Multinet Gas Networks

Attachment 6.3

ACIL Allen – Future of Gas model description

Final Plan 2023/24 – 2027/28

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ACIL ALLEN

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Report to   Australian Gas Networks, Multinet and Ausnet

Future of gas model

Model description

Contents

Contents

Overview 1

This document provides instructions for persons to understand and operate the Future of Gas demand model. It is expected that this will include representatives of Multinet, Australian Gas Networks and Ausnet. It covers the main assumptions and methodology underlying the model.

The model produces a projection of gas demand and customer numbers to the year 2100 at the LGA level. Customer numbers are split into new connections and disconnections, while average consumption per connection is also forecast to the year 2100.

Forecasts are split between residential and commercial customers.

The model allows the model user to forecast the impact of relative energy prices between gas and electricity on the projected demand for gas to 2100, as well as allowing the user to model the impact of changes in relative appliance costs and running costs between gas and electricity on total gas volumes over time.

The model calculates the relative NPV of switching from gas and electricity and uses a logistic curve to estimate the market share of gas versus electricity over time. Separate calculations and projections are made for both disconnections and new connections.

Moreover, the model allows the user to conduct a scenario analysis, such as shutting down all or parts of the network as well as limiting new connections to the existing network.

The modelling tool has been developed in Microsoft Excel and is presented as a set of worksheets which follow a logical structure from left to right.

The model is constructed and documented according to best practice design principles, including:

— Logical structure
— Clear separation of inputs, calculations and outputs
— Logical flow of calculations
— Designed to facilitate sensitivity testing of inputs
— Consistent design standards, colour coding, etc
    – cells which contain hard-coded inputs are coloured light purple
— Clear and comprehensive documentation

The model allows for separate scenarios to be modelled for each set of inputs.

The most important worksheet in the model is the 'Summary' worksheet which contains the gas volumes and customer numbers projected from the model calculations.

The model is structured as three separate sections:

— Model inputs
— Model calculations and
— Model outputs.

These are discussed in the sections that follow.

2 Model inputs

The first ten worksheet tabs of the model (apart from the 'Summary' sheet which is a summary of results) are model input sheets and are purple coloured.

The input worksheets are:

— Control sheet
— Scenarios
— Volumes
— Customers
— Volume per connection
— Weather
— Census
— Households
— GSP
— Prices

2.1 'Control' worksheet

The Control worksheet contains the main model settings that are used in the NPV calculations.

These include:

— Appliance capital costs for cooking, hot water and space heating
— Real percentage annual change in appliance costs over time
— Assumed annual appliance consumption for cooking, hot water and space heating
— Changes in appliance efficiency over time
— Appliance maintenance costs per annum and real percentage changes in maintenance costs
— Assumed asset lives and the decision point for each existing customer

The model user is able to adjust each of the above settings in the worksheet and observe the impact on gas volumes and customer numbers over time.

Figure 2.1 shows a snapshot from this worksheet.

Figure 2.1 Snapshot of the 'Control' worksheet

Customer discount rates	%					Asset lives	Years				Cumulative DF assuming 15 years	
High income	5%		Recoonections as share of gross connections	50%		Cooking	15		High income	10.38	
Medium income	10%					Hot water	12		Medium income	7.61	
Low income	15%		Appliance capital costs			Room heating	15		Low income	5.85	
Commercial	3%		Cooking	$ real 2021		Ducted heating	15		Commercial	11.94	
			Electric cooktop (induction)	2900		Service charge	15				
Appliance costs			Gas stove	2100							
Cooking	real % change (p.a.)					Decision point	15				
Electric cooktop (induction)	-1%		Hot water								
Gas stove	0%		Heat pump hot water	3100		Elasticities	Residential	Commercial			
			Gas instant hot water	1400		Weather	0.3555523	0.1551871			
Hot water						Gas price	-0.1	-0.35			
Heat pump hot water	-1%		Room heating			Elecricity price	0.08	0.3			
Gas instant hot water	0%		RCAC split system	2200							
			Gas wall furnace	1400						Residential	Commercial
Room heating						Distribution share of retail fixed charge	%		Non-Appliance Cost Related Growth	3.50%	3.50%
RCAC split system	-1%		Ducted heating			Residential	28%		Non-Appliance Cost Related Disconnections	1.00%	3.60%
Gas wall furnace	0%		Ducted RCAC	10750		Commercial	35%				
			Ducted gas heating	7600							
Ducted heating											
Ducted RCAC	-1%		Gas disconnection charge	100							
Ducted gas heating	0%		Electricity connection upgrade	1500							
Gas disconnection charge	0%										
Electricity connection upgrade	0%										

Source: ACIL Allen

2.2 'Scenarios' worksheet

The Scenarios worksheet presents two distinct block of indicator variables (0 or 1) which represent whether an LGA is turned on or off for each year in the projection period.

The first two blocks in the worksheet allow the model user to turn the network completely on or off for each LGA within the distribution network for both the residential and commercial customers respectively. The indicator variable is set to 1 when the network is permitted to operate for a given LGA in a given year (see **Figure 2.2**). To turn the network off in a particular LGA the indicator variable needs to be set to zero for each year that the distribution network is switched off. Once the network is turned off it cannot be turned on again. It is also possible for the indicator variable to take a value between zero and 1 reflecting a transitionary period between operating and switching off.

Two additional blocks of data in the worksheet allow the model user to prevent new connections from being added to the network in specific LGAs. This allows the model user to explore scenarios around new government policies that prevent new greenfield developments in specific areas within the distribution network. Separate switches exist for both residential and commercial customers. These indicator variables are set to a default value of zero (indicating that new connections are still permitted).

Figure 2.2   Snapshot of the 'Scenarios' worksheet

	A	B	C	D	E	F	G	H	I	J	K
1	**Residential Network ON/OFF**										
2	**LGA**	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
3	Ararat (RC)	1	1	1	1	1	1	1	1	1	1
4	Ballarat (C)	1	1	1	1	1	1	1	1	1	1
5	Brimbank (C)	1	1	1	1	1	1	1	1	1	1
6	Central Goldfields (S)	1	1	1	1	1	1	1	1	1	1
7	Colac-Otway (S)	1	1	1	1	1	1	1	1	1	1
8	Corangamite (S)	1	1	1	1	1	1	1	1	1	1
9	Darebin (C)	1	1	1	1	1	1	1	1	1	1
10	Glenelg (S)	1	1	1	1	1	1	1	1	1	1
11	Golden Plains (S)	1	1	1	1	1	1	1	1	1	1
12	Greater Bendigo (C)	1	1	1	1	1	1	1	1	1	1
13	Greater Geelong (C)	1	1	1	1	1	1	1	1	1	1
14	Hepburn (S)	1	1	1	1	1	1	1	1	1	1
15	Hobsons Bay (C)	1	1	1	1	1	1	1	1	1	1
16	Horsham (RC)	1	1	1	1	1	1	1	1	1	1
17	Hume (C)	1	1	1	1	1	1	1	1	1	1
18	Macedon Ranges (S)	1	1	1	1	1	1	1	1	1	1
19	Maribyrnong (C)	1	1	1	1	1	1	1	1	1	1
20	Melbourne (C)	1	1	1	1	1	1	1	1	1	1
21	Melton (S)	1	1	1	1	1	1	1	1	1	1
22	Moonee Valley (C)	1	1	1	1	1	1	1	1	1	1
23	Moorabool (S)	1	1	1	1	1	1	1	1	1	1
24	Moreland (C)	1	1	1	1	1	1	1	1	1	1
25	Mount Alexander (S)	1	1	1	1	1	1	1	1	1	1
26	Moyne (S)	1	1	1	1	1	1	1	1	1	1

Source: ACIL Allen

2.3 'Volumes' worksheet

The 'Volumes' worksheet contains all the historical gas volumes that are the basis for the calculations in the model. Volumes are presented on both a quarterly and annual basis (financial year) for each LGA as well as being split by residential and commercial. Units are in Gigajoules (GJ) (see **Figure 2.3** below).

Figure 2.3   Snapshot of the 'Volumes' worksheet

	Residential volume GJ (FY)	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
69											
70	Ararat (RC)	141,319	147,563	145,199	130,267	158,249	154,763	138,591	141,147	148,106	117,880
71	Ballarat (C)	2,328,589	2,361,291	2,385,809	2,140,367	2,692,096	2,761,673	2,568,148	2,600,596	2,941,630	2,329,457
72	Brimbank (C)	2,324,677	2,339,222	2,188,308	1,935,232	2,517,244	2,405,981	2,318,541	2,204,919	2,338,429	1,816,379
73	Central Goldfields (S)	155,671	164,604	155,628	141,906	167,847	176,288	163,018	163,349	170,320	142,344
74	Colac-Otway (S)	197,951	199,268	198,612	175,563	206,276	223,927	216,181	210,803	224,346	180,049
75	Corangamite (S)	47,986	53,837	54,924	45,543	71,829	67,389	64,189	65,041	75,838	55,548
76	Darebin (C)	44	188	148	178	175	165	97	115	95	102
77	Glenelg (S)	151,615	155,610	153,269	136,037	166,200	164,992	155,289	156,564	164,208	131,468
78	Golden Plains (S)	-	-	-	-	-	-	-	2,261	11,176	11,778
79	Greater Bendigo (C)	1,539,642	1,601,023	1,535,920	1,383,531	1,770,568	1,811,846	1,722,802	1,715,804	1,829,527	1,494,974
80	Greater Geelong (C)	3,399,382	3,504,903	3,399,696	3,143,522	3,976,795	3,894,848	3,849,513	3,802,681	4,181,126	3,359,504
81	Hepburn (S)	137,481	143,528	144,943	132,194	153,289	163,249	153,111	156,834	173,530	135,917
82	Hobsons Bay (C)	1,519,285	1,533,890	1,441,650	1,313,791	1,610,229	1,562,966	1,506,439	1,460,678	1,566,147	1,231,306
83	Horsham (RC)	228,261	239,857	243,407	211,731	266,432	280,253	253,302	251,453	262,462	215,743
84	Hume (C)	3,452,314	3,635,800	3,514,037	3,078,491	4,228,638	4,025,444	4,007,997	3,940,721	4,315,492	3,367,395

Source:ACIL Allen

2.4   'Customers' worksheet

The Customers worksheet contains the historical customer numbers by LGA for both the residential and commercial customer classes. Customers are defined as those having a positive volume during the period. Zero volume customers are not counted in the model. For this reason, the total number of customers in the model will not correspond exactly to the total number of customers on the distribution businesses database.

The worksheet also contains new customers and disconnections. New connections include both completely new customers as well as re-connections.

A customer that has not consumed any gas during the period is deemed to have disconnected. Conversely, a customer that goes from zero volume in one period to a positive volume in the next is defined as a new connection.

2.5   'Volume per connection' worksheet

The Volume per connection worksheet contains the historical volume per connection values by LGA and split by the residential and commercial sectors. It is not strictly an input sheet and is calculated using data from the Volumes and Customers worksheets. Units are measured in GJs.

Figure 2.4   Snapshot of the 'Volumes per connection' worksheet

70	**Residential customers**										
71	LGA	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
72	Ararat (RC)	49.0	50.9	49.8	44.3	53.6	52.2	46.6	47.6	49.7	39.9
73	Ballarat (C)	61.8	61.1	60.4	53.5	65.3	66.0	60.4	59.9	66.0	51.4
74	Brimbank (C)	50.1	51.2	47.6	41.9	54.0	51.3	49.2	46.5	49.0	38.0
75	Central Goldfields (S)	42.3	43.9	41.0	37.0	43.2	44.8	41.2	41.0	42.7	35.7
76	Colac-Otway (S)	47.4	47.1	46.3	40.4	46.5	50.5	47.9	46.1	48.6	39.0
77	Corangamite (S)	36.4	38.3	37.4	30.4	46.6	42.7	39.8	39.8	45.6	33.1
78	Darebin (C)	14.7	62.8	49.4	59.3	58.5	55.1	32.5	57.7	31.5	34.1
79	Glenelg (S)	35.4	36.0	35.2	31.1	38.0	37.7	35.5	35.6	37.3	29.9
80	Golden Plains (S)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.9	35.3	29.0
81	Greater Bendigo (C)	45.6	45.6	42.9	37.8	47.1	47.6	44.6	43.8	45.9	37.1
82	Greater Geelong (C)	41.3	41.6	39.1	35.6	43.7	41.8	40.3	38.7	41.4	32.8
83	Hepburn (S)	50.3	50.9	50.0	44.8	51.0	53.3	49.3	50.1	54.9	42.6
84	Hobsons Bay (C)	46.6	46.6	43.4	39.5	48.0	46.3	44.3	42.6	45.2	35.4
85	Horsham (RC)	40.1	41.4	41.4	35.7	44.2	45.9	41.0	40.5	42.0	34.8
86	Hume (C)	60.6	62.1	58.2	49.5	65.6	60.6	58.4	55.9	59.5	45.6
87	Macedon Ranges (S)	58.4	60.3	59.6	54.2	61.9	64.1	60.6	59.8	65.2	52.9
88	Maribyrnong (C)	40.1	40.4	37.5	33.5	40.7	39.3	36.9	35.3	36.5	28.7

Source: ACIL Allen

2.6 'Weather' worksheet

The weather worksheet shows quarterly historical values of heating degree days (HDD) and then aggregates these up to an annual basis. The historical trend is then used as a basis to project the HDDs into the future. A steady long-term decline in HDDs reflects a steady warming trend in the weather since 1980. Heating degree days are defined as the sum of the difference in daily average temperature from some value representing room temperature (say 18 degrees). Only days which are below the reference temperature count towards the HDD value.

Percentage changes in HDD over the forecast period are multiplied by the HDD elasticity in the Control worksheet to calculate the annual percentage change in gas consumption per customer. The HDD elasticity was estimated empirically within a regression model of volume per customer. Separate elasticities are applied for residential and commercial customers. There is a subtle long term decline in the average gas consumption per customer as a result of warming (see **Figure 2.5**).

Figure 2.5   Heating degree days (1980 to 2021), Melbourne Airport

Source: ACIL Allen
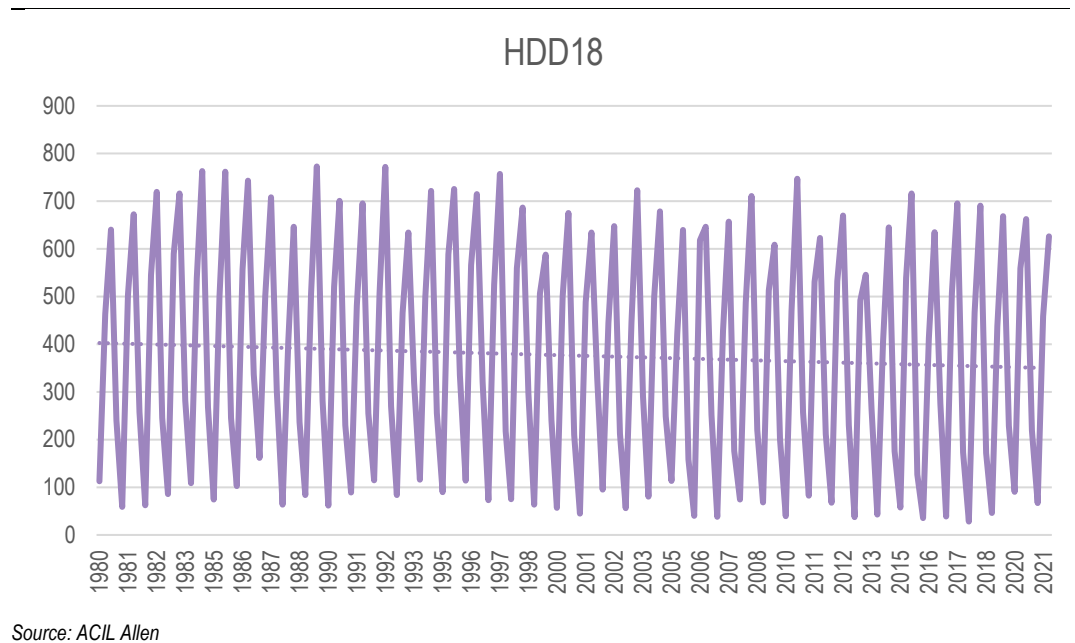
2.7 'Census' worksheet

The 'Census' worksheet contains information from the 2016 Census that is used to classify each LGA (see **Figure 2.6**). The methodology uses three discount rates which can be assigned to each LGA depending on the characteristics of each LGA. The classification is assigned in the 'Control' worksheet of the model and each LGA is assigned either a low, medium or high discount rate in the LGA calculations. LGAs with lower socio-economic characteristics are assigned a higher discount rate on the basis that consumers are constrained by the upfront capital costs of new appliance purchases and are therefore less forward looking in their decision making. The value of the low, medium and high discount rates are assigned in the 'Control' worksheet.

Figure 2.6 Snapshot from 'Census' worksheet

	2	3	4	5	6	7	8	9	10	11	12	13	14
1													
2 LGA	English speakers	Median_age_persons	Median_mortgage_re	Median_tot_prsnl_inc	Median_rent_weekly	Median_tot_fam_inc	Average_num_psns_per_be	Median_tot_hhd_inc_weekly	Average_household_size	Sharehouses	Sharesemidetached	Shareflats	sharerenting
3 Ararat (RC)	0.84	46	1022	556	185	1263	0.7	991	2.3	0.79	0.02	0.02	0.20
4 Ballarat (C)	0.89	38	1350	590	250	1489	0.8	1160	2.4	0.74	0.12	0.03	0.28
5 Brimbank (C)	0.36	35	1599	487	300	1358	0.9	1263	3	0.77	0.12	0.04	0.24
6 Central Goldfields (S)	0.90	50	975	452	195	1001	0.7	775	2.2	0.78	0.05	0.01	0.19
7 Colac-Otway (S)	0.89	45	1300	574	210	1362	0.8	1057	2.3	0.66	0.05	0.01	0.17
8 Corangamite (S)	0.90	46	1083	542	170	1301	0.7	1043	2.4	0.79	0.01	0.02	0.18
9 Darebin (C)	0.56	36	1950	650	339	1784	0.9	1423	2.5	0.54	0.24	0.13	0.35
10 Glenelg (S)	0.90	47	1083	536	182	1362	0.7	1043	2.3	0.76	0.02	0.03	0.19
11 Golden Plains (S)	0.92	39	1550	628	260	1630	0.8	1448	2.8	0.89	0.00	0.00	0.08
12 Greater Bendigo (C)	0.89	39	1387	604	250	1452	0.8	1184	2.4	0.80	0.07	0.01	0.25
13 Greater Geelong (C)	0.83	40	1517	600	280	1576	0.8	1244	2.4	0.73	0.09	0.02	0.24
14 Hepburn (S)	0.86	50	1300	532	235	1287	0.8	996	2.2	0.67	0.02	0.01	0.13
15 Hobsons Bay (C)	0.66	38	1900	704	330	1921	0.9	1567	2.6	0.61	0.24	0.06	0.27
16 Horsham (RC)	0.91	42	1200	617	200	1408	0.7	1110	2.3	0.77	0.05	0.05	0.22
17 Hume (C)	0.49	33	1650	529	320	1473	0.9	1379	3.1	0.81	0.09	0.03	0.23
18 Macedon Ranges (S)	0.89	42	1733	702	315	1932	0.8	1638	2.7	0.84	0.04	0.01	0.13
19 Maribyrnong (C)	0.51	33	2000	703	330	1913	1	1551	2.5	0.47	0.22	0.21	0.40
20 Melbourne (C)	0.40	28	2000	642	450	2062	1.1	1354	2	0.02	0.11	0.71	0.56
21 Melton (C)	0.61	33	1704	658	300	1683	0.9	1542	3	0.82	0.10	0.01	0.20
22 Moonee Valley (C)	0.64	38	2000	744	350	2098	0.9	1635	2.5	0.52	0.19	0.19	0.30
23 Moorabool (S)	0.89	40	1559	635	260	1670	0.8	1391	2.6	0.82	0.06	0.01	0.17
24 Moreland (C)	0.56	34	1950	680	355	1843	0.9	1503	2.5	0.51	0.24	0.15	0.34

Source: ACIL Allen

The LGA specific data shown in the 'Census' worksheet are:

— Proportion of English speakers
— Median age of persons
— Median weekly total personal income
— Median weekly rent
— Median weekly total family income
— Average number of persons per bedroom
— Median weekly total household income
— Average household size (persons)
— Proportion of dwellings that are detached houses
— Proportion of semi-detached dwellings
— Proportion of dwellings thar are flats
— Proportion of renters

2.8 'Households' worksheet

The 'Households' worksheet contains:

— Historical and Projected Population estimates from the Victoria in Future (ViF) (2019)
— Historical population estimates by Local Government Area, 2019 to 2020 from the ABS, ABS_ERP_LGA2020_110820211310519
— An estimate of household numbers by converting the population numbers to households using an estimate of household size from the census.
— An estimate of new connections including reconnections, estimated by applying a scaling factor in cell E2 of the 'Control' worksheet

Figure 2.7 Snapshot from 'Households' worksheet

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1		Population estimates by Local Government Area, 2019 to 2020, ABS_ERP_LGA2020_110820211310519															
2		Victoria in Future 2019 (VIF2019)															
3		**As at June 30**										Actual	Forecast				
4			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5		Ararat (RC)	11,326	11,400	11,490	11,560	11,644	11,745	11,756	11,795	11,844	11,965	11,998	11,881	11,914	11,918	11,921
6		Ballarat (C)	95,185	96,728	98,344	99,914	101,479	103,500	105,422	107,324	109,504	111,361	113,477	113,658	115,817	117,960	120,142
7		Brimbank (C)	191,496	193,774	196,169	198,468	200,860	204,190	206,997	208,744	209,568	208,247	210,084	213,389	215,271	217,203	219,152
8		Central Goldfields (S)	12,579	12,714	12,815	12,884	12,950	13,087	13,148	13,208	13,182	13,092	13,150	13,368	13,427	13,478	13,528
9		Colac-Otway (S)	20,799	20,902	21,035	21,131	21,230	21,362	21,430	21,502	21,562	21,662	21,715	21,625	21,677	21,731	21,785
10		Corangamite (S)	16,526	16,470	16,410	16,340	16,274	16,243	16,210	16,139	16,017	15,929	15,843	15,819	15,733	15,659	15,585
11		Darebin (C)	142,942	144,986	147,272	149,511	151,974	155,126	158,751	161,653	164,224	166,430	169,316	168,716	171,643	174,272	176,942
12		Glenelg (S)	19,848	19,825	19,797	19,755	19,722	19,759	19,692	19,664	19,671	19,621	19,586	19,587	19,551	19,521	19,491
13		Golden Plains (S)	18,958	19,604	20,362	20,899	21,388	22,016	22,568	23,118	23,722	24,249	24,812	24,650	25,222	25,764	26,318
14		Greater Bendigo (C)	101,995	103,905	105,957	107,955	109,908	112,267	114,091	116,041	118,091	119,980	122,039	122,219	124,316	126,426	128,572
15		Greater Geelong (C)	215,837	219,152	223,357	227,744	232,926	239,529	245,728	252,229	258,938	264,866	271,537	270,255	277,062	282,994	289,053
16		Hepburn (S)	14,629	14,825	15,022	15,184	15,334	15,525	15,629	15,812	15,973	16,157	16,269	16,066	16,177	16,285	16,393
17		Hobsons Bay (C)	87,395	88,339	89,188	90,417	91,674	93,445	95,071	96,481	97,765	98,189	99,505	99,925	101,264	102,670	104,095
18		Horsham (RC)	19,523	19,608	19,694	19,748	19,792	19,884	19,885	19,874	19,920	20,018	20,040	20,016	20,038	20,082	20,126
19		Hume (C)	174,290	179,202	184,873	191,278	198,176	207,041	215,238	224,423	233,545	241,188	250,562	247,715	257,342	264,348	271,545
20		Macedon Ranges (S)	42,883	43,794	44,595	45,471	46,373	47,480	48,422	49,387	50,230	50,971	51,877	51,742	52,662	53,486	54,322

Source: ACIL Allen

2.9 'GSP' worksheet

The GSP worksheet presents historical and projected values of Victorian Gross State Product. The first five years of projected growth are obtained from the Victorian Government's most recent budget papers. From 2026 onwards, a long-term historical average is assumed to apply.

GSP was not found to be a statistically significant driver of gas demand and hence is not used in any of the model calculations. The worksheet is retained for informational purposes only and for potential future use in a revised methodology.

2.10 'Prices' worksheet

The 'Prices' worksheet is a key input sheet in the model where gas and electricity price projections are entered.

ACIL Allen provided the Victorian gas distribution network owners with retail electricity price forecasts for commercial and domestic users to input into the Future of Gas Model. We provided four scenarios and four alternative scenarios, each set reflecting the four expert panel environmental scenarios supplied to us (Electric Dreams, Dual Fuel, Muddling Through and Hydrogen Hero).

ACIL Allen maintains a national retail price model that estimates electricity tariffs for typical retail customers in each NEM region, the WA WEM, and the NT DKIS. The retail prices provided to the Victorian distributors were developed using this model (Victorian region). The retail prices are developed using a building block approach with the building blocks consisting of network, wholesale energy, LRET, SRES, other state-based green schemes, losses and retailing costs.

Network costs are developed based on the existing transmission and distribution regulated prices as notified by each network operator to the end of the current regulatory control period. Projections beyond the current regulatory control period are calculated by multiplying the previous year's price by an index reflecting the existing RAB and forward operating and capital costs estimates. A weighted average single network tariff is used for each typical customer class for each year (prices

are not broken out by network distribution area). Network tariffs across the network distribution businesses are typically within 10 per cent of each other. This simplification is considered acceptable for the Future of Gas Model.

Wholesale costs were developed using ACIL Allen's NEM simulator, PowerMark. The results were based on our September Reference case, RC58. We update these cases quarterly, and these prices can change depending on assumed inputs. Assumed government policy (Commonwealth and the various states) is a key driver of the wholesale energy results.

LRET costs market prices where available and our internal projections after that. SRES costs are based on our internal projection of the uptake in qualifying facilities. There are no LRET and SRES costs beyond 2030.

Other state-based schemes are determined by Victorian government policies that result in costs passed through to consumers. In Victoria, this is the VEET scheme.

Losses are determined by wholesale market marginal loss factor estimates and notified distribution loss factors. Residential losses are estimated as 6.09 per cent, and commercial losses are estimated as 5.53 per cent.

Retailing costs are developed by estimating costs faced by retailers, including metering, billing and marketing costs and a profit margin for retailers.

In reviewing the scenarios, we determined that the Dual Fuel scenario was closest to our (as of November 2021) Reference case wholesale market projection and associated retail prices (including all the building blocks).

To develop projections for the other three scenarios, we adjusted the Dual fuel projected prices by multiplying wholesale and network costs in each year by an index reflecting the underlying scenario characteristics. These indices are shown in **Table 2.1** below. Intervening years not shown are a linear interpolation of the above indices.

Table 2.1   Scenario adjustment indices

Year	Electric Dreams		Muddling Through		Hydrogen Hero	
	Network index	Wholesale index	Network index	Wholesale index	Network index	Wholesale index
2020	1.00	1.00	1.00	1.00	1.00	1.00
2025	1.22	0.96	1.11	1.04	1.00	1.04
2030	1.50	0.90	1.25	1.10	0.90	1.10
2035	1.50	0.90	1.25	1.10	0.90	1.10
2040	1.40	0.90	1.20	1.10	0.90	1.10
2045	1.30	0.90	1.15	1.10	0.90	1.10
2050	1.20	0.90	1.10	1.10	0.90	1.10

Source: ACIL Allen

Retail prices are a mixture of fixed and variable payments. There has been a general trend towards increasing the proportion of fixed costs in retail bills over time to make tariffs more cost-reflective. This has become more important for networks as small customers invest in rooftop solar PV systems. Network costs are mostly fixed. When charged as variable costs (per unit of consumption), rooftop solar PV owners avoid a significant portion of the network fixed costs. While the proportion of fixed costs in electricity tariffs is likely to increase over time, the extent of the increase is not yet clear. In 2021, the fixed component for typical residential and small business customers was around 11 per cent.

In the first four scenarios, we assumed that the component of fixed costs in retail tariffs would increase from around 11 per cent in 2021 to about 40 per cent in 2032 and then remain at that level through to 2050. The four alternative scenarios have the same underlying total tariffs, but the fixed component is assumed to remain constant from 2021 to 2050 (around 11 per cent).

The retail gas price is split into a daily fixed charge and a volumetric charge.

The volumetric charge ($/GJ) is built up from the following components:

— Distribution charge

— Wholesale price

— Transmission charge

— AEMO costs

— Environmental charges

— Retail margin

Apart from the distribution charge which is calculated in and linked to the distribution businesses regulatory model, the other components (shaded in purple) are calculated externally in ACIL Allen's proprietary models. The source of each component is shown in **Table 2.2.**

Table 2.2   Components of gas volumetric charge ($/GJ)

Component	Source
Distribution charge	Ausnet, Multinet or AGN regulatory model
Wholesale price	ACIL Allen proprietary modelling
Transmission charge	ACIL Allen modelling based on regulatory data from the owner of the Victorian transmission system, APA.

AEMO costs	From AEMO's 2020-21 AEMO Budget and Fees, refer https://aemo.com.au/-/media/files/about_aemo/energy_market_budget_and_fees/2020/budget-and-fees--final.pdf?la=en#:~:text=AEMO's%20budgeted%20expenditure%20for%20202020,estimated%20to%20be%20%2462.3%20million. The fee schedule of gas functions is Appendix A1.2 and includes:
	
	– VIC declared wholesale gas market - $0.08887 per GJ withdrawn
	– VIC gas FRC – $0.06221 per customer supply point per month
	– Energy Consumers Australia - $0.03429 per customer supply point per month
	– Gas Statement of Opportunities - $0.03869 per customer supply point per month
	– Gas Trading Platform
	  – Variable fee – daily product fee - $0.045 per GJ
	  – Variable fee – daily product fee - $0.035 per GJ
	  – Variable fee – daily product fee - $0.025 per GJ
	  – Day ahead auction - $0.035 per GJ
	
	Costs assumed to be the same in real terms over time.

Environmental charges	Costs associated with the Victorian Energy Efficiency Target scheme (Energy Upgrade program) estimated as follows: – Total number of certificates – increasing from 6.5 million in 2020 and 2021 to 6.7 million in 2022, then increasing by 0.2 million per year from 2022 to 8.3 million in 2030. – Reduction rate – 0.0087 certificates / GJ as per https://www.esc.vic.gov.au/victorian-energy-upgrades-program/participating-veu-program/energy-retailers-veu-program

Component	Source
	– Cost per certificate - $49.64 in 2021 as per ESC, Victorian Default Offer 2022 (draft)
	– Cost in 2021 (per GJ) = Reduction rate x Cost per certificate = $0.43 per GJ
	– Cost in each subsequent year (per GJ) = Cost in 2021 x Number of certificates in year t / Number of certificates in 2021 x Modelled demand in 2021 / modelled demand in year t
Retail margin	Based on ESC, Victorian Default Offer 2021. Estimated to be 5.7%.

Source: ACIL Allen

Figure 2.8 Snapshot from 'Prices' worksheet

Residential   Real $2021

Year	Distribution fixed charge $/day	Distribution $/GJ	Retail fixed charge $/day	Wholesale $/GJ	Transmission $/GJ	AEMO costs $/GJ	Environmental $/GJ	Retail margin $/GJ	Retail gas price $/GJ
2021	0.227667006	$ 3.53	0.83	8.59	$ 2.32	$ 0.23	$ 0.47	$ 1.02	$ 16.15
2022	0.228	$ 3.53	0.83	$ 9.60	$ 2.32	$ 0.23	$ 0.47	$ 0.93	$ 17.08
2023	0.230	$ 3.53	0.83	$ 10.36	$ 2.24	$ 0.23	$ 0.50	$ 0.97	$ 17.82
2024	0.233	$ 3.54	0.83	$ 10.56	$ 2.22	$ 0.23	$ 0.55	$ 0.98	$ 18.08
2025	0.239	$ 3.54	0.84	$ 11.06	$ 2.19	$ 0.23	$ 0.62	$ 1.01	$ 18.66
2026	0.246	$ 3.55	0.85	$ 11.57	$ 2.16	$ 0.23	$ 0.72	$ 1.05	$ 19.27
2027	0.257	$ 3.55	0.86	$ 11.56	$ 2.14	$ 0.23	$ 0.86	$ 1.05	$ 19.39
2028	0.270	$ 3.55	0.87	$ 11.77	$ 2.14	$ 0.23	$ 1.05	$ 1.08	$ 19.81
2029	0.291	$ 3.55	0.89	$ 12.06	$ 2.15	$ 0.23	$ 1.32	$ 1.11	$ 20.41
2030	0.319	$ 3.55	0.92	$ 12.43	$ 2.16	$ 0.23	$ 1.69	$ 1.15	$ 21.21
2031	0.193	$ 3.54	0.79	$ 12.51	$ 2.17	$ 0.23	$ -	$ 1.06	$ 19.51
2032	0.192	$ 3.54	0.79	$ 12.83	$ 2.18	$ 0.23	$ -	$ 1.08	$ 19.86
2033	0.193	$ 3.53	0.79	$ 12.97	$ 2.19	$ 0.23	$ -	$ 1.09	$ 20.00
2034	0.193	$ 3.52	0.79	$ 13.13	$ 2.19	$ 0.23	$ -	$ 1.10	$ 20.18
2035	0.193	$ 3.54	0.79	$ 13.14	$ 2.20	$ 0.23	$ -	$ 1.10	$ 20.21
2036	0.192	$ 3.54	0.79	$ 13.39	$ 2.21	$ 0.23	$ -	$ 1.11	$ 20.48
2037	0.193	$ 3.54	0.79	$ 13.47	$ 2.22	$ 0.23	$ -	$ 1.12	$ 20.58
2038	0.193	$ 3.54	0.79	$ 13.98	$ 2.23	$ 0.23	$ -	$ 1.15	$ 21.13
2039	0.193	$ 3.54	0.79	$ 14.21	$ 2.24	$ 0.23	$ -	$ 1.16	$ 21.37
2040	0.192	$ 3.53	0.79	$ 13.80	$ 2.24	$ 0.23	$ -	$ 1.14	$ 20.94

Source: ACIL Allen

3 Model calculations

3.1 Introduction

The main objective of the calculations worksheets in the model is to obtain a projection of new connections and disconnections from the gas distribution network for both residential and commercial customers. The overall number of customers in the network is therefore equal to the previous periods number of customers plus the difference between new connections and disconnections to the network. The number of customers can then be multiplied by the average consumption in a given year to obtain total consumption.

The decision to disconnect or connect to the network is based on the economic payoff from choosing gas against electricity. This is predominantly driven by the appliance costs of the appliances and the relative running costs of the appliances. A relative NPV measure is calculated assuming a given a specified appliance life. The NPV variable is then used as an input into a logistic function which calculates the probability that a potential new connection will connect to the network or the probability that a potential disconnection will disconnect from the network. The model then keeps a running tally of total gas customers given the number of new connections and disconnections occurring in every year.

The model calculations are conducted in the following worksheets:

— Appliance costs
— Res-Appliance class
— CustomersRes
— RES S curve-disconnect
— Res S curve-connect
— COM-Appliance class
— CustomersCOM
— COM S curve disconnect
— COM S curve-connect

The calculations conducted in each of the worksheets are described in more detail in the following sections.

3.2 Appliance costs worksheet

The appliance costs worksheet calculates the upfront appliance and annual running costs on an annual basis. Appliance capital costs can be set to decline by a certain percentage each year in real terms. This rate of change can be set in the 'Control' worksheet. Appliance capital costs and

appliance consumption inputs were sourced from the Grattan Institute report "Flame Out: The Future of Natural Gas".[1]

The first block of calculations in the worksheet shows the projected capital costs of electric and gas appliances for cooking, hot water, room heating and space heating appliances (see **Figure 3.1**).

Figure 3.1   Appliance costs work sheet- Capital and installation costs

	A	B	C	D	E	F	G	H	I	J	K	
1	**Appliance and installation costs**											
2	**Cooking**	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
3	Electric cooktop (induction)	2900	2871	2842.29	2813.867	2785.7284	2757.871	2730.292	2702.99	2675.96	2649.2	2
4	Gas stove	2100	2100	2100	2100	2100	2100	2100	2100	2100	2100	
5	Difference	-800	-771	-742.29	-713.8671	-685.72843	-657.8711	-630.2924	-602.9895	-575.9596	-549.2	
6	**Hot water**											
7	Heat pump hot water	3100	3069	3038.31	3007.927	2977.8476	2948.069	2918.588	2889.403	2860.509	2831.903	2
8	Gas instant hot water	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	
9	Difference	-1700	-1669	-1638.31	-1607.927	-1577.8476	-1548.069	-1518.588	-1489.403	-1460.509	-1431.903	-1
10	**Room heating**											
11	RCAC split system	2200	2178	2156.22	2134.658	2113.3112	2092.178	2071.256	2050.544	2030.038	2009.738	1
12	Gas wall furnace	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	
13	Difference	-800	-778	-756.22	-734.6578	-713.31122	-692.1781	-671.2563	-650.5438	-630.0383	-609.7379	-5
14	**Ducted heating**											
15	Ducted RCAC	10750	10642.5	10536.08	10430.71	10326.407	10223.14	10120.91	10019.7	9919.505	9820.31	9
16	Ducted gas heating	7600	7600	7600	7600	7600	7600	7600	7600	7600	7600	
17	Difference	-3150	-3042.5	-2936.075	-2830.714	-2726.4071	-2623.143	-2520.912	-2419.702	-2319.505	-2220.31	-2
18	Gas disconnection charge	100	100	100	100	100	100	100	100	100	100	
19	Electricity connection upgrade	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	
20												

Source:ACIL Allen

The next block of calculations shows the running costs per appliance over time for both residential and commercial customers (see **Figure 3.2**).

These are calculated as the average consumption per appliance (in GJs for gas and kWhs for electricity) multiplied by the fuel price (gas or electricity depending on the appliance). The formula also allows for annual appliance consumption to decline as appliance efficiency improves over time. The model can also be adjusted to turn off the annual decline in appliance consumption after some point in time.

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[1] See https://grattan.edu.au/wp-content/uploads/2020/11/Flame-out-Grattan-report.pdf

Figure 3.2   Appliance costs work sheet- Running costs

	A	B	C	D	E	F	G	H	I	J	K
21	**Residential**	**Running costs**									
22	**Cooking**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
23	Electric cooktop (induction)	27.14	29.52	29.90	34.29	35.46	36.25	38.22	43.84	40.57	35.56
24	Gas stove	19.38	20.49	21.39	21.69	22.39	23.12	23.26	23.78	24.50	25.46
25	Difference	- 7.76	- 9.03	- 8.51	- 12.60	- 13.07	- 13.13	- 14.96	- 20.07	- 16.07	- 10.11
26	**Hot water**										
27	Heat pump hot water	466.09	506.99	513.45	588.85	608.95	622.48	656.34	752.88	696.62	610.71
28	Gas instant hot water	332.76	351.78	367.16	372.39	384.34	396.93	399.35	408.15	420.52	437.01
29	Difference	- 133.33	- 155.21	- 146.28	- 216.46	- 224.61	- 225.55	- 257.00	- 344.73	- 276.09	- 173.70 -
30	**Room heating**										
31	RCAC split system	339.37	369.16	373.86	428.76	443.40	453.25	477.91	548.20	507.23	444.68
32	Gas wall furnace	242.30	256.15	267.35	271.16	279.86	289.03	290.79	297.19	306.21	318.21
33	Difference	- 97.07	- 113.00	- 106.51	- 157.61	- 163.54	- 164.22	- 187.12	- 251.00	- 201.02	- 126.47 -
34	**Ducted heating**										
35	Ducted RCAC	791.86	861.35	872.32	1,000.43	1,034.57	1,057.56	1,115.09	1,279.10	1,183.52	1,037.56
36	Ducted gas heating	565.36	597.69	623.82	632.70	653.01	674.40	678.50	693.45	714.48	742.49
37	Difference	- 226.49	- 263.66	- 248.50	- 367.73	- 381.56	- 383.16	- 436.59	- 585.65	- 469.03	- 295.08 -
38	Gas service charge $	302.08	302.08	302.91	303.40	306.17	308.89	312.67	317.04	325.22	335.49
39	Electricity service charge $	-	-	-	-	-	-	-	-	-	-
40											
41	**Commercial**	**Running costs**									
42	**Cooking**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
43	Electric cooktop (induction)	26.78	29.13	29.54	33.71	34.84	35.59	37.51	42.88	39.95	34.76
44	Gas stove	17.44	18.65	19.53	19.82	20.49	21.21	21.33	21.83	22.53	23.47
45	Difference	- 9.33	- 10.48	- 10.01	- 13.90	- 14.35	- 14.38	- 16.18	- 21.05	- 17.42	- 11.29 -
46	**Hot water**										
47	Heat pump hot water	459.81	500.16	507.26	578.89	598.26	611.17	644.18	736.34	686.03	596.83
48	Gas instant hot water	299.44	320.16	335.24	340.16	351.81	364.07	366.25	374.71	386.78	402.93
49	Difference	- 160.37	- 180.01	- 172.02	- 238.73	- 246.45	- 247.10	- 277.93	- 361.63	- 299.25	- 193.90 -
50	**Room heating**										
51	RCAC split system	334.80	364.19	369.35	421.51	435.61	445.02	469.05	536.16	499.52	434.57
52	Gas wall furnace	218.04	233.12	244.11	247.69	256.17	265.10	266.68	272.85	281.64	293.39
53	Difference	- 116.76	- 131.06	- 125.25	- 173.82	- 179.44	- 179.91	- 202.36	- 263.31	- 217.88	- 141.18 -
54	**Ducted heating**										
55	Ducted RCAC	781.20	849.75	861.81	983.51	1,016.41	1,038.35	1,094.42	1,251.00	1,165.53	1,013.99

Source: ACIL Allen

The worksheet also contains a block of calculations which show the annual maintenance costs by appliance type and by customer type. The inputs for these formulas come from the 'Control' worksheet. Maintenance costs were obtained from the Consumer Advocacy Panel report, "Are we still cooking with gas?" from November 2014.

The separate capital, operating and maintenance costs are then aggregated for each appliance type and customer type to present the relative difference in capital and running costs between gas and electric appliances (see **Figure 3.3**).

Relative capital and running costs are defined as gas costs minus electric costs. A negative value therefore means that gas is cheaper then electric.

Figure 3.3 Appliance costs work sheet- Relative capital and running costs

	Capital costs	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
80	Cooking	-800	-771	-742.29	-713.8671	-685.72843	-657.8711	-630.2924	-602.9895	-575.9596	-549.2
81	Hot water	-1700	-1669	-1638.31	-1607.927	-1577.8476	-1548.069	-1518.588	-1489.403	-1460.509	-1431.903
82	Room heating	-800	-778	-756.22	-734.6578	-713.31122	-692.1781	-671.2563	-650.5438	-630.0383	-609.7379
83	Space heating	-3150	-3042.5	-2936.075	-2830.714	-2726.4071	-2623.143	-2520.912	-2419.702	-2319.505	-2220.31
84	Gas disconnection charge	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100
85	Electricity connection upgrade	-1500	-1500	-1500	-1500	-1500	-1500	-1500	-1500	-1500	-1500
86											
87	**Realtive running costs-Residential**	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
88	Cooking	- 5.60	- 6.87	- 6.35	- 10.44	- 10.91	- 10.97	- 12.80	- 17.91	- 13.91	- 7.95
89	Hot water	- 144.13	- 166.01	- 157.09	- 227.27	- 235.41	- 236.35	- 267.80	- 355.54	- 286.90	- 184.51
90	Room heating	- 100.32	- 116.25	- 109.75	- 160.85	- 166.78	- 167.46	- 190.36	- 254.24	- 204.27	- 129.71
91	Space heating	- 226.49	- 263.66	- 248.50	- 367.73	- 381.56	- 383.16	- 436.59	- 585.65	- 469.03	- 295.08
92	Service charge	302.08	302.08	302.91	303.40	306.17	308.89	312.67	317.04	325.22	335.49
93											
94	**Relative running costs-Commercial**	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
95	Cooking	- 7.17	- 8.32	- 7.85	- 11.74	- 12.19	- 12.22	- 14.02	- 18.89	- 15.26	- 9.12
96	Hot water	- 171.17	- 190.81	- 182.82	- 249.53	- 257.25	- 257.90	- 288.73	- 372.43	- 310.05	- 204.71
97	Room heating	- 120.00	- 134.31	- 128.49	- 177.06	- 182.68	- 183.15	- 205.60	- 266.55	- 221.13	- 144.42
98	Space heating	- 272.43	- 305.80	- 292.23	- 405.56	- 418.68	- 419.78	- 472.16	- 614.36	- 508.38	- 329.40
99	Service charge	422.04	422.04	421.29	421.64	422.04	422.04	421.29	421.64	422.04	422.04

Source: ACIL Allen

The last block of calculations in the worksheet is the most important and represents the NPV of the different appliances by customer type and by income class. The NPV is defined the upfront capital relative costs plus the NPV of the relative running costs.

Figure 3.4   Appliance costs work sheet- Relative NPV of switching from gas to electric

101	Residential										
102	NPV (High income)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
103	Cooking	-$858	-$842	-$808	-$822	-$799	-$772	-$763	-$789	-$720	-$632
104	Hot water	-$3,196	-$3,392	-$3,269	-$3,967	-$4,021	-$4,001	-$4,298	-$5,180	-$4,438	-$3,347
105	Room heating	-$1,841	-$1,985	-$1,895	-$2,404	-$2,444	-$2,430	-$2,647	-$3,290	-$2,750	-$1,956
106	Ducted heating	-$5,501	-$5,779	-$5,515	-$6,648	-$6,687	-$6,600	-$7,053	-$8,499	-$7,188	-$5,283
107	Service charge	$3,135	$3,135	$3,144	$3,149	$3,178	$3,206	$3,245	$3,291	$3,376	$3,482
108											
109	NPV (Mid income)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
110	Cooking	-$843	-$823	-$791	-$793	-$769	-$741	-$728	-$739	-$682	-$610
111	Hot water	-$2,796	-$2,932	-$2,833	-$3,337	-$3,368	-$3,346	-$3,556	-$4,194	-$3,643	-$2,835
112	Room heating	-$1,563	-$1,662	-$1,591	-$1,958	-$1,982	-$1,966	-$2,119	-$2,584	-$2,184	-$1,596
113	Ducted heating	-$4,873	-$5,048	-$4,826	-$5,628	-$5,629	-$5,537	-$5,842	-$6,874	-$5,887	-$4,465
114	Service charge	$2,298	$2,298	$2,304	$2,308	$2,329	$2,349	$2,378	$2,411	$2,474	$2,552
115											
116	NPV (Low income)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
117	Cooking	-$833	-$811	-$779	-$775	-$750	-$722	-$705	-$708	-$657	-$596
118	Hot water	-$2,543	-$2,640	-$2,557	-$2,937	-$2,954	-$2,930	-$3,085	-$3,568	-$3,138	-$2,511
119	Room heating	-$1,387	-$1,458	-$1,398	-$1,675	-$1,689	-$1,671	-$1,784	-$2,137	-$1,824	-$1,368
120	Ducted heating	-$4,474	-$4,584	-$4,389	-$4,981	-$4,958	-$4,864	-$5,074	-$5,844	-$5,062	-$3,946
121	Service charge	$1,766	$1,766	$1,771	$1,774	$1,790	$1,806	$1,828	$1,854	$1,902	$1,962
122											
123	NPV Commercial running costs	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
124	Cooking	-$86	-$99	-$94	-$140	-$145	-$146	-$167	-$226	-$182	-$109
125	Hot water	-$2,043	-$2,278	-$2,183	-$2,979	-$3,071	-$3,079	-$3,447	-$4,446	-$3,701	-$2,444
126	Space heating	-$3,252	-$3,651	-$3,489	-$4,842	-$4,998	-$5,011	-$5,637	-$7,334	-$6,069	-$3,932
127	Service charge	$5,038	$5,038	$5,029	$5,034	$5,038	$5,038	$5,029	$5,034	$5,038	$5,038

Source: ACIL Allen

These NPV calculations are the main input into the S curve formulas that determine the rate of disconnections and new connections in the model.

A negative NPV means that the switching decision from gas to electric appliances is not economically viable because the combined capital and running costs of gas appliances are lower than electric appliances.

3.3 RES-Appliance class worksheet

The 'RES-Appliance class' worksheet splits the residential customers into separate classes based on the volume consumed. This is done by LGA.

Those residential customers which consume less than 6 GJ per annum are assumed to have only a gas cooktop. Those households consuming between 6 and 20 GJ are assumed to have both a gas cooktop and a gas hot water system. Those households consuming between 20 and 35 GJ per annum are assumed to have a cooktop, hot water system and a gas room heater. Finally, those households consuming more than 35 GJ per year are assumed to have a gas cooktop, hot water system and space heating system.

The numbers in each volume class are obtained by aggregating the number of individual customers in each group based on their annual consumption. The customer databases of each of the gas distribution businesses was used for this purpose. These groups are further disaggregated into individual LGAs using post code data for each individual customer, also obtained from the customer databases of the gas distribution businesses. A concordance file between post codes and LGAs from the ABS used to allocate each individual customer to each LGA.

The total number of customers are disaggregated into each of the above volume classes by LGA (see **Figure 3.5**).

Figure 3.5 RES-Appliance class worksheet- Number of residential customers with gas cooktops only

	A	B	C	D	E	F	G	H	I	J
1	Cooktops	<6 GJ								
2	**LGA**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
3	Ararat (RC)	350	327	318	327	284	282	290	301	290
4	Ballarat (C)	11246	10385	9481	9333	7941	7225	6733	5985	4757
5	Brimbank (C)	7482	7651	7436	7578	6728	6637	6429	6383	6044
6	Central Goldfields (S)	799	724	725	715	643	595	594	596	592
7	Colac-Otway (S)	935	860	823	809	699	679	605	577	516
8	Corangamite (S)	561	475	423	419	310	303	279	274	242
9	Darebin (C)	0	0	0	0	0	0	0	1	0
10	Glenelg (S)	629	604	595	666	585	598	591	597	569
11	Golden Plains (S)	419	419	419	419	419	419	419	298	134
12	Greater Bendigo (C)	10087	9022	8383	8155	6830	6380	5985	5599	4845
13	Greater Geelong (C)	30521	29124	27118	26656	23308	21480	19810	17729	14838
14	Hepburn (S)	828	742	694	653	572	522	493	476	440
15	Hobsons Bay (C)	6615	6398	6195	6432	5906	5771	5765	5679	5245
16	Horsham (RC)	1293	1205	1131	1175	1001	948	971	916	886
17	Hume (C)	20426	19010	17258	16027	13551	11745	9796	8175	6083
18	Macedon Ranges (S)	4058	3587	3177	2822	2391	2076	1772	1436	1088
19	Maribyrnong (C)	7288	7128	6804	6989	6424	6289	6197	6107	5821
20	Melbourne (C)	1207	1179	1184	1194	1154	1159	1225	1311	1372
21	Melton (S)	23548	22052	20808	20075	17623	15950	13781	11887	8756
22	Moonee Valley (C)	11731	11466	11025	11181	9991	9878	9736	9758	9028
23	Moorabool (S)	3316	3025	2812	2638	2313	2100	1877	1598	1152
24	Moreland (C)	11469	11118	10733	10726	9814	9367	8970	8479	7653
25	Mount Alexander (S)	970	918	903	915	778	756	741	727	651
26	Moyne (S)	989	894	796	736	666	572	500	464	399
27	Northern Grampians (S)	333	315	312	335	309	321	348	353	344
28	Pyrenees (S)	98	98	98	98	98	97	50	27	24
29	Queenscliffe (B)	1113	1160	1180	1179	1095	1061	1015	964	887
30	Southern Grampians (S)	555	538	496	531	466	464	476	492	489
31	Surf Coast (S)	4386	4136	3901	3887	3319	2909	2704	2330	1674
32	Warrnambool (C)	2550	2348	2209	2255	1847	1713	1665	1559	1410
33	Wyndham (C)	41991	39013	36800	34874	31589	27888	24051	17321	13164
34	**Ausnet**	**207793**	**195921**	**184237**	**179799**	**158654**	**146184**	**133868**	**118399**	**99393**

Source: ACIL Allen

These numbers are then used to create weights for each of the customer classes by LGA (see **Figure 3.6**). Each of the set of weights sum to 1 for each LGA. These weights are used to create a single weighted NPV time series for each LGA which is then fed into the Logistic curve calculation. Separate NPV calculations are made for each residential customer class which are multiplied by their respective weights to generate a single NPV time series for each LGA.

Figure 3.6 RES-Appliance class worksheet- Weights of each residential customer class by LGA

36	Weights				
37	LGA	Cooktops	Cooktops plus hot water	C+HW+Room heating	C+HW+Space heating
38	Ararat (RC)	0.093	0.167	0.170	0.570
39	Ballarat (C)	0.099	0.093	0.123	0.685
40	Brimbank (C)	0.116	0.160	0.191	0.533
41	Central Goldfields (S)	0.140	0.195	0.181	0.484
42	Colac-Otway (S)	0.106	0.175	0.177	0.542
43	Corangamite (S)	0.138	0.193	0.180	0.489
44	Darebin (C)	0.000	0.333	0.000	0.667
45	Glenelg (S)	0.123	0.227	0.220	0.430
46	Golden Plains (S)	0.320	0.193	0.141	0.346
47	Greater Bendigo (C)	0.114	0.176	0.177	0.533
48	Greater Geelong (C)	0.137	0.202	0.202	0.459
49	Hepburn (S)	0.132	0.151	0.140	0.578
50	Hobsons Bay (C)	0.138	0.196	0.179	0.487
51	Horsham (RC)	0.134	0.205	0.190	0.470
52	Hume (C)	0.080	0.126	0.135	0.660
53	Macedon Ranges (S)	0.103	0.109	0.117	0.671
54	Maribyrnong (C)	0.200	0.257	0.188	0.354
55	Melbourne (C)	0.216	0.255	0.195	0.335
56	Melton (S)	0.116	0.123	0.157	0.604
57	Moonee Valley (C)	0.175	0.175	0.136	0.515
58	Moorabool (S)	0.115	0.149	0.168	0.568
59	Moreland (C)	0.156	0.207	0.153	0.485
60	Mount Alexander (S)	0.136	0.196	0.184	0.485
61	Moyne (S)	0.184	0.259	0.179	0.378
62	Northern Grampians (S)	0.141	0.181	0.194	0.484
63	Pyrenees (S)	0.245	0.204	0.122	0.429
64	Queenscliffe (B)	0.238	0.284	0.175	0.304
65	Southern Grampians (S)	0.123	0.193	0.188	0.496
66	Surf Coast (S)	0.184	0.217	0.172	0.427
67	Warrnambool (C)	0.099	0.195	0.214	0.492
68	Wyndham (C)	0.129	0.145	0.185	0.541
69	**Ausnet**	0.129	0.167	0.169	0.535

Source: ACIL Allen

3.4 CustomersRes worksheet

The 'CustomersRes' worksheet shows the historical residential customer numbers and the forecast customer numbers up to the year 2100. The first block in the worksheet shows the total number of residential customers within the distribution network by LGA (see **Figure 3.7**). Each yearly forecast of customer numbers is calculated as the previous year's number of customers plus new connections in that year minus the number of disconnections in that year.

Figure 3.7 CustomersRes worksheet- Total residential customers historical and forecast

Residential Customers	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
LGA														
Ararat (RC)	2882	2898	2916	2939	2953	2962	2973	2965	2977	3052	3128	3206	3286	3369
Ballarat (C)	37707	38655	39532	40041	41240	41870	42509	43403	44599	45714	46856	48027	49227	50457
Brimbank (C)	46376	45687	45993	46177	46646	46901	47170	47457	47712	48904	50126	51379	52664	53981
Central Goldfields (S)	3681	3746	3798	3838	3885	3935	3956	3982	3986	4086	4189	4294	4402	4512
Colac-Otway (S)	4174	4231	4291	4345	4437	4433	4509	4568	4613	4728	4846	4967	5091	5219
Corangamite (S)	1320	1405	1467	1499	1543	1579	1612	1633	1664	1706	1748	1792	1837	1883
Darebin (C)	3	3	3	3	3	3	3	2	3	3	3	3	3	3
Glenelg (S)	4286	4326	4351	4368	4377	4372	4379	4395	4398	4508	4620	4735	4853	4974
Golden Plains (S)	0	0	0	0	0	0	0	175	317	325	333	341	349	358
Greater Bendigo (C)	33747	35095	35836	36614	37587	38037	38612	39173	39832	40828	41848	42894	43967	45066
Greater Geelong (C)	82383	84342	86927	88416	91071	93088	95563	98136	100878	103400	105984	108634	111350	114134
Hepburn (S)	2735	2819	2898	2951	3006	3062	3103	3129	3161	3240	3321	3404	3489	3577
Hobsons Bay (C)	32616	32889	33194	33231	33554	33783	34009	34284	34631	35497	36385	37295	38228	39183
Horsham (RC)	5694	5790	5878	5928	6034	6104	6182	6214	6247	6403	6563	6727	6895	7068
Hume (C)	56923	58574	60371	62243	64437	66443	68631	70475	72542	74355	76214	78119	80072	82074
Macedon Ranges (S)	6978	7441	7828	8261	8666	8959	9312	9693	10010	10260	10517	10780	11050	11326
Maribyrnong (C)	23585	23870	24393	24497	24915	25160	25444	25679	26079	26731	27399	28084	28786	29506
Melbourne (C)	6026	6047	6071	6076	6041	6069	6040	6002	5910	6057	6208	6363	6522	6685
Melton (S)	53072	54653	56047	57322	59335	61159	63775	65959	69095	70823	72593	74408	76268	78175
Moonee Valley (C)	42564	42980	43647	44275	44882	45115	45497	45809	46397	47557	48746	49965	51214	52494
Moorabool (S)	6977	7312	7560	7782	8072	8294	8606	8948	9428	9663	9905	10152	10406	10666
Moreland (C)	39516	40031	40603	41184	41967	42624	43528	44147	44920	46043	47194	48374	49584	50824
Mount Alexander (S)	4068	4108	4179	4221	4299	4319	4368	4407	4482	4594	4709	4826	4946	5070
Moyne (S)	1442	1562	1652	1728	1815	1889	1961	2024	2082	2134	2187	2242	2298	2356
Northern Grampians (S)	2234	2253	2268	2273	2287	2277	2277	2277	2278	2335	2393	2453	2514	2576
Pyrenees (S)	0	0	0	0	0	10	65	81	90	93	96	99	102	104
Queenscliffe (B)	3052	3074	3124	3153	3202	3258	3307	3389	3450	3536	3624	3714	3806	3901
Southern Grampians (S)	3618	3642	3683	3683	3707	3711	3704	3722	3718	3811	3906	4003	4103	4205
Surf Coast (S)	5644	5900	6154	6407	6771	7117	7439	7941	8471	8683	8900	9122	9350	9584
Warrnambool (C)	12335	12585	12709	12846	13038	13165	13309	13476	13600	13939	14287	14645	15011	15386
Wyndham (C)	62518	65357	67569	70128	73339	77246	81677	89551	93023	95348	97732	100175	102680	105247
Ausnet	**588156**	**601275**	**614942**	**626429**	**643109**	**656944**	**673520**	**693096**	**710593**	**728356**	**746560**	**765222**	**784353**	**803963**

Source: ACIL Allen

Figure 3.8 shows the number of new connections to the network. Forecasts of new connections are generated in the RES S curve-connect worksheet. The probability of a new customer connecting to the network is multiplied by the number of new customers that are available to connect. More details about how this is done are provided in the sections that follow.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
36	New Residential Customers	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
37	LGA														
38	Ararat (RC)		31	28	35	43	44	42	21	32	104	106	109	112	115
39	Ballarat (C)		1152	1111	885	1413	1537	1012	1107	1410	1560	1599	1639	1680	1722
40	Brimbank (C)		816	742	624	825	703	640	660	617	1669	1711	1754	1798	1843
41	Central Goldfields (S)		99	79	74	88	84	59	67	52	139	143	146	150	154
42	Colac-Otway (S)		96	97	87	118	66	110	95	89	161	165	169	173	178
43	Corangamite (S)		93	75	48	55	53	45	37	51	58	59	61	62	64
44	Darebin (C)		0	0	0	0	0	0	0	1	0	0	0	0	0
45	Glenelg (S)		66	61	53	54	45	45	54	43	153	157	161	165	169
46	Golden Plains (S)		0	0	0	0	0	0	175	142	11	11	11	11	12
47	Greater Bendigo (C)		1538	1092	1056	1219	835	825	788	904	1394	1428	1464	1501	1538
48	Greater Geelong (C)		2446	3606	2575	3190	2867	3154	3205	3428	3530	3618	3709	3802	3897
49	Hepburn (S)		101	98	84	81	90	74	65	63	110	113	116	119	122
50	Hobsons Bay (C)		569	587	515	706	694	701	644	729	1212	1242	1273	1305	1337
51	Horsham (RC)		143	122	111	148	138	130	98	90	218	224	229	235	241
52	Hume (C)		1879	2016	2115	2484	2347	2495	2182	2382	2538	2602	2667	2734	2802
53	Macedon Ranges (S)		511	431	468	447	365	414	434	374	350	359	368	377	386
54	Maribyrnong (C)		576	841	626	777	659	623	624	723	912	935	958	982	1007
55	Melbourne (C)		67	62	53	41	96	60	66	54	206	211	217	222	228
56	Melton (S)		1721	1535	1443	2199	2120	4523	2693	3338	2418	2478	2540	2604	2669
57	Moonee Valley (C)		892	1159	1191	1347	1027	1005	1074	1175	1623	1664	1706	1748	1792
58	Moorabool (S)		379	279	255	326	302	354	390	525	329	338	346	355	364
59	Moreland (C)		1002	1009	1060	1277	1261	1411	1125	1197	1572	1611	1651	1693	1735
60	Mount Alexander (S)		127	99	70	101	71	74	82	106	156	160	164	168	173
61	Moyne (S)		127	98	83	98	90	81	78	66	72	74	76	78	80
62	Northern Grampians (S)		36	30	29	39	29	32	36	25	79	81	83	85	87
63	Pyrenees (S)		0	0	0	0	10	55	16	10	3	3	3	3	3
64	Queenscliffe (B)		55	77	57	75	88	84	106	93	120	123	126	129	133
65	Southern Grampians (S)		60	61	43	57	48	41	56	48	130	133	136	140	143
66	Surf Coast (S)		309	297	286	402	425	383	554	585	296	303	311	319	327
67	Warrnambool (C)		319	195	232	275	243	234	251	211	475	487	500	512	525
68	Wyndham (C)		3030	2408	2781	3364	4163	4671	8093	6101	3255	3337	3420	3506	3593
69	**Ausnet**		**18240**	**18295**	**16939**	**21249**	**20500**	**23377**	**24876**	**24664**	**24853**	**25475**	**26113**	**26768**	**27439**

Source: ACIL Allen

Figure 3.9 shows the segment of the worksheet which contains the residential disconnections in each year. These are calculated in the RES-S curve-disconnect worksheet which calculates the probability of a customer that faces a decision point of disconnecting from the gas network. The number of actual disconnections is the product of the number of customers facing disconnection and the probability of disconnection in any given year.

Figure 3.9   CustomersRes worksheet- Residential disconnections, historical and forecast

New Residential Disconnections	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
72 LGA														
73 Ararat (RC)		15	10	12	29	35	31	29	20	29	30	31	32	32
74 Ballarat (C)		204	234	376	214	907	373	213	214	445	457	468	480	492
75 Brimbank (C)		1505	436	440	356	448	371	373	362	477	489	501	513	526
76 Central Goldfields (S)		34	27	34	41	34	38	41	48	39	40	41	42	44
77 Colac-Otway (S)		39	37	33	26	70	34	36	44	46	47	48	49	50
78 Corangamite (S)		8	13	16	11	17	12	16	20	16	17	17	17	18
79 Darebin (C)		0	0	0	0	0	0	1	0	0	0	0	0	0
80 Glenelg (S)		26	36	36	45	50	38	38	40	43	45	46	47	48
81 Golden Plains (S)		0	0	0	0	0	0	0	0	3	3	3	3	3
82 Greater Bendigo (C)		190	351	278	246	385	250	227	245	398	408	418	428	439
83 Greater Geelong (C)		487	1021	1086	535	850	679	632	686	1008	1034	1059	1086	1113
84 Hepburn (S)		17	19	31	26	34	33	39	31	31	32	33	34	34
85 Hobsons Bay (C)		296	282	478	383	465	475	369	382	346	354	363	372	382
86 Horsham (RC)		47	34	61	42	68	52	66	57	62	64	65	67	68
87 Hume (C)		228	219	243	290	341	307	338	315	725	743	762	781	800
88 Macedon Ranges (S)		48	44	35	42	72	61	53	57	100	102	105	107	110
89 Maribyrnong (C)		291	318	522	359	414	339	389	323	260	267	273	280	287
90 Melbourne (C)		46	38	48	76	68	89	104	146	59	60	62	63	65
91 Melton (S)		140	141	168	186	296	1907	509	202	690	708	725	744	762
92 Moonee Valley (C)		476	492	563	740	794	623	762	587	463	475	487	499	512
93 Moorabool (S)		44	31	33	36	80	42	48	45	94	96	99	101	104
94 Moreland (C)		487	437	479	494	604	507	506	424	449	460	471	483	495
95 Mount Alexander (S)		87	28	28	23	51	25	43	31	44	45	47	48	49
96 Moyne (S)		7	8	7	11	16	9	15	8	20	21	21	22	22
97 Northern Grampians (S)		17	15	24	25	39	32	36	24	22	23	23	24	25
98 Pyrenees (S)		0	0	0	0	0	0	0	1	0	0	0	0	1
99 Queenscliffe (B)		33	27	28	26	32	35	24	32	34	35	36	37	38
00 Southern Grampians (S)		36	20	43	33	44	48	38	52	37	38	39	40	41
01 Surf Coast (S)		53	43	33	38	79	61	52	55	84	86	89	91	93
02 Warrnambool (C)		69	71	95	83	116	90	84	87	136	139	142	146	150
03 Wyndham (C)		191	196	222	153	256	240	219	2629	930	953	977	1001	1026
04 **Ausnet**		**5121**	**4628**	**5452**	**4569**	**6665**	**6801**	**5300**	**7167**	**7090**	**7271**	**7451**	**7637**	**7829**

Source: ACIL Allen

Figure 3.10 shows the number of residential customers in each year that face a decision point to either remain within the gas network or to shift to electric appliances. The number of customers facing a decision point in a given year is calculated as the total number of residential customers in the previous year divided by cell H9 in the 'Control' worksheet which is the number of years after which a decision point is reached. The default setting is 15 years. This means that every year 1/15th of the customer base will face a decision point.

Figure 3.10 CustomersRes worksheet- Residential decision points

	Residential Customers decision points	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
175																				
176	LGA																			
177	Ararat (RC)										198	203	208	213	219	224	230	235	241	247
178	Ballarat (C)										2973	3047	3123	3201	3281	3363	3447	3534	3622	3712
179	Brimbank (C)										3180	3260	3341	3425	3510	3598	3688	3780	3875	3972
180	Central Goldfields (S)										265	272	279	286	293	300	308	315	323	331
181	Colac-Otway (S)										307	315	323	331	339	347	356	365	374	384
182	Corangamite (S)										110	113	116	119	122	125	128	131	135	138
183	Darebin (C)										0	0	0	0	0	0	0	0	0	0
184	Glenelg (S)										293	300	308	315	323	331	339	348	357	366
185	Golden Plains (S)										21	21	22	22	23	23	24	25	25	26
186	Greater Bendigo (C)										2655	2721	2789	2859	2931	3004	3079	3156	3235	3316
187	Greater Geelong (C)										6725	6893	7065	7242	7423	7608	7799	7994	8193	8398
188	Hepburn (S)										210	216	221	226	232	238	244	250	256	263
189	Hobsons Bay (C)										2308	2366	2425	2486	2548	2612	2677	2744	2813	2883
190	Horsham (RC)										416	426	437	448	459	471	483	495	507	520
191	Hume (C)										4836	4957	5080	5207	5338	5471	5608	5748	5892	6039
192	Macedon Ranges (S)										667	684	701	718	736	755	773	793	813	833
193	Maribyrnong (C)										1738	1782	1826	1872	1919	1967	2016	2066	2118	2171
194	Melbourne (C)										394	403	413	424	434	445	456	468	479	491
195	Melton (S)										4606	4721	4839	4960	5084	5211	5342	5475	5612	5752
196	Moonee Valley (C)										3093	3170	3249	3331	3414	3499	3587	3676	3768	3862
197	Moorabool (S)										628	644	660	676	693	711	728	747	765	784
198	Moreland (C)										2994	3069	3146	3224	3305	3388	3472	3559	3648	3740
199	Mount Alexander (S)										298	306	313	321	329	338	346	355	364	373
200	Moyne (S)										138	142	145	149	153	157	161	165	169	173
201	Northern Grampians (S)										151	155	159	163	167	171	176	180	184	189
202	Pyrenees (S)										6	6	6	6	6	6	7	7	7	7
203	Queenscliffe (B)										230	235	241	247	253	260	266	273	280	287
204	Southern Grampians (S)										247	254	260	266	273	280	287	294	301	309
205	Surf Coast (S)										564	578	593	608	623	638	654	671	688	705
206	Warrnambool (C)										906	929	952	976	1000	1025	1051	1077	1104	1132
207	Wyndham (C)										6201	6356	6515	6678	6845	7016	7191	7371	7556	7744
208																				

Source: ACIL Allen

3.5 RES S curve-disconnect worksheet

The RES S curve-disconnect worksheet calculates the probability of disconnecting from the gas network in each year for each of those residential households that have reached a decision point.

The probability of disconnections is a function of the NPV of switching. As the NPV of switching to electricity from gas becomes progressively less negative or becomes positive, the market share of households that make the switch increases. The NPV is a function of relative appliance costs and usage charges which are driven by relative gas and electricity prices. The other main driver of the NPV calculation is the discount rate. LGAs within the model are split into three separate categories, low income, medium income and high income. The high income LGAs are allocated a lower discount rate to reflect their ability to more easily switch between appliance types. The highest discount rate is allocated to the lowest income groups.

Figure 3.11 below shows the NPV of switching from gas to electricity for four appliance categories:

— Cooking

— Cooking plus hot water

— Cooking plus hot water and room heating

— Cooking plus hot water plus space heating

The NPV of each income category is also shown for each of the appliance classes.

Figure 3.11 RES S curve-disconnect – NPV by customer class and income

	A	B	C	D	E	F	G	H	I	J
1	**By customer class**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
2	**Cooking**									
3	High income		$677	$693	$736	$727	$779	$835	$882	$902
4	Medium income		-$145	-$126	-$87	-$86	-$40	$8	$51	$72
5	Low income		-$666	-$645	-$608	-$601	-$559	-$516	-$477	-$454
6										
7	**Cooking plus hot water**									
8	High income		-$2,519	-$2,699	-$2,533	-$3,240	-$3,242	-$3,167	-$3,416	-$4,278
9	Medium income		-$2,941	-$3,057	-$2,920	-$3,422	-$3,408	-$3,338	-$3,505	-$4,121
10	Low income		-$3,209	-$3,285	-$3,165	-$3,538	-$3,514	-$3,446	-$3,561	-$4,022
11										
12	**Cooking plus hot water and room heating**									
13	High income		-$4,360	-$4,684	-$4,428	-$5,644	-$5,687	-$5,597	-$6,063	-$7,567
14	Medium income		-$4,504	-$4,719	-$4,511	-$5,380	-$5,390	-$5,303	-$5,624	-$6,706
15	Low income		-$4,596	-$4,742	-$4,563	-$5,213	-$5,202	-$5,117	-$5,346	-$6,159
16										
17	**Cooking plus hot water and space heating**									
18	High income		-$8,020	-$8,478	-$8,048	-$9,887	-$9,929	-$9,767	-$10,469	-$12,776
19	Medium income		-$7,814	-$8,105	-$7,746	-$9,050	-$9,037	-$8,875	-$9,347	-$10,996
20	Low income		-$7,684	-$7,869	-$7,554	-$8,519	-$8,471	-$8,310	-$8,635	-$9,866
21										

Source: ACIL Allen

The NPV of the decision to disconnect by LGA is shown in **Figure 3.12** below. The NPV is calculated as the weighted average of appliance class NPV depending on the distribution of consumption volumes in each LGA. The discount rate used depends on the income category that the LGA is in.

The key inputs into the NPV calculation for switching decision are:

— Relative capital costs of the appliances

— Relative running costs

— Gas connection charges

— Electricity upgrade connection costs

Figure 3.12   RES S curve-disconnect – NPV by LGA

	LGA	2020	2021	2022	2023	2024	2025	2026	2027	2028
24	Ararat (RC)		-$5,756	-$5,897	-$5,664	-$6,385	-$6,348	-$6,226	-$6,466	-$7,381
25	Ballarat (C)		-$6,194	-$6,429	-$6,140	-$7,187	-$7,173	-$7,040	-$7,414	-$8,732
26	Brimbank (C)		-$5,510	-$5,723	-$5,465	-$6,406	-$6,394	-$6,274	-$6,608	-$7,789
27	Central Goldfields (S)		-$5,269	-$5,397	-$5,184	-$5,840	-$5,804	-$5,691	-$5,907	-$6,737
28	Colac-Otway (S)		-$5,611	-$5,748	-$5,521	-$6,223	-$6,187	-$6,068	-$6,301	-$7,190
29	Corangamite (S)		-$5,294	-$5,423	-$5,209	-$5,868	-$5,832	-$5,719	-$5,936	-$6,770
30	Darebin (C)		-$6,190	-$6,423	-$6,137	-$7,174	-$7,161	-$7,029	-$7,399	-$8,704
31	Glenelg (S)		-$5,127	-$5,253	-$5,047	-$5,688	-$5,655	-$5,546	-$5,758	-$6,568
32	Golden Plains (S)		-$3,953	-$4,101	-$3,908	-$4,578	-$4,558	-$4,461	-$4,688	-$5,523
33	Greater Bendigo (C)		-$5,546	-$5,681	-$5,457	-$6,150	-$6,114	-$5,996	-$6,226	-$7,104
34	Greater Geelong (C)		-$5,196	-$5,323	-$5,113	-$5,761	-$5,727	-$5,616	-$5,830	-$6,649
35	Hepburn (S)		-$5,656	-$5,792	-$5,562	-$6,266	-$6,228	-$6,106	-$6,339	-$7,231
36	Hobsons Bay (C)		-$5,084	-$5,398	-$5,105	-$6,358	-$6,379	-$6,262	-$6,729	-$8,288
37	Horsham (RC)		-$5,237	-$5,364	-$5,153	-$5,806	-$5,771	-$5,659	-$5,874	-$6,700
38	Hume (C)		-$6,143	-$6,377	-$6,092	-$7,132	-$7,120	-$6,988	-$7,360	-$8,670
39	Macedon Ranges (S)		-$6,098	-$6,462	-$6,121	-$7,575	-$7,603	-$7,470	-$8,018	-$9,835
40	Maribyrnong (C)		-$4,176	-$4,443	-$4,191	-$5,256	-$5,269	-$5,164	-$5,555	-$6,874
41	Melbourne (C)		-$4,273	-$4,438	-$4,234	-$4,967	-$4,951	-$4,852	-$5,106	-$6,020
42	Melton (S)		-$5,757	-$6,105	-$5,780	-$7,169	-$7,195	-$7,068	-$7,589	-$9,322
43	Moonee Valley (C)		-$5,044	-$5,352	-$5,060	-$6,297	-$6,316	-$6,197	-$6,657	-$8,197
44	Moorabool (S)		-$5,652	-$5,869	-$5,605	-$6,567	-$6,554	-$6,431	-$6,773	-$7,981
45	Moreland (C)		-$4,969	-$5,275	-$4,987	-$6,212	-$6,231	-$6,114	-$6,570	-$8,093
46	Mount Alexander (S)		-$5,287	-$5,416	-$5,202	-$5,861	-$5,825	-$5,712	-$5,929	-$6,763
47	Moyne (S)		-$4,551	-$4,726	-$4,510	-$5,289	-$5,274	-$5,170	-$5,441	-$6,414
48	Northern Grampians (S)		-$5,284	-$5,413	-$5,199	-$5,858	-$5,823	-$5,710	-$5,927	-$6,761
49	Pyrenees (S)		-$4,674	-$4,781	-$4,591	-$5,158	-$5,122	-$5,017	-$5,199	-$5,915
50	Queenscliffe (B)		-$4,206	-$4,304	-$4,135	-$4,645	-$4,612	-$4,519	-$4,681	-$5,323
51	Southern Grampians (S)		-$5,374	-$5,505	-$5,288	-$5,959	-$5,924	-$5,810	-$6,031	-$6,881
52	Surf Coast (S)		-$4,599	-$4,887	-$4,615	-$5,765	-$5,782	-$5,670	-$6,096	-$7,524
53	Warrnambool (C)		-$5,457	-$5,592	-$5,372	-$6,058	-$6,024	-$5,908	-$6,136	-$7,004
54	Wyndham (C)		-$5,421	-$5,753	-$5,444	-$6,767	-$6,791	-$6,669	-$7,164	-$8,813

Source: ACIL Allen

The number of customers that face a decision point is shown in **Figure 3.13** below. These are a fixed percentage of the total number of customers in each LGA each year. The default setting for the decision point is every 15 years. This means that given a uniform distribution 1/15th of the residential customer base in each year faces the decision of whether to remain connected to the gas network of switch to electric appliances.

Figure 3.13 RES S curve-disconnect – Decision points

	A	B	C	D	E	F	G	H	I	J
55										
56	LGA Number of decision points	2021	2022	2023	2024	2025	2026	2027	2028	2029
57	Ararat (RC)		198	203	208	213	219	224	230	235
58	Ballarat (C)		2,973	3,047	3,123	3,201	3,281	3,363	3,447	3,534
59	Brimbank (C)		3,180	3,260	3,341	3,425	3,510	3,598	3,688	3,780
60	Central Goldfields (S)		265	272	279	286	293	300	308	315
61	Colac-Otway (S)		307	315	323	331	339	347	356	365
62	Corangamite (S)		110	113	116	119	122	125	128	131
63	Darebin (C)		-	-	-	-	-	-	-	-
64	Glenelg (S)		293	300	308	315	323	331	339	348
65	Golden Plains (S)		21	21	22	22	23	23	24	25
66	Greater Bendigo (C)		2,655	2,721	2,789	2,859	2,931	3,004	3,079	3,156
67	Greater Geelong (C)		6,725	6,893	7,065	7,242	7,423	7,608	7,799	7,994
68	Hepburn (S)		210	216	221	226	232	238	244	250
69	Hobsons Bay (C)		2,308	2,366	2,425	2,486	2,548	2,612	2,677	2,744
70	Horsham (RC)		416	426	437	448	459	471	483	495
71	Hume (C)		4,836	4,957	5,080	5,207	5,338	5,471	5,608	5,748
72	Macedon Ranges (S)		667	684	701	718	736	755	773	793
73	Maribyrnong (C)		1,738	1,782	1,826	1,872	1,919	1,967	2,016	2,066
74	Melbourne (C)		394	403	413	424	434	445	456	468
75	Melton (S)		4,606	4,721	4,839	4,960	5,084	5,211	5,342	5,475
76	Moonee Valley (C)		3,093	3,170	3,249	3,331	3,414	3,499	3,587	3,676
77	Moorabool (S)		628	644	660	676	693	711	728	747
78	Moreland (C)		2,994	3,069	3,146	3,224	3,305	3,388	3,472	3,559
79	Mount Alexander (S)		298	306	313	321	329	338	346	355
80	Moyne (S)		138	142	145	149	153	157	161	165
81	Northern Grampians (S)		151	155	159	163	167	171	176	180
82	Pyrenees (S)		6	6	6	6	6	6	7	7
83	Queenscliffe (B)		230	235	241	247	253	260	266	273
84	Southern Grampians (S)		247	254	260	266	273	280	287	294
85	Surf Coast (S)		564	578	593	608	623	638	654	671
86	Warrnambool (C)		906	929	952	976	1,000	1,025	1,051	1,077
87	Wyndham (C)		6,201	6,356	6,515	6,678	6,845	7,016	7,191	7,371

Source: ACIL Allen

The function that is used to determine the probability of switching is the logistic function. This function resembles an S curve which is characterised by a slow build-up, followed by a ramp up phase and then a mature phase where the take up has reached a point of saturation.

The logit model is used to convert underlying drivers of the choice to switch to electric appliances or not into a probability or market share of switching. The model values each of the attributes that drive the decision and applies an elasticity or weight to each factor. In our case we are using a single factor, the NPV of switching, which incorporates the set of underlying drivers such as relative prices and appliance costs into a single measure.

The function takes as inputs any value from zero to infinity and converts them to an output between zero and 1.

Function takes the form of an S curve:

$\pi(x) = 1/(1 + \exp(-y))$ where y is:

— $y = \beta_0 + \beta_1 NPV$

— y is a linear utility function of the drivers denoted by the NPV.

The S curve is shown in **Figure 3.14** below.

Figure 3.14   The logit S curve
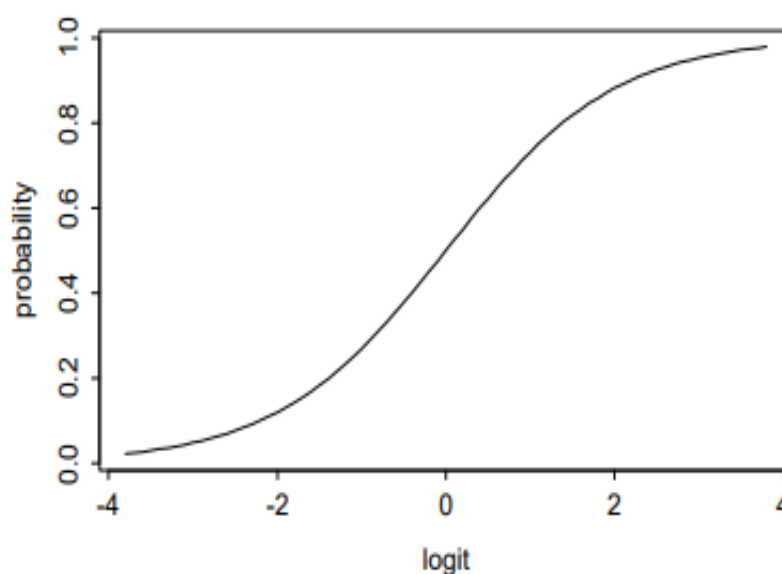
Figure 3.15 shows the part of the worksheet where the coefficients of the S curve to be applied are calibrated.

Please refer to the specific AGN, Multinet or Ausnet user manuals for more details on how the specific utility functions are calibrated.

Figure 3.15   RES S curve-disconnect – Calibrating the utility function

		Relative U	P(Disconnect)	Average Decision	Economic Disconnection Estimate	Economic Stay Estimate	Natural Attrition
Against Gas	3000	- 10.736	100.00%	48,000	47,999	1	4,591
For Gas (status quo)	-1500	10.736	0.00%	48,000	1	47,999	4,591
					Estimate of number of people disconn	Less than one person disco	Solve for 0
Relative U where less than 1 person disconnects		10.7364	0.00217%	46,000	0.99999999	0.99999999	- 0.000284
Current Economics (where households don't switch)	- 1,500	- 0.0072					
Difference in NPV to reach almost 100% disconnections	4,500						
Difference in RU to reach almost 100% disconnections	- 21						
Implied NPV Coefficient	- 0.00477						
Intercept	3.58						
NPV per year of appliance life	200						

Source: ACIL Allen

The utility function values for each LGA by year are shown in **Figure 3.16**.

Figure 3.16   RES S curve-disconnect – Utility function values

	A	B	C	D	E	F	G	H	I	J
121										
122	LGA S curves (Relative utility)	2020	2021	2022	2023	2024	2025	2026	2027	2028
123	Ararat (RC)		31.0436	31.7163	30.6046	34.0462	33.8709	33.2894	34.4345	38.7976
124	Ballarat (C)		33.1335	34.2542	32.8782	37.8717	37.8081	37.1739	38.9574	45.2443
125	Brimbank (C)		29.8730	30.8876	29.6576	34.1471	34.0879	33.5166	35.1118	40.7477
126	Central Goldfields (S)		28.7201	29.3302	28.3137	31.4434	31.2747	30.7361	31.7670	35.7261
127	Colac-Otway (S)		30.3515	31.0063	29.9232	33.2736	33.1009	32.5325	33.6446	37.8894
128	Corangamite (S)		28.8419	29.4550	28.4333	31.5789	31.4096	30.8686	31.9051	35.8848
129	Darebin (C)		33.1142	34.2255	32.8641	37.8106	37.7480	37.1204	38.8868	45.1127
130	Glenelg (S)		28.0426	28.6457	27.6611	30.7220	30.5631	30.0433	31.0539	34.9211
131	Golden Plains (S)		22.4427	23.1460	22.2263	25.4251	25.3284	24.8641	25.9480	29.9331
132	Greater Bendigo (C)		30.0431	30.6890	29.6181	32.9261	32.7536	32.1905	33.2867	37.4766
133	Greater Geelong (C)		28.3728	28.9784	27.9775	31.0709	30.9064	30.3766	31.3963	35.3073
134	Hepburn (S)		30.5669	31.2162	30.1201	33.4772	33.2959	32.7173	33.8268	38.0829
135	Hobsons Bay (C)		27.8387	29.3386	27.9390	33.9162	34.0178	33.4571	35.6864	43.1245
136	Horsham (RC)		28.5671	29.1759	28.1669	31.2816	31.1154	30.5814	31.6081	35.5470
137	Hume (C)		32.8914	34.0091	32.6468	37.6109	37.5514	36.9253	38.7002	44.9478
138	Macedon Ranges (S)		32.6761	34.4116	32.7855	39.7264	39.8599	39.2237	41.8372	50.5066
139	Maribyrnong (C)		23.5056	24.7784	23.5777	28.6567	28.7192	28.2185	30.0843	36.3780
140	Melbourne (C)		23.9682	24.7548	23.7799	27.2795	27.2047	26.7300	27.9410	32.3065
141	Melton (S)		31.0488	32.7095	31.1592	37.7877	37.9127	37.3031	39.7932	48.0628
142	Moonee Valley (C)		27.6451	29.1187	27.7234	33.6267	33.7157	33.1497	35.3435	42.6905
143	Moorabool (S)		30.5494	31.5840	30.3235	34.9127	34.8513	34.2662	35.8979	41.6631
144	Moreland (C)		27.2877	28.7506	27.3751	33.2193	33.3109	32.7545	34.9275	42.1975
145	Mount Alexander (S)		28.8069	29.4202	28.4004	31.5437	31.3753	30.8356	31.8719	35.8482
146	Moyne (S)		25.2939	26.1303	25.0994	28.8157	28.7443	28.2484	29.5434	34.1869
147	Northern Grampians (S)		28.7939	29.4077	28.3879	31.5326	31.3645	30.8249	31.8618	35.8400
148	Pyrenees (S)		25.8809	26.3935	25.4865	28.1924	28.0173	27.5203	28.3868	31.8019
149	Queenscliffe (B)		23.6490	24.1173	23.3088	25.7444	25.5871	25.1410	25.9158	28.9766
150	Southern Grampians (S)		29.2223	29.8486	28.8124	32.0149	31.8466	31.3001	32.3588	36.4116
151	Surf Coast (S)		25.5237	26.8973	25.6023	31.0899	31.1672	30.6359	32.6653	39.4805
152	Warrnambool (C)		29.6192	30.2639	29.2138	32.4858	32.3216	31.7717	32.8593	37.0001
153	Wyndham (C)		29.4472	31.0313	29.5559	35.8693	35.9845	35.4002	37.7650	45.6318

Source: ACIL Allen

The number of disconnections by LGA in each year of the forecast period are calculated by multiplying the probability of switching calculated by the S curve by the number of residential customers that face a switching decision (see **Figure 3.17**).

Figure 3.17   RES S curve-disconnect – Number of disconnections

	LGA S curves (number of disconnections)	2020	2021	2022	2023	2024	2025	2026
188								
189	Ararat (RC)		29	30	31	32	32	33
190	Ballarat (C)		445	457	468	480	492	504
191	Brimbank (C)		477	489	501	513	526	539
192	Central Goldfields (S)		39	40	41	42	44	45
193	Colac-Otway (S)		46	47	48	49	50	52
194	Corangamite (S)		16	17	17	17	18	18
195	Darebin (C)		-	-	-	-	-	-
196	Glenelg (S)		43	45	46	47	48	49
197	Golden Plains (S)		3	3	3	3	3	3
198	Greater Bendigo (C)		398	408	418	428	439	450
199	Greater Geelong (C)		1,008	1,034	1,059	1,086	1,113	1,141
200	Hepburn (S)		31	32	33	34	34	35
201	Hobsons Bay (C)		346	354	363	372	382	391
202	Horsham (RC)		62	64	65	67	68	70
203	Hume (C)		725	743	762	781	800	820
204	Macedon Ranges (S)		100	102	105	107	110	113
205	Maribyrnong (C)		260	267	273	280	287	295
206	Melbourne (C)		59	60	62	63	65	66
207	Melton (S)		690	708	725	744	762	781
208	Moonee Valley (C)		463	475	487	499	512	524
209	Moorabool (S)		94	96	99	101	104	106
210	Moreland (C)		449	460	471	483	495	508
211	Mount Alexander (S)		44	45	47	48	49	50
212	Moyne (S)		20	21	21	22	22	23
213	Northern Grampians (S)		22	23	23	24	25	25
214	Pyrenees (S)		-	-	-	-	1	1
215	Queenscliffe (B)		34	35	36	37	38	39
216	Southern Grampians (S)		37	38	39	40	41	42
217	Surf Coast (S)		84	86	89	91	93	95
218	Warrnambool (C)		136	139	142	146	150	153
219	Wyndham (C)		930	953	977	1,001	1,026	1,052
220								

Source: ACIL Allen

3.6 RES S curve-connect

The RES S curve connect worksheet calculates the number of annual new customer connections to the gas network. The approach taken is the same as the S curve logistic methodology. The relative NPV of connecting to gas versus electricity is used as an input into the logistic function to calculate the probability of a potential new customer connecting to gas rather than electricity.

The NPV calculation in the connection calculation is similar to that of the disconnection NPV in that it includes both relative capital and running costs, but excludes gas disconnection charges or electricity upgrade charges which are relevant to the switching decision.

The first block of data in the worksheet presents the NPVs by appliance class (see **Figure 3.18**).

Figure 3.18   RES S curve-connect – NPV by appliance and income class

	A	B 2020	C 2021	D 2022	E 2023	F 2024	G 2025	H 2026	I 2027	J 2028	
1	**By customer class**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	
2	**Cooking**										
3	High income		$2,277	$2,293	$2,336	$2,327	$2,379	$2,435	$2,482	$2,502	
4	Medium income		$1,455	$1,474	$1,513	$1,514	$1,560	$1,608	$1,651	$1,672	
5	Low income		$934	$955	$992	$999	$1,041	$1,084	$1,123	$1,146	
6											
7	**Cooking plus hot water**										
8	High income		-$919	-$1,099	-$933	-$1,640	-$1,642	-$1,567	-$1,816	-$2,678	
9	Medium income		-$1,341	-$1,457	-$1,320	-$1,822	-$1,808	-$1,738	-$1,905	-$2,521	
10	Low income		-$1,609	-$1,685	-$1,565	-$1,938	-$1,914	-$1,846	-$1,961	-$2,422	
11											
12	**Cooking plus hot water and room heating**										
13	High income		-$2,760	-$3,084	-$2,828	-$4,044	-$4,087	-$3,997	-$4,463	-$5,967	
14	Medium income		-$2,904	-$3,119	-$2,911	-$3,780	-$3,790	-$3,703	-$4,024	-$5,106	
15	Low income		-$2,996	-$3,142	-$2,963	-$3,613	-$3,602	-$3,517	-$3,746	-$4,559	
16											
17	**Cooking plus hot water and space heating**										
18	High income		-$6,420	-$6,878	-$6,448	-$8,287	-$8,329	-$8,167	-$8,869	-$11,176	
19	Medium income		-$6,214	-$6,505	-$6,146	-$7,450	-$7,437	-$7,275	-$7,747	-$9,396	
20	Low income		-$6,084	-$6,269	-$5,954	-$6,919	-$6,871	-$6,710	-$7,035	-$8,266	
21											

Source: ACIL Allen

This is then followed by the projected NPV calculations by LGA (**Figure 3.19**). The NPV calculation is the weighted average across the different customer/appliance class NPVs and classified by low, medium or high income (and given the corresponding discount rate).

Figure 3.19   RES S curve-connect – NPV by LGA

LGA	2020	2021	2022	2023	2024	2025	2026	2027	2028
Ararat (RC)		-$4,156	-$4,297	-$4,064	-$4,785	-$4,748	-$4,626	-$4,866	-$5,781
Ballarat (C)		-$4,594	-$4,829	-$4,540	-$5,587	-$5,573	-$5,440	-$5,814	-$7,132
Brimbank (C)		-$3,910	-$4,123	-$3,865	-$4,806	-$4,794	-$4,674	-$5,008	-$6,189
Central Goldfields (S)		-$3,669	-$3,797	-$3,584	-$4,240	-$4,204	-$4,091	-$4,307	-$5,137
Colac-Otway (S)		-$4,011	-$4,148	-$3,921	-$4,623	-$4,587	-$4,468	-$4,701	-$5,590
Corangamite (S)		-$3,694	-$3,823	-$3,609	-$4,268	-$4,232	-$4,119	-$4,336	-$5,170
Darebin (C)		-$4,590	-$4,823	-$4,537	-$5,574	-$5,561	-$5,429	-$5,799	-$7,104
Glenelg (S)		-$3,527	-$3,653	-$3,447	-$4,088	-$4,055	-$3,946	-$4,158	-$4,968
Golden Plains (S)		-$2,353	-$2,501	-$2,308	-$2,978	-$2,958	-$2,861	-$3,088	-$3,923
Greater Bendigo (C)		-$3,946	-$4,081	-$3,857	-$4,550	-$4,514	-$4,396	-$4,626	-$5,504
Greater Geelong (C)		-$3,596	-$3,723	-$3,513	-$4,161	-$4,127	-$4,016	-$4,230	-$5,049
Hepburn (S)		-$4,056	-$4,192	-$3,962	-$4,666	-$4,628	-$4,506	-$4,739	-$5,631
Hobsons Bay (C)		-$3,484	-$3,798	-$3,505	-$4,758	-$4,779	-$4,662	-$5,129	-$6,688
Horsham (RC)		-$3,637	-$3,764	-$3,553	-$4,206	-$4,171	-$4,059	-$4,274	-$5,100
Hume (C)		-$4,543	-$4,777	-$4,492	-$5,532	-$5,520	-$5,388	-$5,760	-$7,070
Macedon Ranges (S)		-$4,498	-$4,862	-$4,521	-$5,975	-$6,003	-$5,870	-$6,418	-$8,235
Maribyrnong (C)		-$2,576	-$2,843	-$2,591	-$3,656	-$3,669	-$3,564	-$3,955	-$5,274
Melbourne (C)		-$2,673	-$2,838	-$2,634	-$3,367	-$3,351	-$3,252	-$3,506	-$4,420
Melton (S)		-$4,157	-$4,505	-$4,180	-$5,569	-$5,595	-$5,468	-$5,989	-$7,722
Moonee Valley (C)		-$3,444	-$3,752	-$3,460	-$4,697	-$4,716	-$4,597	-$5,057	-$6,597
Moorabool (S)		-$4,052	-$4,269	-$4,005	-$4,967	-$4,954	-$4,831	-$5,173	-$6,381
Moreland (C)		-$3,369	-$3,675	-$3,387	-$4,612	-$4,631	-$4,514	-$4,970	-$6,493
Mount Alexander (S)		-$3,687	-$3,816	-$3,602	-$4,261	-$4,225	-$4,112	-$4,329	-$5,163
Moyne (S)		-$2,951	-$3,126	-$2,910	-$3,689	-$3,674	-$3,570	-$3,841	-$4,814
Northern Grampians (S)		-$3,684	-$3,813	-$3,599	-$4,258	-$4,223	-$4,110	-$4,327	-$5,161
Pyrenees (S)		-$3,074	-$3,181	-$2,991	-$3,558	-$3,522	-$3,417	-$3,599	-$4,315
Queenscliffe (B)		-$2,606	-$2,704	-$2,535	-$3,045	-$3,012	-$2,919	-$3,081	-$3,723
Southern Grampians (S)		-$3,774	-$3,905	-$3,688	-$4,359	-$4,324	-$4,210	-$4,431	-$5,281
Surf Coast (S)		-$2,999	-$3,287	-$3,015	-$4,165	-$4,182	-$4,070	-$4,496	-$5,924
Warrnambool (C)		-$3,857	-$3,992	-$3,772	-$4,458	-$4,424	-$4,308	-$4,536	-$5,404
Wyndham (C)		-$3,821	-$4,153	-$3,844	-$5,167	-$5,191	-$5,069	-$5,564	-$7,213

Source: ACIL Allen

The calibration of the S curve parameters is similar to the disconnection decision. The model user selects the NPVs that correspond to 100% of users going to gas and 100% choosing to connect to electricity. The relative utility over this whole range is divided by range between the bottom and upper bound of the NPV to calculate the implied NPV coefficient. The intercept term is then derived by plugging in the NPV coefficient into the linear utility function and solving for the constant term.

Figure 3.20   RES S curve-connect – Calibrating the utility function

		Relative U	P(connect)	Average Decision Points	Economic Conr	Economic Stay Estimate	
Against Gas	3000	- 10.444	0.00%	46,000	1	45,999	
For Gas (status quo)	- 1,500	10.444	100.00%	46,000	45,999	1.34	
			P(Connect)	Decision points		Less than one pers	Solve for 0
Relative U where less than 1 person doesn't connect on economics (		10.444	100.00%	34,350	0.99999999	0.999999990	0
Current Economics (where households don't switch)	- 1,500	- 0.0070					
Difference in NPV to reach almost 100% disconnections	- 4,500						
Difference in RU to reach almost 100% disconnections	21						
Implied NPV Coefficient	- 0.00464						
Intercept	3.48						
NPV per year of appliance life	200						

Source:ACIL Allen

3.7 COM appliance class

The COM- appliance class worksheet is the first worksheet that deals with commercial gas usage. The worksheet splits commercial gas usage into separate classes based on gas volumes consumed by customer.

The volumes classes are:

— 0-150 GJ

— 150-500 GJ

— 500-900 GJ and

— Greater than 900 GJ

The first block of data in the worksheet shows the total volume consumed by each volume bucket (see **Figure 3.21**).

Figure 3.21   COM appliance class worksheet- Total volume consumed by volume class by year

	A	B	C	D	E	F	G	H	I	J
1	0-150 GJ									
2	**LGA**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
3	Ararat (RC)	4,594	4,666	4,935	4,636	4,470	4,271	4,513	4,442	4,553
4	Ballarat (C)	53,873	52,804	50,465	48,136	52,467	51,404	49,549	48,255	48,751
5	Brimbank (C)	16,767	16,576	17,110	17,451	17,901	17,586	18,170	17,219	17,699
6	Central Goldfields (S)	5,009	4,933	4,727	4,834	5,246	4,822	4,576	4,046	4,550
7	Colac-Otway (S)	5,406	5,476	6,060	5,060	5,898	6,103	5,521	5,268	5,349
8	Corangamite (S)	1,057	1,153	1,068	1,081	967	932	1,016	1,136	938
9	Glenelg (S)	4,947	5,403	4,777	4,532	4,745	4,900	5,123	4,502	4,475
10	Golden Plains (S)	-	-	-	-	-	-	-	40	71
11	Greater Bendigo (C)	35,808	36,283	34,804	33,724	34,462	34,281	34,167	33,569	32,855
12	Greater Geelong (C)	55,317	56,216	55,150	56,111	59,677	58,491	59,971	57,003	58,865
13	Hepburn (S)	7,211	7,968	7,135	7,364	7,461	7,327	7,189	7,734	8,009
14	Hobsons Bay (C)	16,270	16,124	16,262	16,348	17,411	17,462	17,848	17,097	17,052
15	Horsham (RC)	8,392	8,709	8,731	8,604	8,672	8,539	8,401	8,122	8,070
16	Hume (C)	29,440	29,723	29,678	29,410	31,102	32,117	31,967	31,973	33,057
17	Macedon Ranges (S)	9,728	9,828	9,783	10,088	9,662	9,734	9,447	10,476	10,429
18	Maribyrnong (C)	20,340	19,054	20,835	20,403	20,872	21,051	22,862	21,470	22,503
19	Melbourne (C)	5,569	5,706	6,145	5,819	5,351	5,298	5,100	5,762	4,973
20	Melton (S)	24,420	23,998	22,351	22,006	25,235	26,734	25,360	25,856	25,550
21	Moonee Valley (C)	25,000	25,639	24,879	26,854	26,634	27,342	26,957	25,824	26,414
22	Moorabool (S)	4,518	5,726	5,871	5,267	5,723	5,504	5,761	5,929	4,978
23	Moreland (C)	20,742	20,754	21,026	19,342	21,204	22,124	21,710	19,358	18,876
24	Mount Alexander (S)	6,954	6,681	7,296	7,154	7,450	6,893	7,455	7,595	7,636
25	Moyne (S)	1,441	1,794	2,241	2,026	2,231	2,476	2,333	2,499	2,773
26	Northern Grampians (S)	3,259	3,300	3,388	2,969	3,324	3,143	2,972	2,688	3,004
27	Pyrenees (S)	-	-	-	-	-	-	-	16	54
28	Queenscliffe (B)	3,364	3,361	3,180	3,216	3,705	3,538	3,496	3,393	3,283
29	Southern Grampians (S)	5,485	6,008	6,369	5,305	5,608	5,933	5,497	4,534	4,494
30	Surf Coast (S)	2,898	2,592	2,721	2,882	2,861	3,647	3,526	3,201	3,006
31	Warrnambool (C)	13,027	13,503	13,088	12,423	13,651	11,589	12,154	10,740	11,032
32	Whittlesea (C)	-	-	-	-	-	-	-	-	-
33	Wyndham (C)	24,864	26,281	27,098	26,179	27,428	30,283	32,030	34,442	33,147
34	**Ausnet**	**415,698**	**420,261**	**417,173**	**409,225**	**431,417**	**433,521**	**434,673**	**424,191**	**426,448**

Source: ACIL Allen

This is then followed by a block showing the total number of customers in each volume bucket in each historical period (see **Figure 3.22**).

Figure 3.22 COM appliance class worksheet- Customer numbers by volume class by year

	A LGA	B 2012	C 2013	D 2014	E 2015	F 2016	G 2017	H 2018	I 2019	J 2020
36	LGA	2012	2013	2014	2015	2016	2017	2018	2019	2020
37	Ararat (RC)	116	115	118	117	106	107	111	107	107
38	Ballarat (C)	1155	1131	1156	1151	1144	1141	1125	1101	1082
39	Brimbank (C)	372	371	389	413	389	399	403	406	413
40	Central Goldfields (S)	132	124	135	134	130	127	130	125	129
41	Colac-Otway (S)	133	134	135	140	139	134	127	125	123
42	Corangamite (S)	23	24	21	25	22	25	25	26	24
43	Glenelg (S)	155	159	157	160	153	153	156	150	146
44	Golden Plains (S)	0	0	0	0	0	0	0	1	1
45	Greater Bendigo (C)	891	908	907	909	873	861	855	869	846
46	Greater Geelong (C)	1395	1393	1421	1436	1421	1448	1441	1409	1402
47	Hepburn (S)	156	158	154	164	163	153	150	153	157
48	Hobsons Bay (C)	364	372	368	378	376	372	376	361	363
49	Horsham (RC)	222	219	216	214	209	200	202	194	198
50	Hume (C)	541	546	557	581	560	573	570	575	591
51	Macedon Ranges (S)	214	216	216	227	228	223	222	223	227
52	Maribyrnong (C)	463	457	494	511	490	480	505	485	485
53	Melbourne (C)	135	128	133	127	129	129	128	133	127
54	Melton (S)	420	424	433	448	436	458	456	470	469
55	Moonee Valley (C)	540	545	592	616	595	618	607	591	591
56	Moorabool (S)	109	118	122	117	115	114	118	122	114
57	Moreland (C)	461	449	458	469	455	473	464	456	450
58	Mount Alexander (S)	189	187	186	194	191	188	191	195	191
59	Moyne (S)	35	39	44	48	53	53	52	54	57
60	Northern Grampians (S)	94	92	98	96	91	91	86	81	80
61	Pyrenees (S)	0	0	0	0	0	0	0	1	2
62	Queenscliffe (B)	109	108	111	107	107	99	102	102	100
63	Southern Grampians (S)	161	158	162	159	149	147	139	129	121
64	Surf Coast (S)	57	54	57	61	70	78	79	78	73
65	Warrnambool (C)	312	313	317	313	313	299	303	288	294
66	Whittlesea (C)	0	0	0	0	0	0	0	0	0
67	Wyndham (C)	481	511	526	548	535	580	604	667	630
68	**Ausnet**	**9435**	**9453**	**9683**	**9863**	**9642**	**9723**	**9727**	**9677**	**9593**

Source: ACIL Allen

Finally, the total volume is divided by the total number of customers in each volume bucket to calculate the average gas volume consumed per customer for each volume class or bucket. This is the third block of data shown in **Figure 3.23** below.

Figure 3.23   COM appliance class worksheet- Average gas volume consumed per customer by volume class by year

	A	B	C	D	E	F	G	H	I	J
71	**LGA**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
72	Ararat (RC)	39.6	40.6	41.8	39.6	42.2	39.9	40.7	41.5	42.5
73	Ballarat (C)	46.6	46.7	43.7	41.8	45.9	45.1	44.0	43.8	45.1
74	Brimbank (C)	45.1	44.7	44.0	42.3	46.0	44.1	45.1	42.4	42.9
75	Central Goldfields (S)	37.9	39.8	35.0	36.1	40.4	38.0	35.2	32.4	35.3
76	Colac-Otway (S)	40.6	40.9	44.9	36.1	42.4	45.5	43.5	42.1	43.5
77	Corangamite (S)	46.0	48.0	50.8	43.2	44.0	37.3	40.6	43.7	39.1
78	Glenelg (S)	31.9	34.0	30.4	28.3	31.0	32.0	32.8	30.0	30.7
79	Golden Plains (S)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	70.8
80	Greater Bendigo (C)	40.2	40.0	38.4	37.1	39.5	39.8	40.0	38.6	38.8
81	Greater Geelong (C)	39.7	40.4	38.8	39.1	42.0	40.4	41.6	40.5	42.0
82	Hepburn (S)	46.2	50.4	46.3	44.9	45.8	47.9	47.9	50.5	51.0
83	Hobsons Bay (C)	44.7	43.3	44.2	43.2	46.3	46.9	47.5	47.4	47.0
84	Horsham (RC)	37.8	39.8	40.4	40.2	41.5	42.7	41.6	41.9	40.8
85	Hume (C)	54.4	54.4	53.3	50.6	55.5	56.0	56.1	55.6	55.9
86	Macedon Ranges (S)	45.5	45.5	45.3	44.4	42.4	43.7	42.6	47.0	45.9
87	Maribyrnong (C)	43.9	41.7	42.2	39.9	42.6	43.9	45.3	44.3	46.4
88	Melbourne (C)	41.3	44.6	46.2	45.8	41.5	41.1	39.8	43.3	39.2
89	Melton (S)	58.1	56.6	51.6	49.1	57.9	58.4	55.6	55.0	54.5
90	Moonee Valley (C)	46.3	47.0	42.0	43.6	44.8	44.2	44.4	43.7	44.7
91	Moorabool (S)	41.4	48.5	48.1	45.0	49.8	48.3	48.8	48.6	43.7
92	Moreland (C)	45.0	46.2	45.9	41.2	46.6	46.8	46.8	42.5	41.9
93	Mount Alexander (S)	36.8	35.7	39.2	36.9	39.0	36.7	39.0	38.9	40.0
94	Moyne (S)	41.2	46.0	50.9	42.2	42.1	46.7	44.9	46.3	48.7
95	Northern Grampians (S)	34.7	35.9	34.6	30.9	36.5	34.5	34.6	33.2	37.5
96	Pyrenees (S)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.3	27.1
97	Queenscliffe (B)	30.9	31.1	28.7	30.1	34.6	35.7	34.3	33.3	32.8
98	Southern Grampians (S)	34.1	38.0	39.3	33.4	37.6	40.4	39.5	35.1	37.1
99	Surf Coast (S)	50.8	48.0	47.7	47.2	40.9	46.8	44.6	41.0	41.2
100	Warrnambool (C)	41.8	43.1	41.3	39.7	43.6	38.8	40.1	37.3	37.5
101	Whittlesea (C)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
102	Wyndham (C)	51.7	51.4	51.5	47.8	51.3	52.2	53.0	51.6	52.6
103	**Ausnet**	44.1	44.5	43.1	41.5	44.7	44.6	44.7	43.8	44.5

Source: ACIL Allen

Finally, each volume class is given a weighting for each LGA based on the number of customers in each volume class for each LGA (see **Figure 3.24**). These weights are used to create a single weighted NPV for each LGA by combining separate scaled up NPV calculations for each of the volume classes or buckets. Further details on where this occurs in the model is provided in the sections that follow.

Figure 3.24 COM appliance class worksheet- Calculated weights by volume class by year

	A	B	C	D	E	
106	LGA	0-150 GJ	150-500 GJ	500-900GJ	>900 GJ	
107	Ararat (RC)	0.728	0.204	0.048	0.020	
108	Ballarat (C)	0.664	0.204	0.058	0.074	
109	Brimbank (C)	0.563	0.237	0.089	0.111	
110	Central Goldfields (S)	0.763	0.142	0.041	0.053	
111	Colac-Otway (S)	0.728	0.178	0.024	0.071	
112	Corangamite (S)	0.471	0.333	0.098	0.098	
113	Glenelg (S)	0.785	0.151	0.005	0.059	
114	Golden Plains (S)	0.333	0.667	0.000	0.000	
115	Greater Bendigo (C)	0.702	0.188	0.046	0.065	
116	Greater Geelong (C)	0.667	0.204	0.055	0.075	
117	Hepburn (S)	0.695	0.190	0.058	0.058	
118	Hobsons Bay (C)	0.581	0.277	0.066	0.077	
119	Horsham (RC)	0.759	0.161	0.038	0.042	
120	Hume (C)	0.528	0.225	0.097	0.149	
121	Macedon Ranges (S)	0.676	0.223	0.048	0.054	
122	Maribyrnong (C)	0.609	0.234	0.077	0.080	
123	Melbourne (C)	0.525	0.252	0.058	0.165	
124	Melton (S)	0.637	0.194	0.080	0.088	
125	Moonee Valley (C)	0.567	0.292	0.072	0.069	
126	Moorabool (S)	0.640	0.242	0.034	0.084	
127	Moreland (C)	0.616	0.244	0.063	0.078	
128	Mount Alexander (S)	0.830	0.135	0.022	0.013	
129	Moyne (S)	0.640	0.180	0.135	0.045	
130	Northern Grampians (S)	0.755	0.151	0.047	0.047	
131	Pyrenees (S)	0.400	0.400	0.000	0.200	
132	Queenscliffe (B)	0.769	0.138	0.038	0.054	
133	Southern Grampians (S)	0.720	0.179	0.036	0.065	
134	Surf Coast (S)	0.557	0.252	0.092	0.099	
135	Warrnambool (C)	0.665	0.208	0.075	0.052	
136	Whittlesea (C)	0.000	1.000	0.000	0.000	
137	Wyndham (C)	0.594	0.222	0.072	0.112	

Source: ACIL Allen

3.8 Customers COM

The CustomersCOM worksheet keeps a running total of customer numbers buy LGA over the forecast period. Total customer numbers are shown in the first block of data in the worksheet (see **Figure 3.25**).

Figure 3.25 CustomersCOM worksheet- Total commercial customers by LGA

Commercial Customers	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
LGA														
Ararat (RC)	158	158	160	156	152	153	153	151	147	147	146	146	146	146
Ballarat (C)	1655	1642	1671	1622	1693	1684	1661	1637	1629	1626	1624	1621	1619	1617
Brimbank (C)	666	664	676	695	711	722	729	733	733	732	730	729	728	727
Central Goldfields (S)	172	168	176	170	172	171	171	170	169	168	167	166	165	164
Colac-Otway (S)	177	180	175	179	186	181	174	172	169	168	167	166	165	164
Corangamite (S)	40	42	40	42	46	49	50	50	51	50	49	49	48	47
Glenelg (S)	191	192	192	192	192	192	192	190	186	185	185	184	183	183
Golden Plains (S)	0	0	0	0	0	0	1	1	3	3	3	3	3	2
Greater Bendigo (C)	1226	1251	1227	1218	1246	1230	1218	1221	1205	1204	1202	1200	1198	1196
Greater Geelong (C)	1985	1999	2029	2017	2100	2119	2130	2113	2102	2099	2097	2094	2092	2090
Hepburn (S)	226	226	225	229	238	233	228	225	226	225	224	223	222	221
Hobsons Bay (C)	597	613	608	613	624	630	632	622	625	624	622	621	619	618
Horsham (RC)	284	281	279	273	272	266	264	260	261	261	260	260	259	259
Hume (C)	1001	1010	1032	1042	1090	1098	1102	1106	1119	1118	1116	1115	1114	1112
Macedon Ranges (S)	286	298	302	306	325	328	326	328	336	335	334	333	332	331
Maribyrnong (C)	740	733	759	781	799	795	808	802	796	794	793	791	790	788
Melbourne (C)	226	220	226	233	240	244	243	242	242	241	241	240	239	239
Melton (S)	620	636	647	656	686	708	720	726	736	735	733	732	730	729
Moonee Valley (C)	929	938	998	994	1032	1064	1067	1047	1043	1041	1040	1039	1037	1036
Moorabool (S)	163	169	172	169	171	169	177	180	178	178	177	177	176	176
Moreland (C)	709	706	707	717	734	740	735	737	731	730	728	727	726	725
Mount Alexander (S)	236	236	231	230	240	241	237	238	230	211	193	178	166	154
Moyne (S)	65	67	71	79	86	87	84	86	89	88	87	86	84	83
Northern Grampians (S)	121	120	125	122	123	120	114	111	106	105	104	104	103	102
Pyrenees (S)	0	0	0	0	0	0	1	3	5	5	5	4	4	4
Queenscliffe (B)	142	142	145	136	139	132	134	133	130	126	124	120	119	118
Southern Grampians (S)	203	200	200	195	195	188	181	177	168	167	166	165	164	163
Surf Coast (S)	96	95	96	97	119	126	133	134	131	130	130	129	128	128
Warrnambool (C)	465	461	460	451	454	447	444	439	442	441	440	439	439	438
Whittlesea (C)	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Wyndham (C)	788	833	863	885	938	977	1005	1085	1060	1059	1058	1057	1055	1053
Ausnet	14167	14280	14492	14499	15003	15094	15114	15119	15049	14995	14945	14897	14854	14811

Source: ACIL Allen

Total customers in a given year are equal to the previous year's customer plus new connections and minus any disconnections.

New connections and disconnections are also presented within this worksheet. New customer numbers in the worksheet are calculated in the COM S curve- connect worksheet of the model and linked to the CustomersCOM worksheet.

Figure 3.26 CustomersCOM worksheet- New commercial customers by LGA

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
36	**New Commercial Customers**	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
37	**LGA**														
38	Ararat (RC)		3	3	6	1	2	6	4	2	5	5	5	5	5
39	Ballarat (C)		49	93	43	127	66	48	42	45	56	56	56	56	56
40	Brimbank (C)		28	37	42	42	34	28	30	24	25	25	25	25	25
41	Central Goldfields (S)		3	15	3	6	4	3	5	5	5	5	5	5	5
42	Colac-Otway (S)		6	2	6	13	3	3	3	4	5	5	5	5	5
43	Corangamite (S)		2	0	3	4	4	1	0	1	1	1	1	1	1
44	Glenelg (S)		8	5	8	9	5	3	1	2	6	6	6	6	6
45	Golden Plains (S)		0	0	0	0	0	1	1	2	0	0	0	0	0
46	Greater Bendigo (C)		62	35	45	76	48	41	44	37	42	42	41	41	41
47	Greater Geelong (C)		79	106	85	166	111	78	60	61	73	73	73	73	73
48	Hepburn (S)		3	7	7	18	8	9	3	6	7	7	7	7	7
49	Hobsons Bay (C)		40	29	34	35	25	28	18	22	21	21	21	21	21
50	Horsham (RC)		5	8	7	7	7	6	4	7	9	9	9	9	9
51	Hume (C)		40	60	52	78	51	38	45	48	39	39	39	39	38
52	Macedon Ranges (S)		16	13	13	32	16	8	11	18	11	11	11	11	11
53	Maribyrnong (C)		46	63	45	45	38	43	28	29	27	27	27	27	27
54	Melbourne (C)		3	19	15	14	11	7	8	7	8	8	8	8	8
55	Melton (S)		24	25	31	42	49	34	28	24	25	25	25	25	25
56	Moonee Valley (C)		44	85	47	86	78	47	36	44	36	36	36	36	36
57	Moorabool (S)		11	8	2	9	7	12	6	4	6	6	6	6	6
58	Moreland (C)		37	31	39	52	41	24	35	19	25	25	25	25	25
59	Mount Alexander (S)		6	5	6	15	10	2	6	2	0	0	0	0	0
60	Moyne (S)		4	5	11	7	3	2	4	3	2	2	2	2	2
61	Northern Grampians (S)		3	6	2	3	2	0	4	2	3	3	3	3	3
62	Pyrenees (S)		0	0	0	0	0	1	2	2	0	0	0	0	0
63	Queenscliffe (B)		3	7	1	7	0	2	2	1	2	3	2	3	3
64	Southern Grampians (S)		5	3	4	5	3	2	5	1	5	5	5	5	5
65	Surf Coast (S)		1	7	7	26	11	10	4	6	4	4	4	4	4
66	Warrnambool (C)		12	14	10	18	15	10	12	13	15	15	15	15	15
67	Whittlesea (C)		0	0	0	0	0	0	0	1	0	0	0	0	0
68	Wyndham (C)		61	49	55	80	67	51	109	53	37	37	37	36	36
69	**Ausnet**		604	740	629	1023	719	548	560	495	**500**	**501**	**499**	**499**	**498**

Source: ACIL Allen

Commercial disconnections are also shown within the CustomersCOM worksheet (see **Figure 3.27**). Customer disconnections in the worksheet are calculated in the COM S curve-disconnect worksheet of the model and also linked to the CustomersCOM worksheet.

Figure 3.27   CustomersCOM worksheet- New commercial disconnections by LGA

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
71	**New Commercial Disconnections**	2012	2013	2014	2015	2016	2017	2018	2019	2020	**2021**	**2022**	**2023**	**2024**	**2025**
72	**LGA**														
73	Ararat (RC)		3	1	10	5	1	6	6	6	5	5	5	5	5
74	Ballarat (C)		62	64	92	56	75	71	66	53	59	59	58	58	58
75	Brimbank (C)		30	25	23	26	23	21	26	24	26	26	26	26	26
76	Central Goldfields (S)		7	7	9	4	5	3	6	6	6	6	6	6	6
77	Colac-Otway (S)		3	7	2	6	8	10	5	7	6	6	6	6	6
78	Corangamite (S)		0	2	1	0	1	0	0	0	2	2	2	2	2
79	Glenelg (S)		7	5	8	9	5	3	3	6	7	7	7	7	7
80	Golden Plains (S)		0	0	0	0	0	0	1	0	0	0	0	0	0
81	Greater Bendigo (C)		37	59	54	48	64	53	41	53	43	43	43	43	43
82	Greater Geelong (C)		65	76	97	83	92	67	77	72	76	76	75	75	75
83	Hepburn (S)		3	8	3	9	13	14	6	5	8	8	8	8	8
84	Hobsons Bay (C)		24	34	29	24	19	26	28	19	23	22	22	22	22
85	Horsham (RC)		8	10	13	8	13	8	8	6	9	9	9	9	9
86	Hume (C)		31	38	42	30	43	34	41	35	40	40	40	40	40
87	Macedon Ranges (S)		4	9	9	13	13	10	9	10	12	12	12	12	12
88	Maribyrnong (C)		53	37	23	27	42	30	34	35	29	29	29	28	28
89	Melbourne (C)		9	13	8	7	7	8	9	7	9	9	9	9	9
90	Melton (S)		8	14	22	12	27	22	22	14	26	26	26	26	26
91	Moonee Valley (C)		35	25	51	48	46	44	56	48	38	37	37	37	37
92	Moorabool (S)		5	5	5	7	9	4	3	6	6	6	6	6	6
93	Moreland (C)		40	30	29	35	35	29	33	25	26	26	26	26	26
94	Mount Alexander (S)		6	10	7	5	9	6	5	10	19	18	15	12	12
95	Moyne (S)		2	1	3	0	2	5	2	0	3	3	3	3	3
96	Northern Grampians (S)		4	1	5	2	5	6	7	7	4	4	4	4	4
97	Pyrenees (S)		0	0	0	0	0	0	0	0	0	0	0	0	0
98	Queenscliffe (B)		3	4	10	4	7	0	3	4	6	6	5	4	4
99	Southern Grampians (S)		8	3	9	5	10	9	9	10	6	6	6	6	6
100	Surf Coast (S)		2	6	6	4	4	3	3	9	5	5	5	5	5
101	Warrnambool (C)		16	15	19	15	22	13	17	10	16	16	16	16	16
102	Whittlesea (C)		0	0	0	0	0	0	0	0	0	0	0	0	0
103	Wyndham (C)		16	19	33	27	28	23	29	78	38	38	38	38	38
104	**Ausnet**		491	528	622	519	628	528	555	565	554	551	547	542	541

Source: ACIL Allen

The other key data contained in the CustomersCOM worksheet is the number of commercial customers that face a decision point to switch from gas to electricity (see **Figure 3.28**). These customers are assumed to follow a uniform distribution and face the decision to switch on average every 15 years. The time between decision points can be set by the user in the Control worksheet in the cell labelled 'Decision point'. For example, when the decision point is set to 15, one fifteenth of the total number of commercial customers at the end of the previous year will face a decision point in the current year.

Figure 3.28 CustomersCOM worksheet- Number of commercial customer decision points by LGA

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
174	Commercial Customers decision points														
175	LGA														
176	Ararat (RC)										9	9	9	9	9
177	Ballarat (C)										108	108	108	108	107
178	Brimbank (C)										48	48	48	48	48
179	Central Goldfields (S)										11	11	11	11	10
180	Colac-Otway (S)										11	11	11	11	10
181	Corangamite (S)										3	3	3	3	3
182	Glenelg (S)										12	12	12	12	12
183	Golden Plains (S)										0	0	0	0	0
184	Greater Bendigo (C)										80	80	80	80	79
185	Greater Geelong (C)										140	139	139	139	139
186	Hepburn (S)										15	14	14	14	14
187	Hobsons Bay (C)										41	41	41	41	41
188	Horsham (RC)										17	17	17	17	17
189	Hume (C)										74	74	74	74	74
190	Macedon Ranges (S)										22	22	22	22	22
191	Maribyrnong (C)										53	52	52	52	52
192	Melbourne (C)										16	16	16	15	15
193	Melton (S)										49	48	48	48	48
194	Moonee Valley (C)										69	69	69	69	69
195	Moorabool (S)										11	11	11	11	11
196	Moreland (C)										48	48	48	48	48
197	Mount Alexander (S)										15	14	12	11	11
198	Moyne (S)										5	5	5	5	5
199	Northern Grampians (S)										7	7	6	6	6
200	Pyrenees (S)										0	0	0	0	0
201	Queenscliffe (B)										8	8	8	8	7
202	Southern Grampians (S)										11	11	11	10	10
203	Surf Coast (S)										8	8	8	8	8
204	Warrnambool (C)										29	29	29	29	29
205	Whittlesea (C)										0	0	0	0	0
206	Wyndham (C)										70	70	70	70	70

Source: ACIL Allen

3.9 COM S curve disconnect

The disconnection decision faced by commercial customers follows a similar methodology to that used to determine the number of residential disconnections. In the first panel, the relative NPV of the unweighted capital, running, disconnection and service costs are presented (see **Figure 3.29**).

Figure 3.29 Unweighted capital cost, running cost , disconnection charge and service charge NPVs

	A	B	C	D	E	F	G	H	I	J
1	By customer class	2020	2021	2022	2023	2024	2025	2026	2027	2028
2										
3	Unweighted Capital costs NPV		-$7,150	-$6,983	-$6,817	-$6,653	-$6,490	-$6,329	-$6,170	-$6,012
4	Unweighted Running costs NPV		-$5,381	-$6,028	-$5,765	-$7,961	-$8,215	-$8,236	-$9,251	-$12,006
5	Gas disconnection cost NPV		-$100	-$100	-$100	-$100	-$100	-$100	-$100	-$100
6	Gas service charge NPV		$5,038	$5,038	$5,029	$5,034	$5,038	$5,038	$5,029	$5,034
7										

Source: ACIL Allen

The unweighted capital costs are based on the residential appliance capital costs but are scaled up based on the relative gas consumption by commercial customers and residential gas customers. This scaling takes place at the LGA level. Unweighted running costs are also scaled up by the relative consumption of commercial to residential customers, however they incorporate commercial gas and electricity prices rather than their residential equivalents.

The scaling up is done for each volume class or bucket by LGA. These scaled up capital and running costs are then combined into a single weighted average set of capital and running costs using the weights calculated in the COM-Appliance class worksheet. These weight the capital and running costs by the share of customers in each volume consumption category (see **Figure 3.24**).

Figure 3.30 COM S curve- disconnect NPV values by LGA

	A	B	C	D	E	F	G	H	I	J
7										
8	LGA		2021	2022	2023	2024	2025	2026	2027	2028
9	Ararat (RC)		-$137,456	-$142,794	-$137,949	-$160,716	-$161,701	-$160,096	-$169,672	-$198,791
10	Ballarat (C)		-$76,362	-$79,419	-$76,655	-$89,678	-$90,243	-$89,328	-$94,813	-$111,469
11	Brimbank (C)		-$119,864	-$124,556	-$120,308	-$140,301	-$141,170	-$139,766	-$148,179	-$173,749
12	Central Goldfields (S)		-$63,512	-$66,010	-$63,698	-$74,437	-$74,875	-$74,091	-$78,599	-$92,343
13	Colac-Otway (S)		-$76,265	-$79,301	-$76,543	-$89,501	-$90,057	-$89,141	-$94,594	-$111,169
14	Corangamite (S)		-$120,980	-$125,708	-$121,423	-$141,576	-$142,450	-$141,032	-$149,512	-$175,288
15	Glenelg (S)		-$71,317	-$74,071	-$71,499	-$83,374	-$83,848	-$82,970	-$87,948	-$103,151
16	Golden Plains (S)		-$41,937	-$43,794	-$42,187	-$49,980	-$50,349	-$49,840	-$53,145	-$63,100
17	Greater Bendigo (C)		-$74,039	-$76,967	-$74,289	-$86,814	-$87,342	-$86,445	-$91,712	-$107,736
18	Greater Geelong (C)		-$85,166	-$88,536	-$85,475	-$99,855	-$100,473	-$99,456	-$105,507	-$123,901
19	Hepburn (S)		-$72,375	-$75,317	-$72,683	-$85,175	-$85,729	-$84,866	-$90,134	-$106,107
20	Hobsons Bay (C)		-$89,901	-$93,484	-$90,255	-$105,503	-$106,171	-$105,108	-$111,531	-$131,030
21	Horsham (RC)		-$86,289	-$89,684	-$86,588	-$101,097	-$101,715	-$100,682	-$106,784	-$125,346
22	Hume (C)		-$182,951	-$190,083	-$183,671	-$213,979	-$215,323	-$213,222	-$225,985	-$264,739
23	Macedon Ranges (S)		-$71,744	-$74,632	-$72,024	-$84,322	-$84,856	-$83,994	-$89,175	-$104,903
24	Maribyrnong (C)		-$102,708	-$106,769	-$103,104	-$120,391	-$121,148	-$119,939	-$127,219	-$149,327
25	Melbourne (C)		-$146,488	-$152,164	-$147,011	-$171,219	-$172,267	-$170,560	-$180,742	-$211,705
26	Melton (S)		-$116,610	-$121,240	-$117,092	-$136,744	-$137,620	-$136,263	-$144,546	-$169,673
27	Moonee Valley (C)		-$81,403	-$84,655	-$81,718	-$95,569	-$96,173	-$95,202	-$101,036	-$118,751
28	Moorabool (S)		-$82,816	-$86,107	-$83,125	-$97,159	-$97,766	-$96,777	-$102,685	-$120,636
29	Moreland (C)		-$84,867	-$88,230	-$85,178	-$99,523	-$100,141	-$99,128	-$105,165	-$123,514
30	Mount Alexander (S)		-$23,677	-$24,701	-$23,743	-$28,168	-$28,339	-$28,007	-$29,867	-$35,533
31	Moyne (S)		-$60,339	-$62,820	-$60,597	-$71,132	-$71,597	-$70,867	-$75,311	-$88,781
32	Northern Grampians (S)		-$59,110	-$61,460	-$59,295	-$69,378	-$69,793	-$69,062	-$73,299	-$86,203
33	Pyrenees (S)		-$105,575	-$109,674	-$105,924	-$123,461	-$124,203	-$122,949	-$130,319	-$152,756
34	Queenscliffe (B)		-$44,748	-$46,521	-$44,852	-$52,525	-$52,822	-$52,246	-$55,462	-$65,287
35	Southern Grampians (S)		-$74,186	-$77,104	-$74,424	-$86,928	-$87,449	-$86,549	-$91,803	-$107,802
36	Surf Coast (S)		-$87,683	-$91,155	-$88,007	-$102,814	-$103,453	-$102,409	-$108,641	-$127,581
37	Warrnambool (C)		-$79,086	-$82,203	-$79,354	-$92,688	-$93,251	-$92,298	-$97,904	-$114,963
38	Whittlesea (C)		-$43,458	-$45,308	-$43,661	-$51,503	-$51,852	-$51,313	-$54,626	-$64,652
39	Wyndham (C)		-$149,950	-$155,824	-$150,541	-$175,508	-$176,613	-$174,880	-$185,395	-$217,320

Source: ACIL Allen

A similar S curve methodology is applied to commercial disconnections as that applied to residential disconnections. The number of customers facing decision points (every 15 years) is multiplied by the probability of that customer disconnecting to obtain an estimate of the total number of commercial disconnections. The parameters of the S curve are calibrated using the same process as that described for residential customers.

3.10 COM S curve connect

The COM S curve-connect worksheet calculates the number of new commercial connections over the forecast period. The NPV values by LGA that are the basic input into the S curve function are similar to the NPV values used in the disconnection decision but are adjusted for the fact that new gas connections do not face an electricity connection upgrade charge, which is paid by households and businesses switching from gas to electric appliances (see **Figure 3.31**).

Figure 3.31   COM S curve- connect NPV values by LGA

| C9 | fx | ='COM S curve-disconnect'!C9-'COM S curve-disconnect'!C$5-'Appliance costs'!B$85 |

	A	B	C	D	E	F	G	H	I
7									
8	LGA	2020	2021	2022	2023	2024	2025	2026	2027
9	Ararat (RC)		-$135,856	-$141,194	-$136,349	-$159,116	-$160,101	-$158,496	-$168,072
10	Ballarat (C)		-$74,762	-$77,819	-$75,055	-$88,078	-$88,643	-$87,728	-$93,213
11	Brimbank (C)		-$118,264	-$122,956	-$118,708	-$138,701	-$139,570	-$138,166	-$146,579
12	Central Goldfields (S)		-$61,912	-$64,410	-$62,098	-$72,837	-$73,275	-$72,491	-$76,999
13	Colac-Otway (S)		-$74,665	-$77,701	-$74,943	-$87,901	-$88,457	-$87,541	-$92,994
14	Corangamite (S)		-$119,380	-$124,108	-$119,823	-$139,976	-$140,850	-$139,432	-$147,912
15	Glenelg (S)		-$69,717	-$72,471	-$69,899	-$81,774	-$82,248	-$81,370	-$86,348
16	Golden Plains (S)		-$40,337	-$42,194	-$40,587	-$48,380	-$48,749	-$48,240	-$51,545
17	Greater Bendigo (C)		-$72,439	-$75,367	-$72,689	-$85,214	-$85,742	-$84,845	-$90,112
18	Greater Geelong (C)		-$83,566	-$86,936	-$83,875	-$98,255	-$98,873	-$97,856	-$103,907
19	Hepburn (S)		-$70,775	-$73,717	-$71,083	-$83,575	-$84,129	-$83,266	-$88,534
20	Hobsons Bay (C)		-$88,301	-$91,884	-$88,655	-$103,903	-$104,571	-$103,508	-$109,931
21	Horsham (RC)		-$84,689	-$88,084	-$84,988	-$99,497	-$100,115	-$99,082	-$105,184
22	Hume (C)		-$181,351	-$188,483	-$182,071	-$212,379	-$213,723	-$211,622	-$224,385
23	Macedon Ranges (S)		-$70,144	-$73,032	-$70,424	-$82,722	-$83,256	-$82,394	-$87,575
24	Maribyrnong (C)		-$101,108	-$105,169	-$101,504	-$118,791	-$119,548	-$118,339	-$125,619
25	Melbourne (C)		-$144,888	-$150,564	-$145,411	-$169,619	-$170,667	-$168,960	-$179,142
26	Melton (S)		-$115,010	-$119,640	-$115,492	-$135,144	-$136,020	-$134,663	-$142,946
27	Moonee Valley (C)		-$79,803	-$83,055	-$80,118	-$93,969	-$94,573	-$93,602	-$99,436
28	Moorabool (S)		-$81,216	-$84,507	-$81,525	-$95,559	-$96,166	-$95,177	-$101,085
29	Moreland (C)		-$83,267	-$86,630	-$83,578	-$97,923	-$98,541	-$97,528	-$103,565

Source: ACIL Allen

The calibration of the S curve parameters in the commercial connection decision is similar to the commercial disconnection decision. The model user selects the NPVs that correspond to 100% of users going to gas and 100% choosing to connect to electricity. The relative utility over this whole range is divided by range between the bottom and upper bound of the NPV to calculate the implied NPV coefficient. The intercept term is then derived by plugging in the NPV coefficient into the linear utility function and solving for the constant term.

4 Model outputs

4.1 Forecasts

The Forecasts worksheet is where the calculations of the model are finally integrated into a set of gas volume forecasts for the commercial and residential sectors. The forecasts are made up of two separate components, Gas consumption per customer and Total customers. The total volume consumed is then obtained by multiplying the per customer consumption by the total number of customers. The calculations are made at the LGA level.

Figure 4.1 shows the residential usage per customer. Forecasts of residential (and commercial) usage per customer are driven by the retail price of gas and by the weather. As the real price of gas increases (declines) over time, gas usage per declines (increases) by the percentage increase in price multiplied by the price elasticity of demand. The price elasticity of demand is set in the Control worksheet of the model. There is also a slight downward trend in the annual heating degree days over time. This translates into a small reduction in the average consumption per customer as the heating requirements of households and businesses reduce over time. The extent to which this happens is determined by the weather elasticity factor which is set in the Control sheet of the model.

Figure 4.1   Forecast worksheet- Residential consumption per customer

K3		fx	=J3+J3*Control!$H$12*Weather!AM$21+J3*Control!$H$13*Prices!AA$15+ J3*Control!$H$14*Prices!AA$17										
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Residential GJ per customer												
2	FY	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
3	Ararat (RC)	49.03	50.92	49.79	44.32	53.59	52.25	46.62	47.60	49.75	48.20	48.18	47.94
4	Ballarat (C)	61.75	61.09	60.35	53.45	65.28	65.96	60.41	59.92	65.96	63.90	63.88	63.56
5	Brimbank (C)	50.13	51.20	47.58	41.91	53.96	51.30	49.15	46.46	49.01	47.48	47.47	47.23
6	Central Goldfields (S)	42.29	43.94	40.98	36.97	43.20	44.80	41.21	41.02	42.73	41.40	41.38	41.18
7	Colac-Otway (S)	47.42	47.10	46.29	40.41	46.49	50.51	47.94	46.15	48.63	47.12	47.10	46.87
8	Corangamite (S)	36.35	38.32	37.44	30.38	46.55	42.68	39.82	39.83	45.58	44.15	44.14	43.92
9	Darebin (C)	14.66	62.78	49.37	59.29	58.48	55.11	32.49	57.71	31.51	30.53	30.52	30.37
10	Glenelg (S)	35.37	35.97	35.23	31.14	37.97	37.74	35.46	35.62	37.34	36.17	36.16	35.98
11	Golden Plains (S)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.92	35.26	34.16	34.15	33.98
12	Greater Bendigo (C)	45.62	45.62	42.86	37.79	47.11	47.63	44.62	43.80	45.93	44.50	44.48	44.26
13	Greater Geelong (C)	41.26	41.56	39.11	35.55	43.67	41.84	40.28	38.75	41.45	40.15	40.14	39.94
14	Hepburn (S)	50.27	50.91	50.01	44.80	50.99	53.31	49.34	50.12	54.90	53.18	53.17	52.90
15	Hobsons Bay (C)	46.58	46.64	43.43	39.54	47.99	46.26	44.30	42.61	45.22	43.81	43.80	43.58
16	Horsham (RC)	40.09	41.43	41.41	35.72	44.16	45.91	40.97	40.47	42.01	40.70	40.69	40.49

Source: ACIL Allen

Figure 4.2 shoes the number of historical and projected residential customers over time. Customer numbers are generated in the CustomersRes and CustomersCOM worksheets, after adding and subtracting new connections and disconnections from the previous year's customers. These are then brought into the 'Forecast' worksheet to be used in the final gas volume/consumption calculations.

Figure 4.2 Forecast worksheet- Number of residential customers

K38   fx   =CustomersRes!K3*Scenarios!B3

	A	B	C	D	E	F	G	H	I	J	K	L	M
36	Residential customers												
37	FY	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
38	Ararat (RC)	2882	2898	2916	2939	2953	2962	2973	2965	2977	3052	3128	3206
39	Ballarat (C)	37707	38655	39532	40041	41240	41870	42509	43403	44599	45714	46856	48027
40	Brimbank (C)	46376	45687	45993	46177	46646	46901	47170	47457	47712	48904	50126	51379
41	Central Goldfields (S)	3681	3746	3798	3838	3885	3935	3956	3982	3986	4086	4189	4294
42	Colac-Otway (S)	4174	4231	4291	4345	4437	4433	4509	4568	4613	4728	4846	4967
43	Corangamite (S)	1320	1405	1467	1499	1543	1579	1612	1633	1664	1706	1748	1792
44	Darebin (C)	3	3	3	3	3	3	3	2	3	3	3	3
45	Glenelg (S)	4286	4326	4351	4368	4377	4372	4379	4395	4398	4508	4620	4735
46	Golden Plains (S)	0	0	0	0	0	0	0	175	317	325	333	341
47	Greater Bendigo (C)	33747	35095	35836	36614	37587	38037	38612	39173	39832	40828	41848	42894
48	Greater Geelong (C)	82383	84342	86927	88416	91071	93088	95563	98136	100878	103400	105984	108634
49	Hepburn (S)	2735	2819	2898	2951	3006	3062	3103	3129	3161	3240	3321	3404
50	Hobsons Bay (C)	32616	32889	33194	33231	33554	33783	34009	34284	34631	35497	36385	37295
51	Horsham (RC)	5694	5790	5878	5928	6034	6104	6182	6214	6247	6403	6563	6727
52	Hume (C)	56923	58574	60371	62243	64437	66443	68631	70475	72542	74355	76214	78119

Source: ACIL Allen

Figure 4.3 shows the final residential gas volume forecasts. These forecasts then feed into the Summary worksheet which presents the final forecasts. This is also done for the commercial sector.

Figure 4.3 Forecast worksheet- Total residential volume (TJ)

K73   fx   =K3*K38/1000

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
71	Total residential volume (TJ)													
72	FY	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
73	Ararat (RC)	141.3	148	145	130	158	155	139	141	148	147	151	154	159
74	Ballarat (C)	2329	2361	2386	2140	2692	2762	2568	2601	2942	2921	2993	3053	3156
75	Brimbank (C)	2325	2339	2188	1935	2517	2406	2319	2205	2338	2322	2379	2427	2509
76	Central Goldfields (S)	156	165	156	142	168	176	163	163	170	169	173	177	183
77	Colac-Otway (S)	198	199	199	176	206	224	216	211	224	223	228	233	241
78	Corangamite (S)	48	54	55	46	72	67	64	65	76	75	77	79	81
79	Darebin (C)	0	0	0	0	0	0	0	0	0	0	0	0	0
80	Glenelg (S)	152	156	153	136	166	165	155	157	164	163	167	170	176
81	Golden Plains (S)	0	0	0	0	0	0	0	2	11	11	11	12	12
82	Greater Bendigo (C)	1540	1601	1536	1384	1771	1812	1723	1716	1830	1817	1862	1899	1963
83	Greater Geelong (C)	3399	3505	3400	3144	3977	3895	3850	3803	4181	4152	4254	4339	4486
84	Hepburn (S)	137	144	145	132	153	163	153	157	174	172	177	180	186
85	Hobsons Bay (C)	1519	1534	1442	1314	1610	1563	1506	1461	1566	1555	1594	1625	1681
86	Horsham (RC)	228	240	243	212	266	280	253	251	262	261	267	272	282
87	Hume (C)	3452	3636	3514	3078	4229	4025	4008	3941	4315	4285	4391	4479	4631
88	Macedon Ranges (S)	407	448	466	447	536	575	565	580	653	649	665	678	701
89	Maribyrnong (C)	945	965	914	822	1014	989	940	906	953	946	969	989	1022

Source: ACIL Allen

4.2 Summary worksheet

The summary worksheet contains the outputs of all the calculations made in the other parts of the model. Specifically, it shows the total customers, gross new connections and disconnections per year (see **Figure 4.4**).

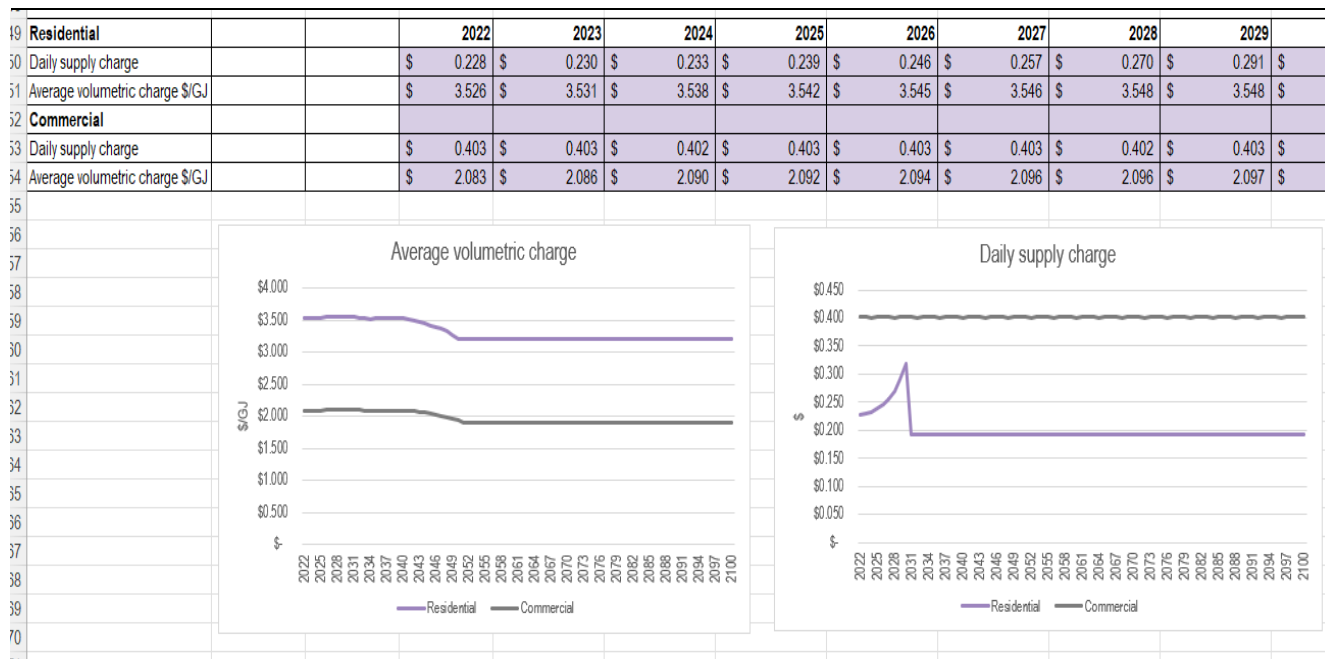**Figure 4.4**   Summary worksheet- Customer numbers and Volumes

	A	B	C	D	E	F	G	H
1								
2	**Customers**	2020	2021	2022	2023	2024	2025	2026
3	**Residential**	710,593	728,356	746,560	765,222	784,353	803,963	824,063
4	Gross new connections	24,664	24,853	25,475	26,113	26,768	27,439	28,123
5	Disconnections	7,167	7,090	7,271	7,451	7,637	7,829	8,023
6	**Commercial**	15,049	14,995	14,945	14,897	14,854	14,811	14,770
7	Gross new connections	495	500	501	499	499	498	498
8	Disconnections	565	554	551	547	542	541	539
9	**Ausnet**	**757,473**	**775,294**	**794,251**	**813,683**	**833,612**	**854,042**	**874,979**
10								
11	**Volumes (TJ)**	2020	2021	2022	2023	2024	2025	2026
12	Residential	34,765	34,521	35,374	36,078	37,303	38,155	38,987
13	Commercial	6,000	5,688	5,677	5,586	5,773	5,741	5,688
14	**Ausnet**	**40,765**	**40,210**	**41,051**	**41,664**	**43,076**	**43,896**	**44,675**
15								

Source: ACIL Allen

It also shows the projected daily supply charge and volumetric charge for residential and commercial customer classes (see **Figure 4.5**). These prices are generated in the separate regulatory model and linked to the summary sheet. The linked prices are generated in rows 87 to 91 of the ACIL Input-Output interface worksheet of the distribution business' building block model.

The 'Prices' worksheet obtains the projected prices from the summary worksheet which then feed through into the rest of the model, leading to revised volume projections. These revised volumes are then used as inputs into the regulatory model which then generates a new set of price projections as part of an iterative process.

Figure 4.5   Summary Worksheet- Projected supply charge and Volumetric charges

			2022	2023	2024	2025	2026	2027	2028	2029	
49	**Residential**										
50	Daily supply charge		$ 0.228	$ 0.230	$ 0.233	$ 0.239	$ 0.246	$ 0.257	$ 0.270	$ 0.291	$
51	Average volumetric charge $/GJ		$ 3.526	$ 3.531	$ 3.538	$ 3.542	$ 3.545	$ 3.546	$ 3.548	$ 3.548	$
52	**Commercial**										
53	Daily supply charge		$ 0.403	$ 0.403	$ 0.402	$ 0.403	$ 0.403	$ 0.403	$ 0.402	$ 0.403	$
54	Average volumetric charge $/GJ		$ 2.083	$ 2.086	$ 2.090	$ 2.092	$ 2.094	$ 2.096	$ 2.096	$ 2.097	$

Source: ACIL Allen