned risk category.

Risk functionality is included only for Future Projects and Programs. Committed Projects and Programs do not have risk functionality.

The risk functionality of the CAM can be switched on and off (set to either “Active” or “Inactive”) by using the risk dropdown box in the *Input_Fixed* worksheet.

The model requires @Risk proprietary software, by Palisade Corporation to generate the distributions to calculate the mean. The columns that contain @Risk formulas are identified within the CAM by the column headings refer Figure 9. The risk component of the CAM is still able to be used if the user doesn't have @Risk however the distributions cannot be updated.



Risk Profiles

Index

Risk Active

BetaGeneral Distribution

Pert Distribution

Working Values Only

Working for @Risk

Updated Working Values Only (Only Click if @Risk is currently running)

Risk Profile	Risk Expenditure Category	Risk Factor	Basis Project(s)	Risk Distribution	Alpha	Beta	Minimum	Maximum	Most Likely	Risk Output (Mean)	Betageneral (Mean) Values Only	Pert (Mean) Values Only	Betageneral (Mean) @Risk formula	Betageneral function @Risk formula	Pert (Mean) @Risk formula	Pert Function @Risk formula
A	500kV new route			Betageneral	2.9172	10.2290	0.94	1.46	1.00	105.6%	105.6%	106.7%	105.6%	105.6%	106.7%	106.7%
B	330kV new route			Betageneral	3.1040	8.3871	0.92	1.40	1.00	105.0%	105.0%	105.4%	105.0%	105.0%	105.4%	105.4%
C	330kV existing route			Betageneral	3.1795	6.2828	0.88	1.38	1.00	104.5%	104.5%	104.2%	104.5%	104.5%	104.2%	104.2%
D	132kV new route			Betageneral	3.1568	9.3626	0.90	1.38	1.00	102.4%	102.4%	104.7%	102.4%	102.4%	104.7%	104.7%
E	132kV existing route			Betageneral	3.1869	5.4648	0.91	1.20	1.00	101.9%	101.9%	101.9%	101.9%	101.9%	101.9%	101.9%
F	Greenfields substation			Betageneral	4.5104	6.1002	0.90	1.33	1.00	105.4%	105.4%	103.8%	105.4%	105.4%	103.8%	103.8%
G	Brownfields substation			Betageneral	3.4615	6.1387	0.93	1.32	1.00	106.8%	106.8%	104.1%	106.8%	106.8%	104.1%	104.1%
H	Cable project			Betageneral	13.5480	14.3810	0.90	1.16	1.00	102.6%	102.6%	101.0%	102.6%	102.6%	101.0%	101.0%
I	SCADA Communications			Betageneral	2.8487	5.1018	0.92	1.25	1.00	103.7%	103.7%	102.8%	103.7%	103.7%	102.8%	102.8%
J	SCADA Installation			Betageneral	8.4336	18.5030	0.91	1.31	1.00	103.8%	103.8%	103.7%	103.8%	103.8%	103.7%	103.7%
K	Land			Betageneral	10.9220	24.453	0.88	1.43	1.00	105.2%	105.2%	105.2%	105.2%	105.2%	105.2%	105.2%
L	Easements			Pert			1.00	1.00	1.00	100.0%	#N/A	100.0%	#N/A	#VALUE!	100.0%	100.0%
M	Telecommunications			Pert			1.00	1.00	1.00	100.0%	#N/A	100.0%	#N/A	#VALUE!	100.0%	100.0%
N				None						100.0%	#N/A	0.0%	#N/A	#VALUE!	0.0%	0.0%
O				None						100.0%	#N/A	0.0%	#N/A	#VALUE!	0.0%	0.0%
P				None						100.0%	#N/A	0.0%	#N/A	#VALUE!	0.0%	0.0%
Q				None						100.0%	#N/A	0.0%	#N/A	#VALUE!	0.0%	0.0%
R				None						100.0%	#N/A	0.0%	#N/A	#VALUE!	0.0%	0.0%
S				None						100.0%	#N/A	0.0%	#N/A	#VALUE!	0.0%	0.0%
T				None						100.0%	#N/A	0.0%	#N/A	#VALUE!	0.0%	0.0%
U				None						100.0%	#N/A	0.0%	#N/A	#VALUE!	0.0%	0.0%
V				None						100.0%	#N/A	0.0%	#N/A	#VALUE!	0.0%	0.0%
W				None						100.0%	#N/A	0.0%	#N/A	#VALUE!	0.0%	0.0%
X				None						100.0%	#N/A	0.0%	#N/A	#VALUE!	0.0%	0.0%
Y	Zero Risk			Pert			1.00	1.00	1.00	100.0%	#N/A	100.0%	#N/A	#VALUE!	100.0%	100.0%
Z	Zero Risk			Pert			1.00	1.00	1.00	100.0%	#N/A	100.0%	#N/A	#VALUE!	100.0%	100.0%

Figure 9: Risk Profile Calculations

5.7 Project & Program Inputs

For the purpose of the CAM, "projects" are discrete projects which are forecast to have a defined expenditure profile and are commissioned on a single date at the completion of the project, while "programs" consist of a series of smaller projects, each with their own completion dates to be progressively commissioned as they are placed into service.[2].

The model deals with four types of project and program expenditure:

(1) **Committed Projects.**

Projects for which expenditure has already been committed, and may have already commenced. Because these projects have progressed through the corporate governance process (including more detailed planning studies to reaffirm the network need), they are considered scenario-independent.

Data is sourced from TransGrid's Oracle database, where the approved budgets are kept, and entered into the "Committed Projects" sheet in the CAM.

(2) **Committed Programs.**

Scenario-independent work programs to which financial commitments have already been made.

Data is sourced from TransGrid's Oracle database, and entered into the "Committed Programs" sheet in the CAM.

[2] Programs include items such as on-going IT infrastructure, high voltage equipment maintenance and vehicle fleet maintenance

(3) **Future Projects.**

Projects which are forecast to be required in the future. The requirement or need for these projects is dependent on the future scenario under consideration, so future projects are scenario-dependent.

Future project expenditure information, including scenario-based needs-dates and forecast expenditure S-curves, is sourced from TransGrid's Success estimating system and entered into the "Forecast Projects" sheet in the CAM.

(4) **Future Programs.**

Work programs which have yet to be commenced, and which occur equally across each scenario (ie. scenario-independent).

Data sourced from TransGrid's Oracle database, and entered into the "Committed Programs" sheet in the CAM.

Future projects and programs are subject to risk and escalation adjustment, while committed projects and programs are subject only to escalation adjustment. This is in line with previous iterations of the CAM.

Work Type	Input	Corporate Governance	Scenario
Project - Committed	Oracle	Pre Decision Gate 2	Scenario Independent
Project –Future	Success Estimating Database	Post Decision Gate 2	Scenario Dependent
Program – Committed	Oracle	Pre Decision Gate 2	Scenario Independent
Program – Future	Oracle	Post Decision Gate 2	Scenario Independent

Figure 10 – Summary of Work Types

5.8 Error Checking

The model has several built-in error checks to ensure that entered data is consistent. The error checking cells check if there is a difference between the values entered for the total CAPEX estimate for a project / program and the following:

- Cash flow
- Regulatory Assets Classes
- Project Components

If a difference does exist then a non-zero value will be shown at the top of the columns and the cell will be highlighted in red.

Error Exists if Non- Zero	0.000	0.000	0.000
		Error Checking	
	Cashflow Variance from Estimate	RAC Variance from Estimate	Component Variance from Estimate
Project/Program	0	0	0
Project/Program	0	0	0
Project/Program	0	0	0
Project/Program	0	0	0

Figure 11: Error checking columns found on Project and Program data input sheets

6 Outputs& Calculations

6.1 Output Sheets

Primary output sheets in the CAM (input model) have tabs coloured orange, with secondary output sheet tabs coloured light orange, and alternative outputs coloured purple as per the following:

- *Future_Capex*
- *Committed_Capex*
- *Future_Capex_Esc*
- *Committed_Capex_Esc*
- *Output_Single Scenario*
- *TOTAL_Capex_Esc*
- *ALT_Future_Capex_Esc*
- *ALT_Total_Capex_Esc*

Refer to Appendix A for further detail on each of the work sheets.

6.2 Capex Estimates

The base case estimates on the output Summary Sheets are calculated by multiplying the estimated Capex value for the year by the Cumulative CPI percentage.

$$Base\ Case\ Est. = Capex\ Estimate_{Projects} \times Cum\ CPI\ \% + Capex\ Estimate_{Programs} \times Cum\ CPI\ \%$$

Note: For Future Projects scenario weighing is used to determine the base case estimate, refer to Section 6.3.

Note: The cumulative CPI Percentage is calculated using the following:

For Real

$$Cum\ CPI\ \% = Cum\ CPI\ to\ reporting\ Year$$

For Nominal

$$Cum\ CPI\ \% = Cum\ CPI\ /\ Cum\ CPI\ to\ reporting\ Year$$

The Risk and/ or Commodity Escalation portion of the estimated Capex value (on the output Summary Sheets) are determined by using the same formula used for the base case and including the risk and commodity multiplier and subtracting the base case estimate.

The breakdown of the Capex into Regulatory Asset Class or the Project Category is calculated the same way as for the Capex summary except that the Regulatory Asset Class or Project Component percentage is multiplied by the estimate and the Cumulative CPI. The CAM uses the Excel Function Sum Product to calculate the total for the all the project or programs

6.3 Scenario Weighted Cost

Future Project outputs are determined on a scenario weighted cost basis, that is an expenditure profile is calculated for each scenario, with the output of each scenario weighted to determine the final weighted average cost.

Since scenarios are only applicable for future projects, this methodology is only applicable to future projects.

The scenario weighted cost outputs are carried through the CAM into the AER Template Output Model (ATOM), consistent with previous versions of the CAM.

The Scenario Weighted cost is calculated using the following formula:

$$Scenario\ Weighted\ Cost = \sum_{i=scenario}^{n} Capex_{year} \times Scenario\ Weighting_i$$

6.4 Weighted Average Commissioning Date

The Weighted Average Commissioning Date is used in the ATOM as a proxy for the project commissioning date to calculate the 'as commissioned' expenditure to estimate the RAB.

The weighted average commissioning year is calculated using the following formula:

$$Weighted\ Ave.Comm\ Year = \left\| \frac{\sum Commisioning\ Year\ \times Scenario\ weighting}{\sum Scenario\ weightings\ (withno\ Commisioning\ Year)} \right\|$$

Excel form of the equation

ROUND(SUMPRODUCT(BF5:CS5,ScenWgts)/SUMPRODUCT(--(BF5:CS5<>""),ScenWgts)

> **Explanatory formula note:** The Sumproduct function requires a "divide by" to allow for projects not occurring in particular scenarios, where the sum of the weightings for years in which the project does occur summing to less than 100%. The "--"operator in the formulas returns an array of 0's or 1's based on whether the condition is true or not.
>
> For example, for a project with a 10% probability (scenario weighting) of occurring in Year 10 and a 20% probability of occurring in Year 20 would have a simple Sumproduct output of Year 5. To provide the correct result of the project occurring in Year 17, the simple Sumproduct is divided by the sum of the scenario weightings only in the years

that the project occurs (in this case 10% + 20% = 30%). The formula now provides for the simple Sumproduct output of Year 5 divided by 30% to give an output of 16.7 (17) years.

The "Round" function provides a whole (financial) year for calculation purposes, instead of providing a fractional year.

6.5 As Commissioned Expenditure

There are two different methodologies for calculating “As Commissioned” expenditure, as required for the unique depreciation requirements of both the Roll Forward Model (RFM) and the Post Tax Revenue Model (PTRM).

2009/10 – 2013/14 Nominal As-Commissioned Output

The first of these methodologies calculates “nominal” as-commissioned **project** expenditure for the period 2009/10 – 2013/14. This nominal expenditure is calculated by setting the Real/Nominal switch in the *Input_Fixed* sheet to “Nominal”, which calculates the nominal expenditure for each project in any given year (including both CPI and Commodity escalation), then escalates each of these expenditure years by CPI to the commissioning year. Each of these escalated expenditures is accumulated at the commissioning year to provide the as-commissioned expenditure (noting that expenditure prior to 2008/09 is not included, as this has been depreciated in previous regulatory periods).

(**Note** – for projects which have expenditure within, but are commissioned after, the 2010-14 period no as-commissioned expenditure is recorded for the 2010-14 period).

The commissioning date for **programs,** in the CAM, is assumed to be the date in which the program expenditure is incurred, with each program expenditure year effectively representing a project with a single year of expenditure. The as-commissioned program data is then a sum of nominal program expenditure for each year from 2009/10 to 2013/14.

2014/15 – 2018/19 Real As-Commissioned Output

The second methodology provides “real” as-commissioned **project** expenditure for the period 2014/15 – 2018/19. This real expenditure is calculated by setting the Real/Nominal switch in the *Input_Fixed* sheet to “Real” and setting the reporting year as required (for example set the reporting year to 2014 to provide outputs in $2013/14). This calculates the real expenditure for each project in any given year in the required reporting year dollars (for example $2013/14), then accumulates each of these project expenditures at the commissioning year to provide the as-commissioned expenditure (noting that any expenditure prior to 2008/09 is not included).

(**Note** – for projects which are commissioned in the 2015-19 period and have expenditure in the 2010-14, the total expenditure in both periods is recorded as as-commissioned expenditure for the 2015-19 period).

The commissioning date for **programs** is assumed to be the year in which the program expenditure is incurred, with each program expenditure year effectively representing a project

with a single year of expenditure. The as-commissioned program data is then a sum of the real program expenditure for each year from 2014/15 to 2018/19.

As-Commissioned Output

To prevent reporting errors, the *TOTAL_Capex_Esc* worksheet will provide as-commissioned outputs for either the 2009/10 – 2013/14 period or the 2014/15 – 2018/19 period, dependent on the Real/Nominal switch setting chosen.

If the risk switch in the *Input_Fixed* sheet is set to "Active", and risk settings are present in the *Input Risk & Exp* Profile, the as-commissioned outputs will include a risk factor.

Total As-Commissioned outputs are shown in the *TOTAL_Capex_Esc* sheet in the Input CAM, which is a summation of the as-commissioned expenditure shown in the *Future_Capex_Esc* and the *Committed_Capex_Esc* sheets.

6.6 Single Scenario Output

Provision has been made to determine the expenditure profile for a Single Scenario – for future projects only – in addition to the Scenario Weighted Cost and the Weighted Average Commissioning Date expenditure profiles. This functionality is provided in the *Output_Single_Scenario* worksheet.

To determine the expenditure profile for a single scenario, complete the following steps in the *Output_Single_Scenario* worksheet:

(a) Choose the required scenario in cell E3

(b) Choose the required date range in cells E4:E5

(c) Set the dropdown filter in cell B8 to "Yes".

All future projects which occur in the selected scenario and within the specified date range will now be shown. This output is for reference purposes only, and is not used for any subsequent calculations in the CAM or the ATOM.

7 AER Template Outputs

7.1 Updating

AER Template Outputs are contained in a separate spreadsheet, the *AER Template Output* model.

The data in the *AER Template Output* model can be updated by either:

- updating the links on opening the model; or,
- by first opening the *Input CAM* from the same directory as the *AER Template Output* model.

Once the AER Template Output model is open, click the "Update AER Templates" macro button in the *Index* worksheet to update the detailed AER templates. (This runs a macro which assigns Network and Non-Network Capex to AER Template worksheets 3.3, 3.4, 4.3 and 4.4. Other worksheets are directly linked to the *Input CAM.*)

There are two additional macro buttons in the AER Template Output model – "Current 5 years Network and Non-Network update report" and the "Next 5 years Network and Non-Network update report" – which have been left as-is[3] per TransGrid's previous alterations to the CAM. It is understood that this output information is used for internal TransGrid purposes.

8 Assumptions

The following assumptions have been made in formulating the Model. When using the Model, they should be kept in mind as some may have an impact on the decision making process. They are as follows:

1. Inputs are in $. Outputs are $.
2. For Excel calculation reference reasons, financial years are recorded in CAM as tax years (eg. 2011/12 is shown as 2012, 2014/15 is shown as 2015)
3. Escalation is treated as follows:
    a. CPI escalation and Commodity escalation are treated separately.
    b. Escalation escalates costs from one financial year to the next: for example 2014 escalation multiplies $2012-13 to get $2013-14.
    c. Escalation is applied to Project Component percentages (commodities - land, labour etc)
4. "Scenario" spreadsheets reflect only scenario-dependent future projects, and exclude future programs, committed projects, and committed program expenditures (since these are independent of scenarios). "Output" spreadsheets include both project and program data.
5. "Output Single Scenario" calculations record zero values for projects which are outside of the required scenario and date range. These zero-value Projects can be filtered out entirely by setting the filter arrow in column B to "Yes".
6. The CAM has risk capability for future projects and programs. Committed projects and programs do not have risk capability included.

[3] Evans & Peck extended the macro from 500 lines to 1000 lines to deal with additional input data.

7. The CAM is based on "scenario weighted-estimates", with scenario weighting applied after the expenditure was calculated for each individual project.
8. Project Components (commodities) are provided as a proportion of the total project, with the ratio of expenditure assumed to occur equally over each year of the expenditure S-curve (e.g. $0.5m Copper, $0.5m Steel, $5m Land and $4m Labour for a total project cost of $10m), with this ratio assumed to be consistent for each year of project expenditure.
9. "As commissioned" project costs represent the full cost of the project in the commissioning year of that project (i.e. it is the sum of the escalated "as incurred" project costs).
10. With the inflation toggle switch (Real / Nominal reporting switch) set to "Real" As-Commissioned expenditure provides a sum of the real expenditure as incurred.
11. With the inflation toggle switch (Real / Nominal reporting switch) set to "Nominal", As-Commissioned expenditure is the sum of the Nominal "as-incurred" expenditure, with "as-incurred" expenditure escalated by CPI to the commissioning year."
12. As commissioned Program expenditure is treated as-incurred - i.e. "as commissioned" expenditure equals the expenditure in each year of the program.

AER Templates

13. "Forecast Capex - Projects" sheets reference Project Input.
14. "Forecast Capex - Programs" sheets reference Program Input.
15. Program commissioning dates are shown as "ongoing" as these are effectively rolling programs.

9 Exclusions, Limitations and Constraints

The Model is subject to the following exclusions, limitations and constraints:

- All project and program inputs should have expenditure greater than zero for the period 2009-2024. If "zero expenditure" projects are included, a *#DIV0!* error will occur in the output sheets.

10 Model Validation

Model validation will be undertaken by way of User Acceptance Testing (UAT). The UAT will consist of the following tests:

- Case 01 – Real / Nominal & Year Controls
- Case 02 – Risk Result
- Case 03 – Risk Profiles
- Case 04 – Scenarios
- Case 05 – CPI Calculations
- Case 06 – Escalation Calculations
- Case 07 – Regulatory Asset Classes
- Case 08 – Project Components
- Case 09 – CAPEX by Project Category
- Case 10 – Output Scenario CAPEX
- Case 11 – AER Output
- Case 12 – Program & Project Output
- Case 13 – Output Escalated Asset Classes & Material Components
- Case 14 – Output "As Commissioned"

- Case 15 – Budgets per Regulatory Asset Class Splits

11 System & Platform Requirements

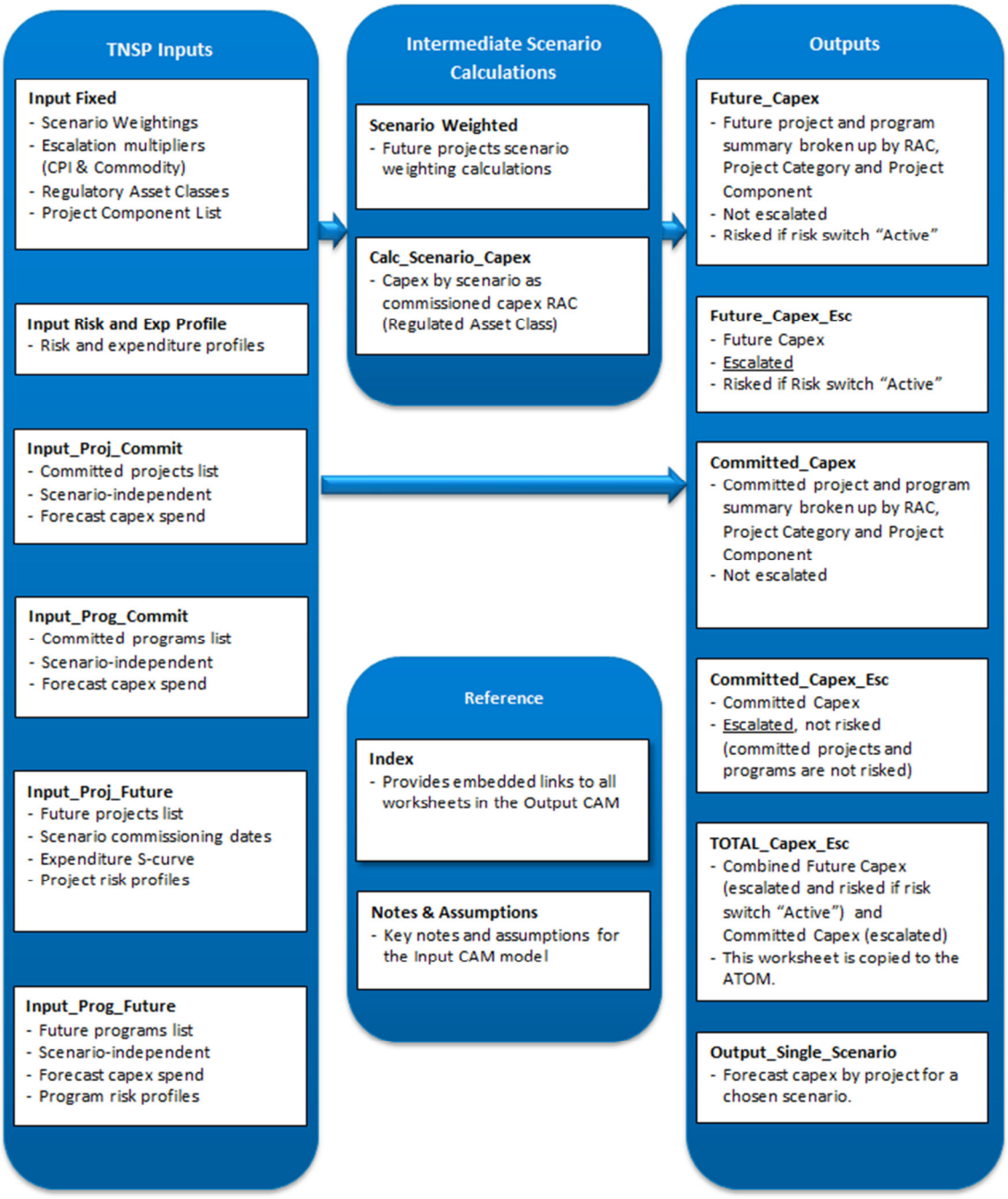
The model was developed using Microsoft Excel 2007.

Software requirements: Microsoft Excel 2007, and Microsoft Windows operating environment compatible with Microsoft Excel 2007.

Appendix A

Detailed CAM Structure – Input Model

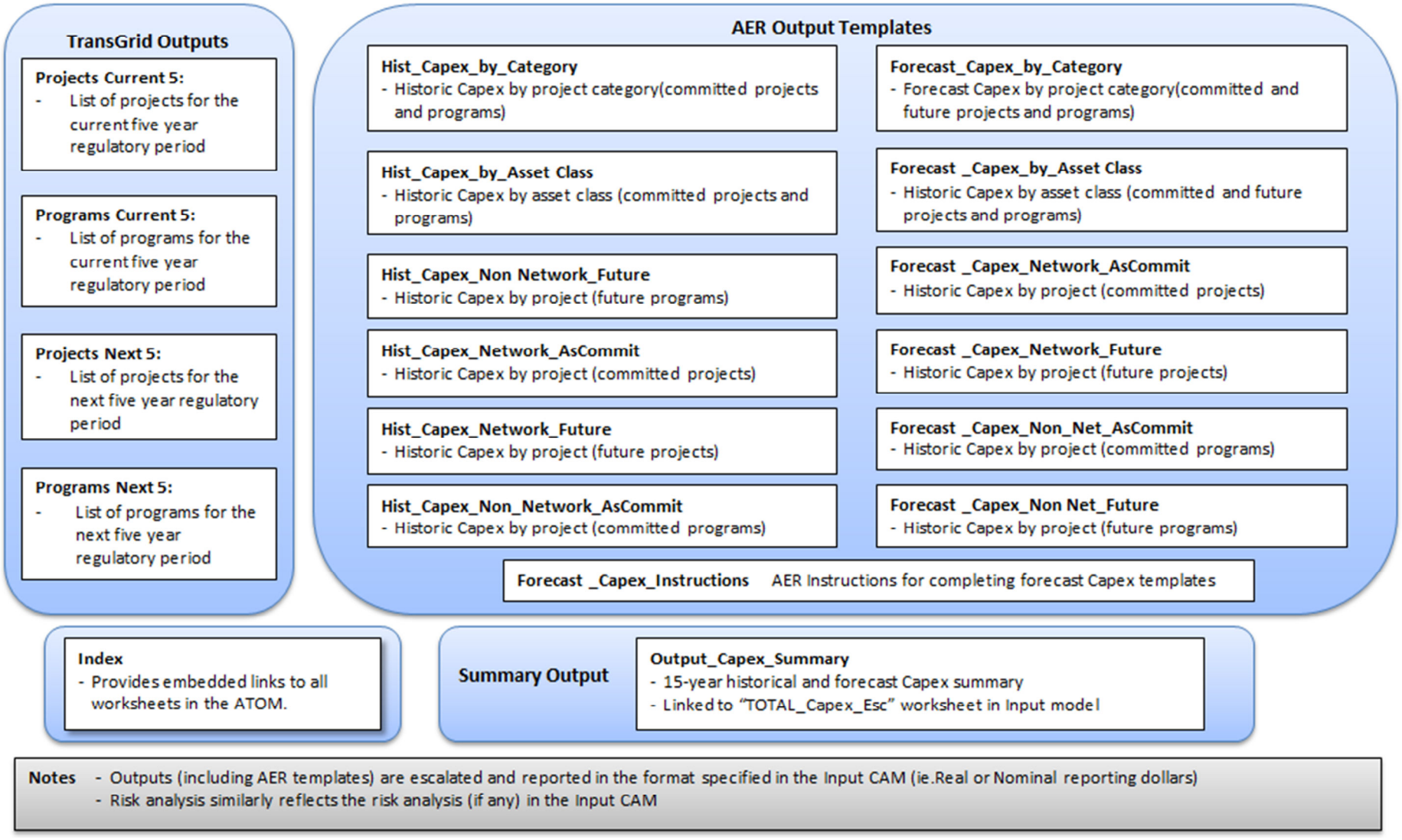
Schematic of "Input" Capital Accumulation Model



Appendix B

Detailed CAM Structure – AER Template Output Model

Schematic of AER Template Output Model (ATOM)



Appendix C **Model Modification**

Model Modification

The CAM has been significantly updated from previous versions, effectively merging the last three CAM versions (version 1.8: May 2008, version 2.7: January 2009, and version 2.8: January 2010) to provide both 40 scenarios and Real/Nominal reporting coverage for 15 years, and streamlining the model to improve both the usability and auditability.

This latest iteration of the CAM (version 3.10) is based largely on the scenario-based CAM version 2.7, with the key changes made to version 2.7 of the CAM are as follows:

- Regulatory period dates changed to match the upcoming regulatory period from 1 July 2014 to 30 June 2019
- Allowed the model to incorporate expenditure either side of the regulatory period, commencing from 1 July 2008 and extending through to 30 June 2024
- Disabling the risk function by outputting the most likely values only, effectively not using the CAM's risk capability while retaining the capability for potential future use
- Merged future and committed projects into a single model
- Expanded the number of Project Categories from nine to twelve
- Expanded the number of Project Components from five to thirteen
- Provided for either Real or Nominal dollar outputs
- Provided for Real dollar output reporting in years chosen by the user
- Separated Project and Program expenditure in the AER Output Template Model
- Simplified formula and worksheet structure to improve both the usability and auditability, and
- Retained existing CAM functionality where practical

Existing and Removed Functionality

While the structure of the CAM has been substantially simplified, existing functionality from previous versions of the CAM has been retained as much as possible.

One item that has not been retained is the ability to enter project and program escalation as "no escalation" or "CPI-only" escalation. The only escalation choices in the updated CAM are "Real" or "Nominal" outputs. To obtain the portfolio estimate without escalation set the reporting year to the current financial year, i.e. 2012 (fy 2011/12).

Existing output worksheets and associated macros developed by TransGrid have not been altered from previous versions of the CAM. These worksheets are in the AER Template Output Model and are *Projects current 5*, *Programs current 5*, *Projects next 5* , and *Programs next 5*. These worksheets extract information from other AER Template Output Model (ATOM) worksheets.

Scope of works

Model Structure

- Combine future and committed projects into a single "input" model
- Leave the "input" and "output" CAM models separate
- Retain the dedicated input sheet(s) for forecast project and program expenditure/s-curves.
- Set the risk distributions to provide most likely values only, effectively not using the CAM's risk capability while retaining the capability for potential future use.

Regulatory Period

- Change the regulatory period dates to match the upcoming regulatory period from 1 July 2014 to 30 June 2019
- Allow the model to incorporate expenditure either side of the regulatory period, commencing from 1 July 2008 and extending through to 30 June 2024

CAM Inputs

- Retain the existing 18 Regulatory Asset Classes (nine of which are currently unused and are for future expansion)
- Expand the five existing Forecast Project Components into 13 Project Components for escalation purposes.
- Convert the existing Risk Categories into Expenditure Categories, increasing the number of Expenditure Categories to be modified as required at a future stage. For example replacement, augmentation, information technology etc.
- Allow for input cost estimates to be provided in any dollars).

Scenarios

- Enable CAM to deal with 40 different input scenarios (even though only 20 scenarios are anticipated)
- CAM to calculate weighted average commissioning dates for each project using scenario probabilities (for comparison and RAB estimate purposes).

CAM Outputs

- Allow for output reporting in either Real or Nominal dollars (noting that historical expenditure would always be entered using actual (nominal) dollars)
- Allow for real dollar output reporting in any financial year e.g. $2013/14 dollars.

Cost Estimates

- Refer to Clause 5.7.
- Cost estimates for all projects and programs will be summarised into financial year expenditure prior to being input into CAM.
- Future projects will have annual expenditure recorded in CAM as an S-curve output based on when the expenditure occurs relative to commissioning, to allow scenario calculations to be conducted.
- Committed projects and all programs will have annual expenditure recorded in CAM as the actual forecast expenditure.

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