

C Australia

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In GTAP 11, there were 2 contributions of Australian data for reference years 2014-2015 and 2017-2018. First, we received the 2014-2015 from Jacob Conway Smith, then at the Productivity Commission. Afterward, we received the data from Glyn Wittwer from the Centre of Policy Studies, Victoria University.

The first Australian contribution is based on the Australian Bureau of Statistics (ABS) 2014-15 Input-Output (I-O) tables (ABS 2017). These tables require substantial processing to meet the requirements for the submission. The necessary steps and the methodology are outlined in this document. The result of this processing is four arrays:

- * the supply and use of commodities without commodity taxes (array UF)
- * the supply and use of commodities with commodity taxes (array UP)
- * output of each sector with non-commodity indirect tax includes (array OP)
- * imports by commodity with import duties excluded (array MF)

The transformations of the data into the required format is based on the contribution guide supplied by GTAP (Huff, McDougall and Walmsley 2000) and builds on the previous Australian submissions (Harslett, Marshall and Jomini 2015; Maidment and Gabbitas 2007).

C.1 Source data

Four tables from the ABS 2014-15 I-O tables (ABS 2017) were used:

- * a commodity by industry I-O table (ABS I-O table 2, 'Use table')
- * a non-diagonal make matrix (ABS I-O table 1, 'Australian supply table')
- * an imports array (ABS I-O table 3, 'Imports')
- * a commodity tax array (ABS I-O table 35, 'Net taxes on products by product group').

C.2 Source data transformations

The transformation steps required are outlined in table 8.6, and their various methodologies are outlined further in this section.

Table 8.5: Array descriptions: Input data explained

Array	Dimensions	How it's used
Use table	119 x 121	The main I-O table that is transformed
Supply table	114 x 114	The 'make' matrix that is used to transform the use table into commodity-by-commodity
Imports table	119 x 121	Used to subtract indirect imports from the use table
Net taxes on commodities table	114 x 121	Adds commodity taxes to produce array UP
Mapping	119 x 65	Used to map the 114 ABS sectors to the 65 GTAP sectors.

Table 8.6: Transformations: Steps, data and software required

Steps	Data required	Software
1. Missing values imputation	ABS use table	GAMS
2. Removing indirect imports	ABS imports table	GEMPACK
3. Add net taxes on commodities (UP only)	ABS net taxes table	GEMPACK
4. Convert multi-product to single-product industries	ABS supply table	GEMPACK
5. Remove negative values		GEMPACK
6. Remove re-exports	ABS I-O Product Details	GEMPACK/GAMS
7. Adjust factor payments	MMRF database	GEMPACK
8. Aggregate ABS investment categories		GEMPACK
9. Map from ABS products to GTAP sectors	ABS Product Details	GEMPACK/EXCEL/R
10. Diagnostics		GEMPACK

Step 1 – Missing values imputation

The ABS does not publish data on the use of some products for confidentiality reasons. The two input-output product categories that are not published are ‘Air and Space Transport’ and ‘Postal and Courier Pick-up and Delivery Service’. However, the total values of use and production of these categories are published. This allows for reasonable values to be imputed using an minimum cross-entropy approach that is straightforward to implement in the GAMS software. The resulting values were then manually inserted into the input use array (table 1.4).

Table 8.7: Imputed missing values: Results from cross-entropy minimisation

	Households (C)	Government (G)	Private (I)	Public Enterprise (I)	General Government (I)	Exports (X)
Air and Space Transport	13 879	0	49	6	2	7295
Postal and Courier Pick-Up and Delivery Service	121	0	48	6	2	517

Sources: ABS (2017); Productivity Commission estimates.

Step 2 – Removing indirect imports

The original ABS use data aggregates domestic production and import data. GTAP requires these to be disaggregated. Imports sourced from the ABS imports table (ABS 2017 Table 3) are subtracted from the original ABS use table to conform to GTAP’s standards.

Step 3 – Multi-product to single-product industries

GTAP requires that each industry produce only a single product. However, in the ABS use table every industry produces multiple products. This step requires the use of the ABS supply table (ABS 2017) to derive shares of each good’s contribution to an industry’s overall production. The process used for transforming the domestic use table to a single product industry structure is as follows:

- * All outputs produced by an industry were assumed to be produced with the same input structure.
- * Shares representing each good’s individual contribution to an industry’s overall production were derived from the ABS supply table.
- * These shares were multiplied through the domestic and import use tables to impose a single product industry format while maintaining existing cost structures.

Step 4 – Negative values

There were some minor values within the domestic commodity use and imports tables that required adjustments.

The minor negative values arose in the domestic commodity use table due to some import values being slightly higher than the use. As a result, subtracting indirect imports from total use generates negative values that cannot be present in the submission (the exception to this rule is stocks, which can be negative). The negative values in imports are due to the way the ABS treats some sectors whereby some sectors have minor negative values.

All negative values in the domestic use table were set to zero and the corresponding stocks were adjusted by the same value to maintain balance. This is a standard practice when correcting for minor negative values (Huff, McDougall and Walmsley 2000). Negative values in the imports table were set to zero and exports reduced by the equivalent amount.

Step 5 – Re-exports

GTAP requires that re-exports are removed from the exports final use category in the domestic use table. Balance is maintained by adjusting imports accordingly. In cases where re-exports exceeded intermediate imports, the adjustment was made to stocks instead.

Re-exports are published in the ABS Product Details (ABS 2017). These data are published at the IOPG level, and are easily used to make the necessary adjustments. This is a slightly different approach to Australia's last submission due to better data being available for this submission.

Step 6 – Factor payments

GTAP require the final arrays to include three types of factors: labour, capital and land. The ABS publish values for 'Compensation of employees' and 'Gross operating surplus & mixed income'. These are broadly taken as the contribution of labour and capital, respectively. However, mixed income includes some share of labour that is not disaggregated in the ABS data. Reliable estimates for this share are not available and therefore these two categories have been left as is, but should be noted.

The imputation of factor payments to land used the same approach as the previous GTAP submission, which used the VURM (previously MMRF) model, from the Centre of Policy Studies, estimates of apportioning 'Gross operating surplus & mixed income' to capital and land (Table 8.8). Further, land shares are only applied to agriculture sectors that are based on estimates from the 2005-06 VURM model that are based in original ABS I-O data. These shares are not routinely published and must be calculated with CGE techniques. This data submission disaggregated agriculture further, and thus the shares were applied to the relevant disaggregates directly.

Table 8.8: Land share

Previous submission, agriculture sectors	Shares of capital attributed to land
Sheep, Grains, Beef and Dairy Cattles	0.663
Other Agriculture	0.430

Productivity Commission estimates.

Step 7 – Aggregating investment categories

The ABS 2014-15 I O tables include three disaggregated measures of investment: ‘Gross fixed capital formation — Private’, ‘Gross fixed capital formation — Public enterprise’ and ‘Gross fixed capital formation — General government’. These categories were aggregated to a single investment final use category to meet GTAP requirements.

Step 8 – GTAP sector mappings

There are 114 sectors in the ABS I-O Product Group (IOPG) used in the original I-O table. GTAP requires a mapping from these sectors to GTAP’s new 65 sector classification, referred to as GSEC3. Some of these sectors map directly to a GTAP sector, some are aggregated as part of a GTAP sector, and others are disaggregated across several GTAP sectors. There are also many that require more than one of these steps.

To simplify this process and to improve accuracy of mappings, the following steps were taken:

- * Domestic supply at the smaller, I-O Product Category (IOPC) level, was taken from the Product Details (ABS 2017).
- * Each of the 918 IOPC products were mapped to one GTAP sector.
- * The contribution of each IOPC product, to each GTAP sector, as a share of each IOPG was then calculated to produce a set of weights.
- * These weights were used to map the ABS sectors to the final GTAP sectors.

This final step enables the final arrays to be calculated from the transformed data.

Step 9 – Net commodity taxes

The UP array requires net commodity taxes to be included in the use values. The same steps as outlined above, are required, but with net commodity taxes added to the input use and import table before mapping. The net taxes data are from the ABS table, ‘Net taxes on products by product group’ (ABS 2017). This process is almost identical to creating the UF array, but requires modified balance checks, due to the inclusion of taxes.

Step 10 – Diagnostics

The process included ongoing checks to make sure the data had not been corrupted throughout the transformation process. This takes the form of identities to check that the data is initially balanced, and that it remains balanced after each transformation. That is, total sales must equal total costs throughout the process. Where there are small balancing issues, adjustments can be made ad hoc.

Other checks once the final arrays had been constructed were conducted to confirm the following:

- * total sales equalled total costs (balance).
- * there are no negative values except where appropriate (i.e. stocks).
- * the values of GDP was consistent with the underlying ABS data.

C.3 1.3 Final Outputs for submission

Once the data has been successfully transformed and it satisfies basic diagnostic checks, the data must be composed into a specific format. The four main arrays must be submitted in the .HAR array format, a document outlining the approach taken; and a mapping file that contains the link between the ABS sectors and the GTAP sectors.

References

ABS (Australian Bureau of Statistics) 2017, Australian National Accounts: Input-Output Tables (Product Details), 2014-15, 10 November, Cat. no. 5215.0.55.001.

—— (Australian Bureau of Statistics) 2017, Australian National Accounts: Input-Output Tables, 2014-15, 16 June, Cat. no. 5209.0.55.001.

Harslett, P., Marshall, D. and Jomini, P. 2015, GTAP 9 Data Base Documentation - Chapter 7.A: Australia, Center for Global Trade Analysis.

Huff, K., McDougall, R. and Walmsley, T. 2000, Contributing Input-Output Tables to the GTAP Data Base.

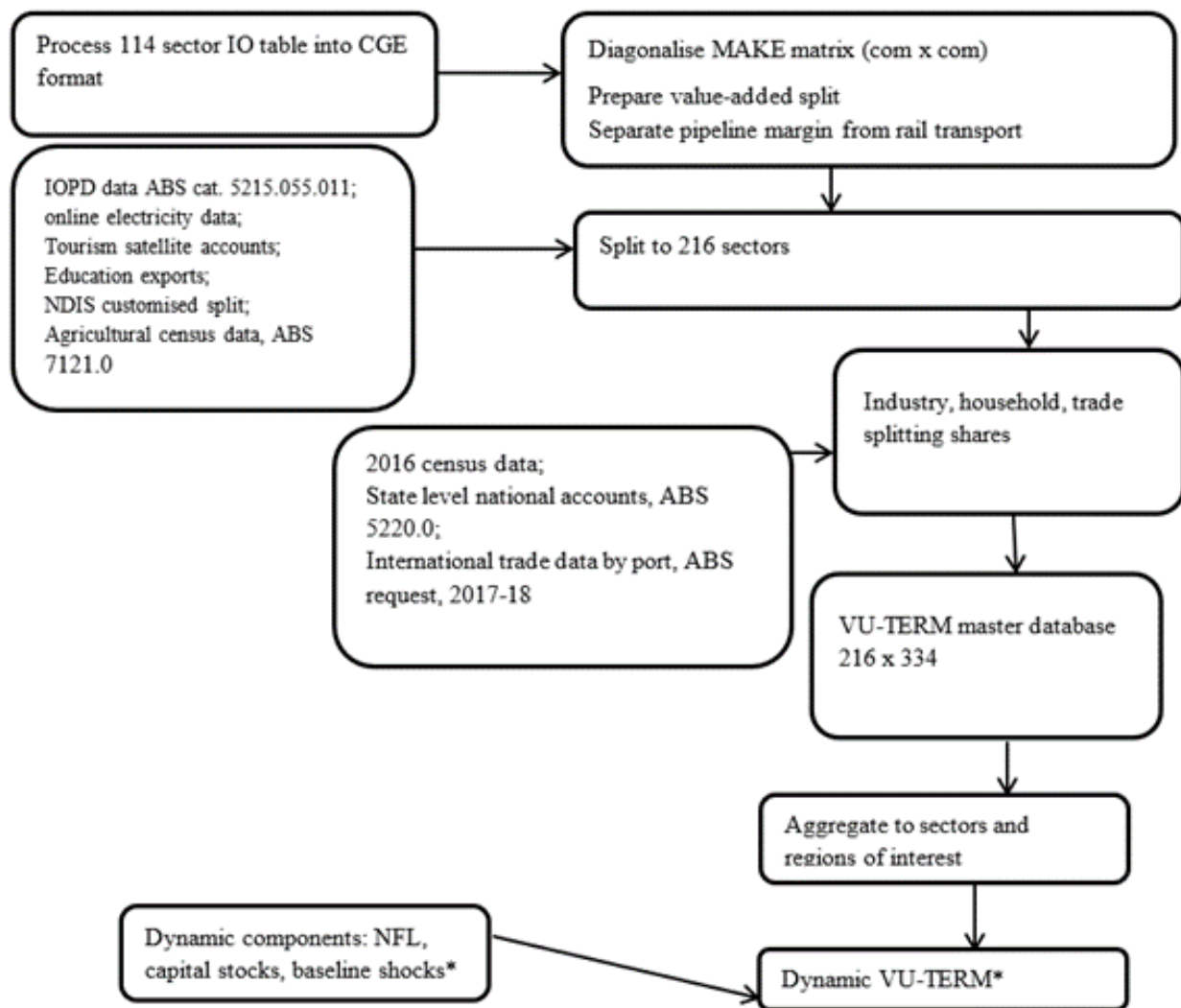
Maidment, T. and Gabbitas, O. 2007, GTAP 6 Data Base Documentation - Chapter 11.B: Australia, Center for Global Trade Analysis.

C.4 Preparation of national and sub-national multi-regional 2017-18 CGE databases for Australia

Introduction

Figure 8.1 provides an overview of the sequence of VU-TERM database preparation tasks. The task starts with the published 2017-18 national input-output table.

Figure 8.1: Preparing VU-TERM with a 2017-18 initial year database



* Not applicable in comparative static applications

1. Industry splits

There are two broad ways of splitting the sectoral dimension of the initial CGE database. The first is a disaggregation of cost and sales shares. An example is the split of “OtherAgric” into various,

mainly horticultural, sectors. The split of costs for the new sectors from the old may be gathered from ABS agricultural census data (catalogue 7121.0). To split sales, we use a combination of IOPD data and international export data.

Other splits involve the use of dummy industries. Dummy industries consist of a bundle of intermediate inputs without primary inputs. For the first time in this exercise, DAGGHAR was used for the sectoral splits instead of a specific GEMPACK-generated program Disagg.exe.

Input-output product details data

IOPD data from the ABS were used extensively in splitting the 114 sector database. DAGGHAR provides a default split. A program allocates specific splitting shares based on IOPD data (the ABS 5215* series). It is better to treat the IOPD data as shares of the original IO sectors rather than as absolute numbers. That is, an aggregation of split database to the original sectors should be the same as the original database.

An exception arises in the case of dummy industries, which include NDIS and tourism and education export sectors. In preparing these dummy industries, some sales to households, government and direct exports are moved to intermediate inputs into the dummy industries.

NDIS sectors

These include NDIS (National Disability Insurance Scheme) sectors, based on the original community services sector. There two types of NDIS services, namely residential and other social assistance. Inputs into NDIS include GPs, Specialist (medical) services, RC_disable and OSA_disable. NDIS consists only of these services as intermediate inputs without any primary factor inputs.

Table 8.9: Sales structure of community health, childcare, residential care and other social assistance sectors

	Interm	Invest	HouseH	Export	GovGE
RC_Aged	10	0	7924	25	29772
RC_Disable	6018	0	0	1	2987
RC_Other	0	0	1485	3	2181
ChildCare	0	0	8493	128	2584
OSA_Disable	2811	0	0	0	1809
OSA_Other	613	0	1316	1	6298
NDIS	0	0	13822	0	1

Table 8.9 shows us that residential aged care (RC_Aged), child care and OSA_other (other social assistance not related to disabilities) are purchased about 1/3 by households and 2/3 by government. The sectors providing services to disabled people (RC_Disable and OSA_Disable) are intermediate inputs to NDIS. NDIS in turn is consumed almost entirely by households. Appendix A describes the work undertaken by Janine Dixon in greater detail.

Tourism

Other examples of dummy industries concern tourism and education exports. For tourism, we ex-

tract data from 52490DO001_201718 Australian National Accounts: Tourism Satellite Account, 2017-18. The “ExpTourism” dummy industry reflects the bundle of expenditures on travel, restaurants, accommodation and sight-seeing undertaken by foreign visitors to Australia. The “Holiday” industry captures the tourism activities of Australians within Australia, while “Foreign holiday” captures corresponding overseas activities by Australians. We split tourism sectors from the core database based on the methodology of Dixon and Rimmer (2003) in the USAGE model, summarised in table 6.1 of Wittwer (2017). At this stage, sales to households and exports are split between tourism and non-tourism activities.

Tourism expenditures are transferred from final use sales (i.e., to households and exports) to intermediates in the new tourism-specific sectors. Notes in the TABLO file indicate that according to ABS 5216.0, foreign tourism includes business activity. The modified CGE database gets tourism totals close to tourism satellite accounts for Holidays and Tourism Exports without using existing intermediate inputs.

This is not the case for “FgnHoliday”. The database includes amendments to sell business tourism to “FgnHoliday”. The sector uses a substantial share of intermediate imports (the remainder being domestic sales of “AirInt”) and is treated as an export in final demands. The database amendments were more difficult than in the USAGE case (Wittwer 2017), because there are not substantial non-competing imports in the ABS IO table.

Table 8.10 summarises the inputs into each of the tourism industries. Note that Australian consumers can substitute between Holiday and Foreign Holidays.

Table 8.10: Tourism industries

	Holiday (1)	Foreign Holidays (2)	Exports of Tourism (3)
1 International airfares: Aust sourced		C	F
2 International airfares: imported		D	G
3 Domestic airfares	A		H
4 Other purchases within Aust	B		I
5 Other purchases in other countries		E	
6 Total industry output	$h=A+B$	$fh=C+D+E$	$xt=F+G+H+I$
7 Tourism expenditure of Aust households		$CES[h+fh]$	
8 Tourism expenditure in Aust by non-residents			$=xt-G$

One important modification is that exports of “Air Transport” are moved entirely to “AirInt”. The latter treatment is not identical to that of Dixon and Rimmer, in so far as the sector has zero usage as a margin (table 8.11).

Education exports

Exports of education are split into a separate sector “ExpEdu”. This sector takes account of ed-

Table 8.11: Allocation of air transport sales (\$m)

	AirTrans		AirInt	
	Domestic	Imported	Domestic	Imported
Inputs to users				
Foreign holidays	0	0	5161	11578
Domestic holidays	9112	0	0	16
Exports of tourism	0	0	5052	0
Exports of education	9	0	0	0
Other	4585	0	0	278
Total	13706	0	10216	11872
Margins usage	533	365	0	0

ucation export fees plus the living expenses of overseas students. Household demands V3PUR that reflect living expenses of students become intermediate inputs into “ExpEdu”. There were 645,185 international enrolments in 2015, equal to about 2.5% of the national population. Expenditure shares for international students are lower than the population share for some commodities, but not air transport.

Exports related to tertiary education are transferred from the export column to the intermediate inputs column of “ExpEdu”.

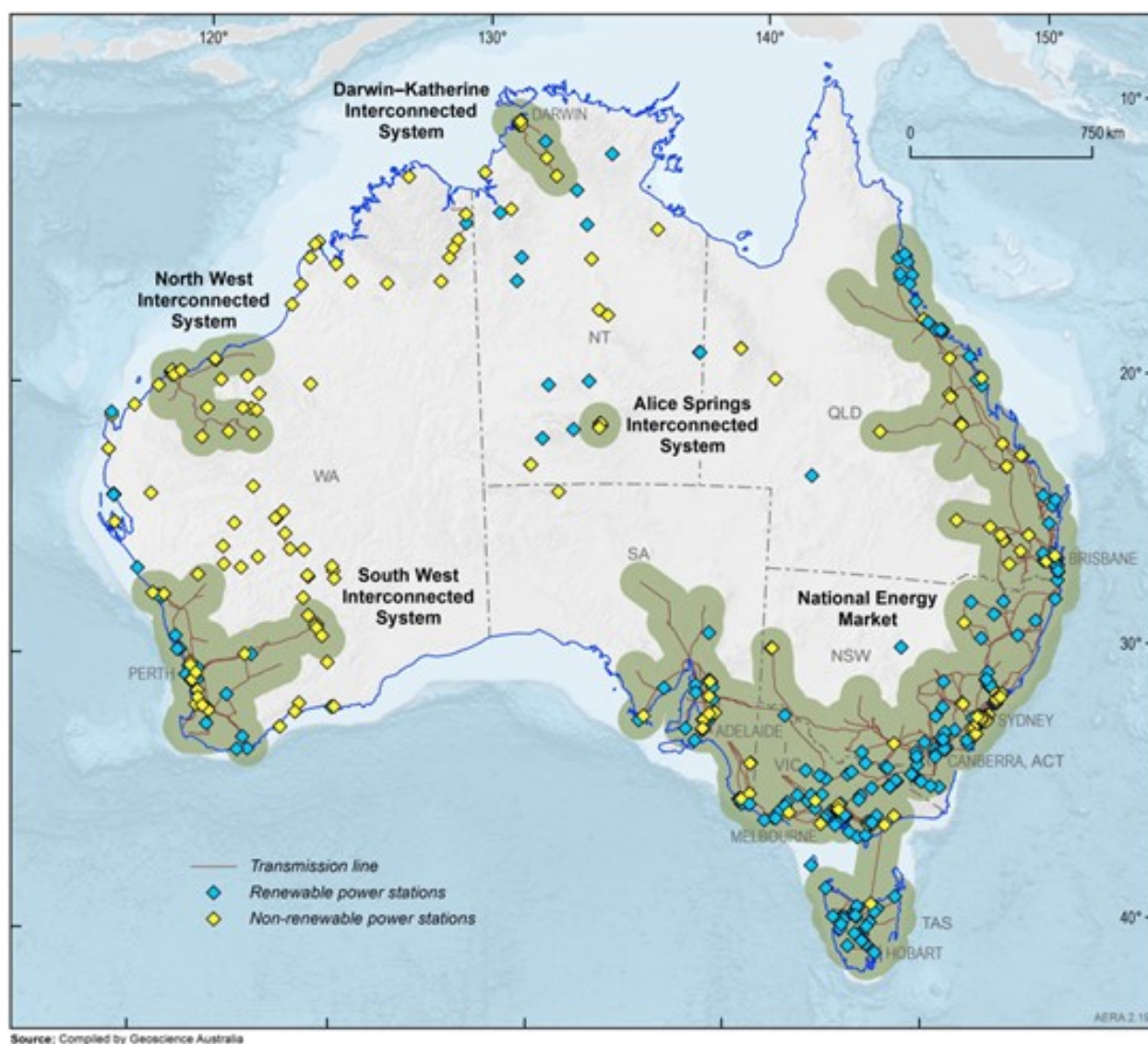
Split of electricity generation sectors

The convention used in the published ABS IO table, which follows international conventions, is that electricity transmission & distribution is mainly a margins commodity, with remaining sales being to electricity generators, own-inputs and non-housing construction. This differs from the convention adopted by Philip Adams before there was an international convention. The Adams convention is that electricity generators sell virtually all of their own to electricity distribution, which in turn sells to users.

Table 8.12: Electricity sales and margins in national database (\$m)

	Basic	Margin	TAX
ElecBlacCoal	5404	8912	759
ElecBrowCoal	2157	1867	159
ElecGas	4704	2011	171
ElecOil	606	501	16
ElecHydro	662	1442	123
ElecBiomass	83	54	5
ElecBiogas	83	107	9
ElecWindGen	489	864	74
ElecSolar	324	45	4
ElecTranDist	24075	0	32
Total	39342	15803	1352

Figure 8.2: Electricity infrastructure



Source: <https://aera.ga.gov.au/#!/energy-resources-and-market>

The ABS IOPD data provide limited information for the split of electricity generation (table 8.12). All margins transactions shown in Table 8.12 consist of electricity transmission & distribution. An online search provided the basis for the split and also provided regional data. Renewable power sources have some meaning at the regional level. Land owners receive annuities for windmills located on their properties.

New splits using IOPD data Some additional indirect tax detail is available in IOPD data. New splits include:

- **Dairy Prods** split into MilkCream, IceCream, FlavWMilk, Yoghurt, Butter, CheeseCurd, OthDairy;

- **InsuranceSup** split into LifeInsur, HealthIns, FireOthIns, HouseInsur, OtherInsur, EmployerIns, Superannuatn;
- **Cafes** split into Restaurants, PubsClubs;
- **Gambling** split into Casinos, LotteryTAB, GamblingNEC;
- **WineSpirTob** split into NPwine, CPwine, SPwine, SpiritCider, Tobacco

Remaining national database splits

The main sources of agricultural production splits are Agricultural Commodities, Australia, 2015-16 (catalogue 7121.0) and Value of Agricultural Commodities Produced, Australia, 2015-16 (7503.0). Sales of agricultural products are based on IOPD data and international export data by ports. Cotton ginning is split from agricultural services also using IOPD data.

Coal is split into black and brown coal. The original motivation for this was that brown coal is more GHG emissions intensive than black coal. Victoria is the sole state in which brown coal generation occurs following the closure of Port Augusta's (South Australia) relatively small coal-fired power station in 2016.

By international convention, oil and gas is reported as a single sector in published input-output tables. In cases in which oil and gas are produced from the same well, this makes sense. However, gas can also be extracted from gas wells, shale gas wells and coal bed wells. Figure 8.2 shows gas resources in Australia. Figure 8.3 shows gas resources. These figures are helpful for information on the regional split between oil, LNG and gas. In addition, they provide some information for the regional split of pipeline, which in turn is split in the sectoral dimension from water transport. There has been a

Bauxite is split from other non-ferrous ores and alumina and aluminium are split from non-ferrous metals in order to depict the energy intensity of aluminium production in VURM.

The remaining services sector splits are based on a combination of census data and IOPD. For relatively labour-intensive activities, employment data provide defensible shares for industry splits.

Table 8.13 summarises the splits undertaken in preparing a new national CGE database.

2. Regional splits

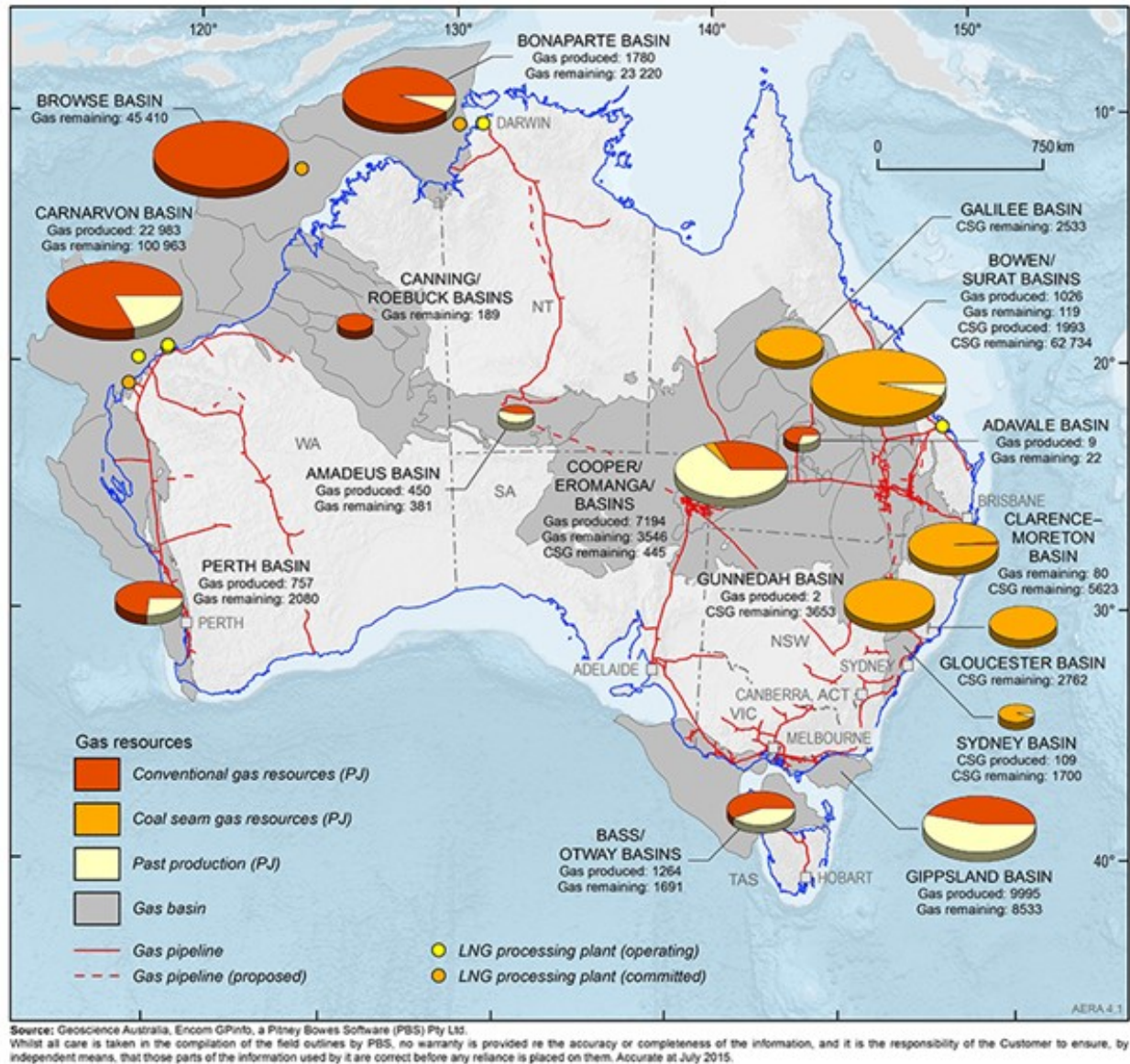
Horridge (2012) describes how the TERM database inputs are processed so as to produce a multi-regional CGE database. This section details data sources. The main difference in the regional dimension between the present database and past preparations is that regions are now based on SA2 and SA3 regions. The master database of VU-TERM includes 334 bottom-up regions. In addition, a top-down module assigns regional activities to 2206 non-zero SA2 regions.

ABS catalogue 7053.0 contains regional shares for agricultural outputs at the SA2 level.

Table 8.13: IO sectors split in the master database preparation

SheepGrnCatl	Various broadacre splits – see section 3 (7)
PigsPoultry	Poultry & other livestock – see section 3 (2)
OtherAgric	Mainly horticultural splits – see section 3 (18)
AgricSrvces	Services + cotton ginning– see section 3 (2)
Coal	Black and brown coal –the latter has disappeared from SA, Vic is following (2)
OilGas	Oil, gas, LNG, coal seam gas, LPG (5)
OthMetalOres	Bauxite, other non-ferrous ores, gold ores (3)
WineSpirTob	NPwine, CPwine, SPwine, SpiritCider, Tobacco (5)
Dairy Prods	MilkCream, IceCream, FlavWMilk, Yoghurt, Butter, CheeseCurd, OthDairy (7)
PetrolCoalP	Petrol, other petroleum products, diesel, aviation fuel, refined LPG (5)
BasicNferMtl	Alumina, aluminium, refine gold and other non-ferrous metals (4)
ElecGen	Coal, gas, hydro, wind, other renewables, biogas ... (9)
RoadTransprt	Passenger, freight (2)
RailTransprt	Passenger, freight and inter-urban (3)
WaterTrnsprt	Water transport, pipeline (2)
AirTransport	Air transport, International air transport (2)
Cafes	Restaurants, PubsClubs (2)
ProSciTchSrv	Scientific & architecture, legal, accounting, other (4)
InsuranceSup	LifeInsur, HealthIns, FireOthIns, HouseInsur, OtherInsur, EmployerIns, Superannuatn (7)
GovAdmin	Federal, State, Local (3)
PublicOrder	Police, fire brigades, other public order (3)
SchoolEduc	Pre-school, primary, secondary (3)
TertVocEduc	Technical & vocational, tertiary, education exports (3)
Health	Hospitals/nursing, GPs, specialists, pathology, dental, optometry, other health (7)
ResidCare	RC-Aged, RC.Disable, RC_other, Childcare, OSAdisable. OSAother, NDIS dummy (7)
PersonalSrv	Hairdressing & beauty salons, Other personal (2)
Gambling	Casinos, LotteryTAB, GamblingNEC (3)
OtherServices	A number of 4 digit ANZSIC sectors (4)
Tourism sectors	Dummy industries for Holidays, Foreign holidays and Tourism Exports (3)

Figure 8.3: Gas resources in Australia



Source: Geoscience Australia <http://www.ga.gov.au/aera/gas>

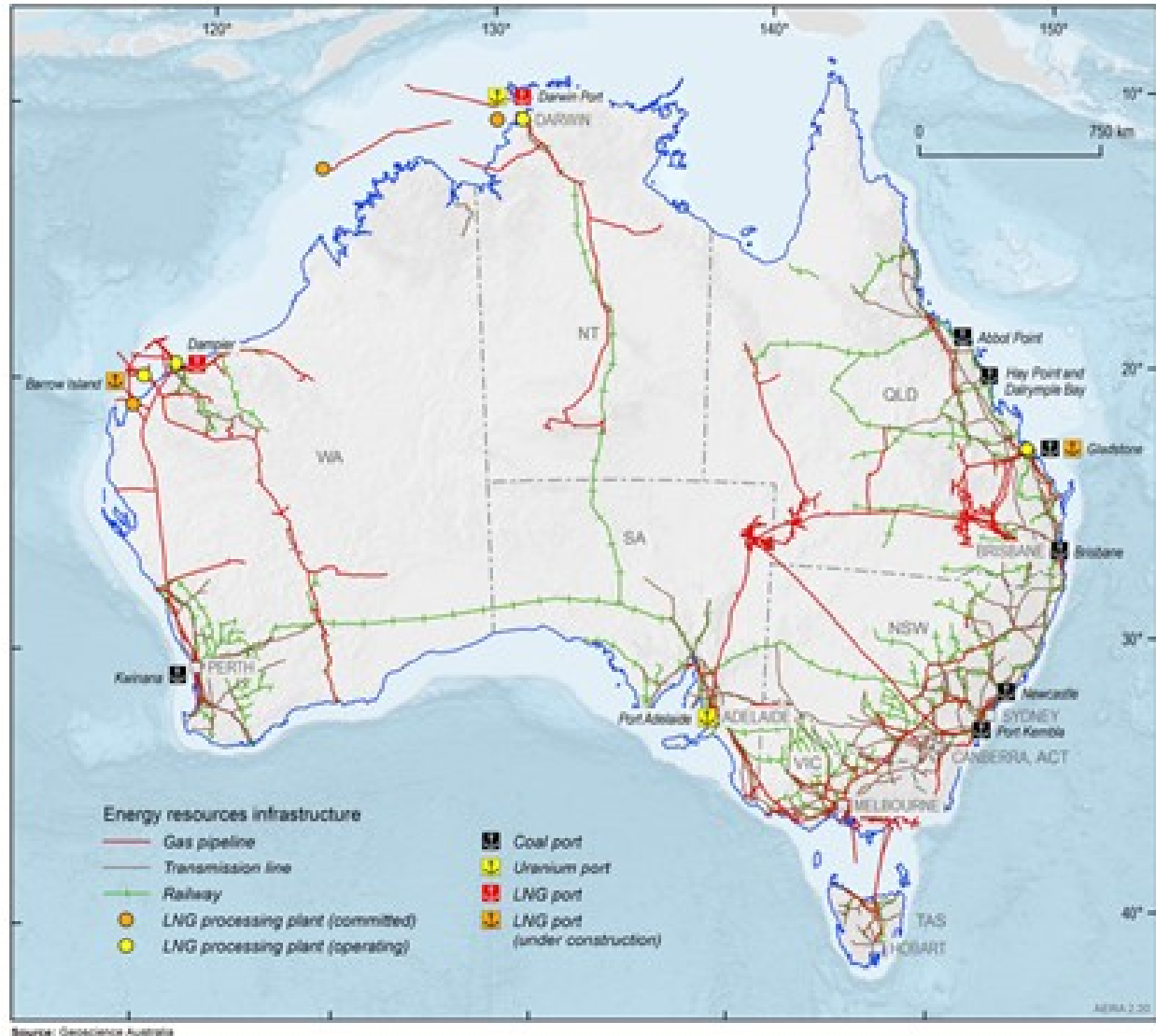
Sectors other than agriculture, electricity and tourism rely heavily on SA2 level employment data from the ABS 2016 census.

Electricity generation data are compiled from an internet search for all power stations in Australia. These data include latitude and longitude coordinates. From these coordinates, a program maps each station to an SA2 region.

Tourism activity shares were mapped from TRA's National Visitor Survey.

3. Modifications to enable representation of GTAP sectors

Figure 8.4: Energy resources infrastructure

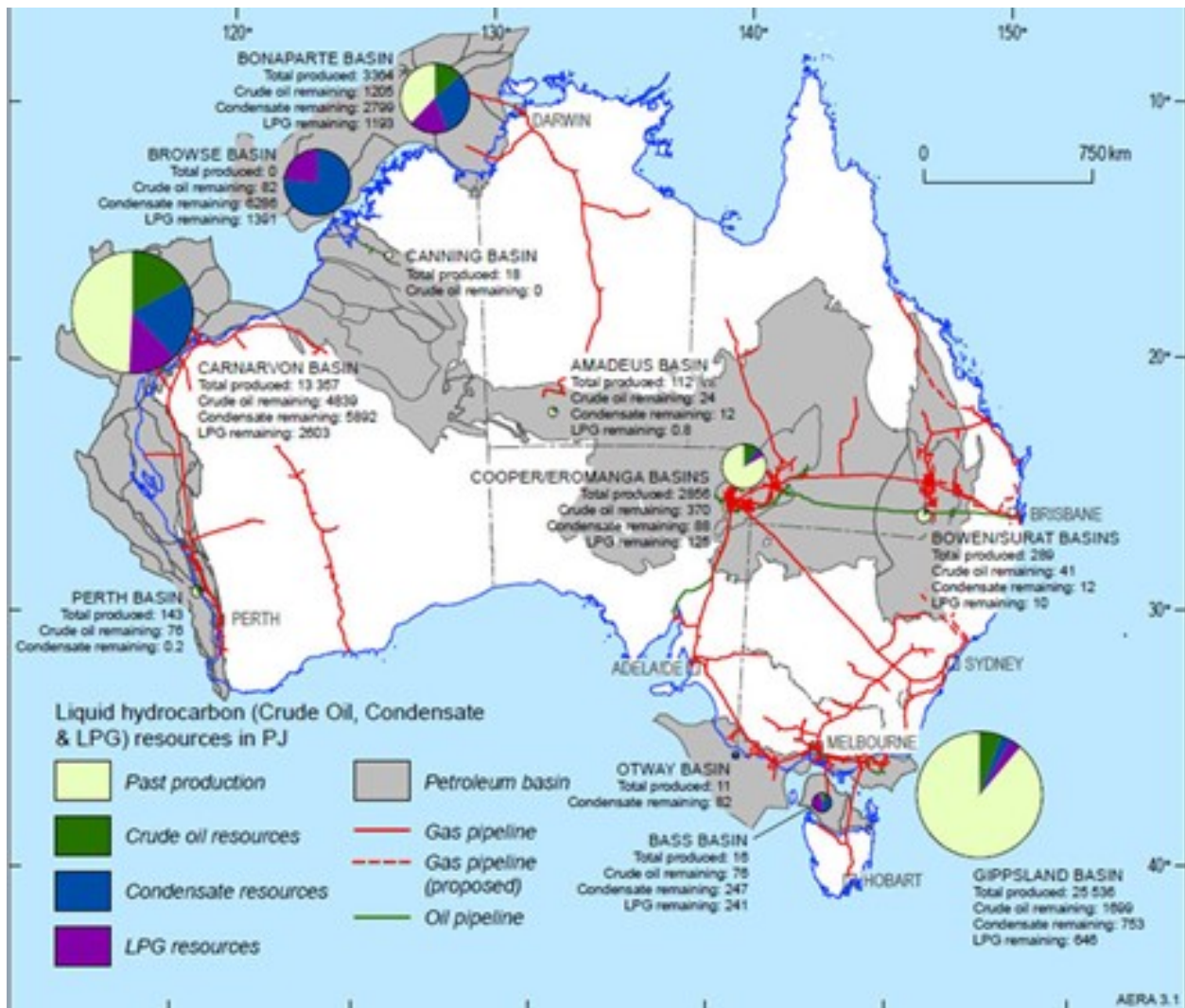


Source: <https://aera.ga.gov.au/#!/energy-resources-and-market>

The official ABS input-output tables contain only four agricultural sectors. These are split as follows: Sheep, grains, beef and dairy cattle:

- Sheep 0.209 BeefCattle 0.343 Rice 0.004 Wheat 0.104 Barley 0.051 OthGrainLegu 0.081 DairyCattle 0.138
- Other agriculture: OtherAgriclt 0.159 OthVegetble 0.182 Potatoes 0.034 TableGrapes 0.022 WineGrapes 0.027 BerriesAll 0.027 ApplesPears 0.036 Stonefruit 0.038 Citrusfruit 0.038 Olives 0.014 Bananas 0.023 Orchardfruit 0.023 AlmondMacad 0.034 SugarCane 0.078 Cotton 0.12 HayCerealFod 0.089
- Poultry and other livestock: Poultry 0.52 OthLivestock 0.48

Figure 8.5: Oil, condensate and LPG resources



Source: Geoscience Australia <http://www.ga.gov.au/aera/oil>

— Agriculture, forestry and fishing support services: AgriSrvces 0.679 GinnedCotton 0.321

The 216 version of the Australian database used to generate national and multi-regional sub-national databases is suitable for an aggregation to all but three of the 65 GTAP sectors. These three are “pcr”, “omt” and “wol”. The following splits using a further DAGGHAR run are necessary:

- split: Sheep Sheep1 4716 wol 4189
- split: FlourCereals FlourCereal 5226 pcr 515
- split: MeatProds cmt 29327 omt2 3675
- file: DATA S Adjust216b.upd Nat219.har

The reason “omt2” is created instead of “omt” is because the 216 sector database contains a separate seafood sector. On aggregation from 219 to 65 sectors, omt is an aggregation of “omt2” and “seafood”.

A TABLO program allocates all “wol” intermediate sales to textiles and accounts for most exports of the 216 version “Sheep” sector, barring live sheep exports which are assigned to “sheep1”.

The only supporting data to split “FlourCereals” into “FlourCereal1” and “pcr” is the sale of rice to “FlourCereals”. Rice now sells all output to “pcr” with no sales to “FlourCereal1”.

All livestock inputs other than beef cattle and dairy cattle formerly sold to “MeatProds” are now sold to “otm2”. Cattle inputs formerly sold to “MeatProds” are sold to “cmt”.

This split was undertaken retrospectively after the 216 master database was created. In the future, the GTAP-specific splits may be included in the core splits.

The amended 219 sector database is rebalanced and aggregated to the 65 GTAP sectors. “FlourCereal1” is aggregated with a number of other sectors into “ofd”.

4. How we use the master database

A master database is designed to be aggregated so as to preserve sectors and regions of specific interest in a study while aggregating elsewhere. To put this in context, the master database of VU-TERM is 2.8 gigabytes in size. An aggregation of 22 sectors and 2 regions is less than 0.4 megabytes. This aggregation in a 20 year dynamic simulation solved in 75 seconds. Solution time increases with database ratios with an exponent of around 1.7. To calculate the solution time (assuming that computing memory is not exhausted) we use the database size ratios ($2800/0.4=11200$) to the exponent of 1.7 ($7.6 \text{ million} = 11200^{1.7}$). On this basis, the master database would take around 18 years of solution time to run the same baseline.

In practice, we create the master database and attempt to balance it in its full dimensions. But all of our modelling is undertaken with aggregations. We prefer to keep a minimum of around 15 sectors so as to maintain compositional differences between sectors. Most aggregations run with VU-TERM contain no more than 40 sectors and typically no more than 12 or so regions.

The aggregation programs used at CoPS automate much of the aggregation procedure. The use of a given aggregation for more than one project tends to be exception rather than the rule.

VU-TERM includes a top-down module in addition to bottom-up regions. An aggregation might consist of 30 sectors and 3 regions (one local, one rest of state and one rest of nation). The model will generate solutions for 30 sectors in 3 regions. It will also generate solution for all or a subset of 2206 SA2 regions using top-down methodology.

References

ABS sources:

- <http://www.abs.gov.au/ausstats/abs@.nsf/mf/5249.0>
- <http://www.abs.gov.au/ausstats/abs@.nsf/mf/5209.0.55.001>
- <http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/7121.02015-16?OpenDocument>
- <http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5206.0Sep\%202017?OpenDocument>
- <http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5220.02015-16?OpenDocument>
- <http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/1270.0.55.006July\%202011?OpenDocument>
- <http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/7503.02015-16?OpenDocument>

2016 census data downloaded using TableBuilder

Unpublished international trade data by port and destination (4 dig. ANZSIC) purchased from ABS

Dixon P, Rimmer M (2003) Regional database for USAGE. Centre of Policy Studies Mimeo. <http://www.copsmodels.com/archivep.htm> TPGW0157. Accessed 15 July 2016

Horridge M (2012), “The TERM Model and Its Database”. In: Wittwer G (ed) Economic Modeling of Water: The Australian CGE Experience. Springer, Dordrecht, pp 13-36

Wittwer, G. (2017), “Tourism and Transport in a CGE Model and an Illustrative Application”, in Wittwer, G. (ed.), Multi-Regional Dynamic General Equilibrium Modeling of the U.S. Economy, USAGE-TERM Development and Applications, pp. 99-112.

Tourism Research Australia:

- <https://www.tra.gov.au/Research/International-visitors-to-Australia/international-tourism>
- <https://www.tra.gov.au/Research/View-all-publications/All-Publications/National-Visitors-national-visitor-survey-results>

Appendix

NDIS sectors in national CGE database

Author: Janine Dixon (originally prepared for 2015-16 report)

The standard Vic Uni model database was augmented to reflect detail in the sectors of relevance to the NDIS. Disability care activities fall mainly under the input-output category Residential Care and Social Assistance (RCSA) Services, an aggregation of the ANZSIC classifications Aged Care Residential Services (8601), Other Residential Care Services (8609), Child Care Services

(8710) and Other Social Assistance Services (8790). Disability care activities are a component of Other Residential Care Services (8609) and Other Social Assistance Services (8790).

To isolate disability care activities, the RCSA input-output group was split into the following six parts:

- Aged Care Residential Services (ANZSIC 8601)
- Residential care services for the disabled (part of ANZSIC 8609)
- Other residential care services (incl mental health, illnesses or substance abuse) (part of ANZSIC 8609)
- Child care services (ANZSIC 8710)
- Other social assistance services for the disabled (part of ANZSIC 8790)
- Other social assistance services (incl elderly, marriage and adoption services) (part of ANZSIC 8790). Also referred to as community disabled care.

The ABS publishes data on residential care from various sources, summarised in Table 8.14 below. The data are published in respect of various years, for differing purposes and using differing methodologies. Differences between data derived from industry surveys (Community services, ABS 2010 (Cat. no. 8696); Input output product details, ABS 2016 (Cat. no. 5215)) and data based on household surveys of employment (Census, ABS 2011; Labour Force detailed quarterly, ABS 2016 (Cat. no. 6291)) are well known (Connolly et al 2016) yet there are also differences between the two sources of industry data, and the two sources of employment data. Some differences are probably legitimate, for example, other social assistance may account for a high proportion of employment (as suggested by census and labour force data) relative to production or value added (as suggested by input-output) because it is a relatively labour-intensive activity.

None of the ABS sources enabled other social assistance services for the disabled to be identified separately.

The Community Services data is probably the highest quality, being part of an annual program of surveys targeting the services sector of the economy. The estimate of total employment from this survey has a relative standard error of 0.5 per cent, meaning that it is highly accurate. However, the data from this survey are for 2008-09 and are now more than seven years out of date.

The Input-output product details publication contains data supplementary to the main input-output tables. The input output product classification (IOPD) comprises over 900 product categories, including five categories in RCSA, making it the most detailed data source. IOPD is the only data source to classify residential care services for the disabled separately from other residential care services (incl mental health, illnesses or substance abuse) nec. The IOPD data is compiled from various data sources and users are advised to “be cautious when considering isolated fragments of the tables, especially details at the product level and or when looking at the supply or use of products that may be related to an activity or industry but are being analysed

Table 8.14: ABS data sources for the residential care and social assistance sector

	Community Services (ABS cat. no. 8696)	Community Services (ABS cat. no. 8696)	Census of population and housing	Input output product details (ABS cat. no. 5215)	Labour force (ABS cat. no. 6291) and VUEF
Year	2008-09	2008-09	2011	2013-14	2016
Measure	value added	employment	employment	production	employment
Proportions					
Aged Care	0.48	0.44	0.37	0.53	*0.26
Residential Disabled Care	*0.04	*0.04	*0.02	0.11	*0.05
Other Residential	*0.03	*0.03	*0.02	0.09	*0.04
Child Care	0.19	0.2	0.23	0.12	0.25
Other Social Assistance (disabled and other)	0.27	0.28	0.36	0.15	0.39

* data split based on input-output product details data

outside the economic structure of the I–O tables” (ABS 2016). The IOPD data for the share of residential care (aged, disabled and other) in total RCSA is much larger than the share suggested by any other data source. Correspondingly, the shares for child care and other social assistance are much smaller, and inconsistent with some occupation data. For example, if we apply the IOPD share for childcare to the disaggregation of the RCSA sector, the child care sector would be too small to employ all of the workers in the occupation “child carer” as reported in the labour market statistics.

The census data is subject to no sampling error and is available at the ANZSIC class level (in which the RCSA categories are aged care, other residential care, child care, and other social assistance). The size and nature of the census means that it is likely to be subject to non-sampling error, such as householders incorrectly identifying their industry of employment. One advantage of the census is that it also provides a breakdown of industry employment by detailed occupation. The LMQ/VUEF data is taken from the CoPS VUEF database (J.Dixon 2016). This data makes use of the latest labour market quarterly data (ABS 2016), which is the most up-to-date data source available. Industry employment is published at the ANZSIC group level. At this level, RCSA comprises three categories: residential care (ANZSIC 860), child care (ANZSIC 871), and other social assistance (ANZSIC 879). In Table 1, VUEF residential care is split into aged, disabled, and other care according to the IOPD data. Like census, VUEF includes a breakdown of industry employment by detailed occupation. This is estimated using LMQ data on employment by detailed occupation, census data, and the dynamic Vic-Uni CGE model.

Non-ABS data

Sources of data other than the ABS were used to derive the final split of the RCSA category. Data on aged care was obtained from the Aged Care Financing Authority (ACFA 2015). This data was supplemented with IBIS World data (IBIS World 2016) on retirement villages. Although

identified separately in Table 2 below, social assistance for the aged is included in other social assistance in the final model database.

Data on the other sectors was built up from estimates of government and private expenditure. Data on government-funded social assistance, including services for the disabled, was taken from the Productivity Commission's Report on Government Services (PC 2015). Private expenditure on child care is derived from NATSEM (2014) and other estimates of private expenditure, which are small, are provided by NDIS. These estimates, all in respect of 2013-14, were projected forward to 2015-16 on the basis of growth in employment in the corresponding ANZSIC classes. According to this method, total expenditure on disabled services (residential and social assistance for the disabled) was estimated to be \$8.65 billion in 2015-16.

Table 8.15: Non-ABS estimates of RCSA activity

	Estimated revenue, 2013-14 (\$b)			Estimated revenue, 2015-16 (\$b)	Adjusted proportion (%)
	Gov	Priv	Total		
Residential care					
– Aged care (including retirement villages)	n.a.	n.a.	18	18.4	36.4
– Disability care	3.8	0.5	4.3	4.4	8.8
– Other (e.g. homelessness)	0.7	0	0.7	0.7	1.4
Social Assistance					
– Aged care(Home care and HACC)	n.a.	n.a.	3.1	3.4	6.7
– Disability care	3.7	0.2	3.9	4.3	8
– Child care	7.7	6.8	14.5	16	29.8
– Other	4	0.2	4.2	4.6	8.6
TOTAL	n.a.	n.a.	48.7	51.8	100

Total expenditure on RCSA activities in the Vic-Uni input-output database is slightly higher than the total derived above. Expenditure on disabled care was kept at the estimated level and expenditure on the remaining RCSA activities was adjusted slightly, which is reflected in the adjusted proportions in the final column of Table 8.15.

Occupational disaggregation

The occupational disaggregation for the six RCSA sectors in the amended Vic-Uni model database is based on VUEF data. VUEF includes detailed occupational employment data at the 3-digit ANZSIC level, that is, for residential care services (ANZSIC 861), child care services (ANZSIC 871) and other social assistance (ANZSIC 879).

A simple method is used to estimate occupational shares for the six RCSA industries. First, the occupational shares for each three digit ANZSIC are mapped onto the corresponding detailed sectors. For example, the occupational shares from residential care services (ANZSIC 861) are applied to each of aged care, disabled residential care, and other residential care. Second, some adjustments are made. The main adjustment is that other social assistance for the disabled is assumed to employ a larger proportion of personal carers and assistants than the remaining

other social assistance activities. To accommodate this, other social assistance for the disabled is assumed to employ a smaller proportion of other occupations, in particular, social and welfare professionals.

The NDIS activity

A dummy industry “NDIS” was added to the database. The purpose of this industry is to create a single NDIS commodity which is purchased by households. The NDIS industry purchases a bundle of goods representative of NDIS expenditure, and sells all of its output to the household sector. Household expenditure on the relevant input-output activities is reduced and instead assigned to household expenditure on the NDIS bundle.

Total expenditure on NDIS activities (as yet not formally administered as part of the scheme) in 2017-18, based on earlier NDIA estimates, is almost \$14 billion. The NDIS bundle is assumed to consist of 100 per cent of the national supply of residential care and social assistance for the disabled, and expenditure on various other goods and services including administration of the scheme. Each expenditure item is assigned to an input-output activity in the model database, as listed in Table 8.16 below.

Table 8.16: Composition of the NDIS bundle

Activity	Estimated expenditure (\$m) 2015-16	Corresponding input-output activity
Residential care	6028	Residential care for the disabled
Other social assistance	2628	Other social assistance for the disabled
Administration	1218	Public administration
Assistive technology	808	Professional, Scientific, Computer and Electronic Equipment Manufacturing
Allied health services	2462	Health Care Services
Transport services	390	Road Transport
Home modifications	222	Construction Services
Total	13756	

SA3 codes and regions

x10102	Queanbeyan	Queanbeyan
x10103	SnowyMnts	Snowy Mountains
x10104	SouthCoast	South Coast
x10105	GoulburnNSW	Goulburn
x10106	YassYoungNSW	Yass - Young
x10201	Gosford	Gosford
x10202	Wyang	Wyang
x10301	Bathurst	Bathurst
x10302	LachlanVlley	Lachlan Valley
x10303	LithgwMudgee	Lithgow - Mudgee
x10304	Orange	Orange
x10401	ClarenceVlly	Clarence Valley
x10402	CoffsHrbrNSW	Coffs Harbour
x10501	BrkCbrCnbNSW	Bourke - Cobar - Coonamble
x10502	BrokenHilNSW	Broken Hill and Far West
x10503	DubboNSW	Dubbo
x10601	LwrHunterNSW	Lower Hunter
x10602	MaitlandNSW	Maitland
x10603	PtStephnsNSW	Port Stephens
x10604	UprHunterNSW	Upper Hunter
x10701	DaptoPtKmbra	Dapto - Port Kembla
x10703	KiamaShlHNSW	Kiama - Shellharbour
x10704	Wollongong	Wollongong
x10801	GrtLakesNSW	Great Lakes
x10802	KmpsyNmbcNSW	Kempsey - Nambucca
x10803	LordHoweIs	Lord Howe Island
x10804	PtMcquarieNSW	Port Macquarie
x10805	TreeGlstrNSW	Taree - Gloucester
x10901	AlburyNSW	Albury
x10902	LwrMurrayNSW	Lower Murray
x10903	UprMurrayNSW	Upper Murray exc. Albury
x11001	ArmidaleNSW	Armidale
x11002	InvrITntrNSW	Inverell - Tenterfield
x11003	MreeNaribNSW	Moree - Narrabri
x11004	TamwrthGnNSW	Tamworth - Gunnedah
x11101	LakeMacqENSW	Lake Macquarie - East
x11102	LakeMacqWNSW	Lake Macquarie - West
x11103	NewcastleNSW	Newcastle
x11201	RichValCsNSW	Richmond Valley - Coastal
x11202	RichValHnNSW	Richmond Valley - Hinterland
x11203	TweedValNSW	Tweed Valley
x11301	GrffthMrmNSW	Griffith - Murrumbidgee (West)
x11302	TumutTumbNSW	Tumut - Tumbarumba
x11303	WaggaNSW	Wagga Wagga
x11401	Shoalhaven	Shoalhaven
x11402	SthHighldNSW	Southern Highlands
x11501	BaulkhamHills	Baulkham Hills
x11502	DuralWiseNSW	Dural - Wisemans Ferry
x11503	Hawkesbury	Hawkesbury
x11504	RouseMcGrath	Rouse Hill - McGraths Hill

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x11601	BlacktownNSW	Blacktown
x11602	BlacktownNth	Blacktown - North
x11603	MountDruitt	Mount Druitt
x11701	Botany	Botany
x11702	MarrckvSydPe	Marrickville - Sydenham - Petersham
x11703	SydneyInnerC	Sydney Inner City
x11801	ESubNorth	Eastern Suburbs - North
x11802	ESubSouth	Eastern Suburbs - South
x11901	Bankstown	Bankstown
x11902	Canterbury	Canterbury
x11903	Hurstville	Hurstville
x11904	KogrhRckdale	Kogarah - Rockdale
x12001	CanadaBay	Canada Bay
x12002	Leichhardt	Leichhardt
x12003	StrfdBwdAshf	Strathfield - Burwood - Ashfield
x12101	ChtswdLaneCv	Chatswood - Lane Cove
x12102	Hornsby	Hornsby
x12103	Kuringgai	Ku-ring-gai
x12104	NthSydneyMsmn	North Sydney - Mosman
x12201	ManlyNSW	Manly
x12202	Pittwater	Pittwater
x12203	Warringah	Warringah
x12301	Camden	Camden
x12302	CampbltwnNSW	Campbelltown (NSW)
x12303	Wollondilly	Wollondilly
x12401	BlueMntains	Blue Mountains
x12403	Penrith	Penrith
x12404	RichWindsNSW	Richmond - Windsor
x12405	StMarysNSW	St Marys
x12501	Auburn	Auburn
x12502	Carlingford	Carlingford
x12503	MrylndGldfrd	Merrylands - Guildford
x12504	Parramatta	Parramatta
x12601	PennantEppng	Pennant Hills - Epping
x12602	RydeHntrsHill	Ryde - Hunters Hill
x12701	BringllyGrnV	Bringelly - Green Valley
x12702	Fairfield	Fairfield
x12703	Liverpool	Liverpool
x12801	CrnllaMirCar	Cronulla - Miranda - Caringbah
x12802	SuthMenHeath	Sutherland - Menai - Heathcote
x20101	BallaratVic	Ballarat
x20102	CresDylBlBic	Creswick - Daylesford - Ballan
x20103	MaryPyrVic	Maryborough - Pyrenees
x20201	BendigoVic	Bendigo
x20202	HthClmKynVic	Heathcote - Castlemaine - Kyneton
x20203	LoddonVic	Loddon - Elmore
x20301	BarwonWstVic	Barwon - West
x20302	GeelongVic	Geelong
x20303	SurfCstBPVic	Surf Coast - Bellarine Peninsula
x20401	UpGolbValVic	Upper Goulburn Valley
x20402	WangarattVic	Wangaratta - Benalla
x20403	WodongaVic	Wodonga - Alpine

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x20501	BawBawVic	Baw Baw
x20502	GippslndEVic	Gippsland - East
x20503	GippslndSWVi	Gippsland - South West
x20504	LatrobeVIVic	Latrobe Valley
x20505	WellngtonVic	Wellington
x20601	BrunswickVic	Brunswick - Coburg
x20602	DarebinSVic	Darebin - South
x20603	EssendonVic	Essendon
x20604	MelbCityVic	Melbourne City
x20605	PortPhlipVic	Port Phillip
x20606	StonngtonVic	Stonnington - West
x20607	YarraVic	Yarra
x20701	BoroondarVic	Boroondara
x20702	ManngnhamVic	Manningham - West
x20703	WhitehrsWVic	Whitehorse - West
x20801	BaysidMlbVic	Bayside
x20802	GlenEiraVic	Glen Eira
x20803	KingstonVic	Kingston
x20804	StonngtnEVic	Stonnington - East
x20901	BanyuleVic	Banyule
x20902	DarebinNVic	Darebin - North
x20903	NllmbkKLVic	Nillumbik - Kinglake
x20904	WhittleseaVic	Whittlesea - Wallan
x21001	KeilorVic	Keilor
x21002	MacedonVic	Macedon Ranges
x21003	MorelandNVic	Moreland - North
x21004	SunburyVic	Sunbury
x21005	TullaBrdMVic	Tullamarine - Broadmeadows
x21101	KnoxVic	Knox
x21102	ManngnhamEVic	Manningham - East
x21103	MaroondahVic	Maroondah
x21104	WhitehrsEVic	Whitehorse - East
x21105	YarraRngVic	Yarra Ranges
x21201	CardiniaVic	Cardinia
x21202	CaseyNthVic	Casey - North
x21203	CaseySthVic	Casey - South
x21204	DandenongVic	Dandenong
x21205	MonashVic	Monash
x21601	BrimbankVic	Brimbank
x21602	HobsonBayVic	Hobsons Bay
x21603	Maribyrnong	Maribyrnong
x21604	MeltonBacVic	Melton - Bacchus Marsh
x21605	WyndhamVic	Wyndham
x21401	FrankstonVic	Frankston
x21402	MornngPenVic	Mornington Peninsula
x21501	GrampiansVic	Grampians
x21502	MilduraVic	Mildura
x21503	MurRivSwnHil	Murray River - Swan Hill
x21601	CampaspeVic	Campaspe
x21602	MoirVic	Moir
x21603	SheppartnVic	Shepparton
x21701	GlenSGrmpVic	Glenelg - Southern Grampians

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x21703	ColacCorVic	Colac - Corangamite
x21704	WarrnmbiVic	Warrnambool - Otway Ranges
x30101	CapalabaQld	Capalaba
x30102	ClevelandStrd	Cleveland - Stradbroke
x30103	WynnumManly	Wynnum - Manly
x30201	BaldHIEvPark	Bald Hills - Everton Park
x30202	ChermsideQld	Chermside
x30203	NundahQld	Nundah
x30204	SandgateQld	Sandgate
x30301	CarindaleQld	Carindale
x30302	HollandPkYrg	Holland Park - Yeronga
x30303	MtGravattQld	Mt Gravatt
x30304	NathanQld	Nathan
x30305	RockleaAcQld	Rocklea - Acacia Ridge
x30306	SunnybankQld	Sunnybank
x30401	CentenaryQld	Centenary
x30402	KenBrookMogg	Kenmore - Brookfield - Moggill
x30403	SherIndoorpy	Sherwood - Indooroopilly
x30404	TheGapEnogra	The Gap - Enoggera
x30501	BrisbaneInnr	Brisbane Inner
x30502	BrisbaneInnE	Brisbane Inner - East
x30503	BrisbaneInnN	Brisbane Inner - North
x30504	BrisbaneInnW	Brisbane Inner - West
x30601	CairnsNthQld	Cairns - North
x30602	CairnsSthQld	Cairns - South
x30603	InnsCasCsQld	Innisfail - Cassowary Coast
x30604	PtDougDaintr	Port Douglas - Daintree
x30605	TablndEQld	Tablelands (East) - Kuranda
x30701	DarlDMrnoQld	Darling Downs (West) - Maranoa
x30702	DarlDwnEQld	Darling Downs - East
x30703	GranitBltQld	Granite Belt
x30801	CentHlndQld	Central Highlands (Qld)
x30803	RockhmptnQld	Rockhampton
x30804	BiloelaQld	Biloela
x30805	GladstoneQld	Gladstone
x30901	BroadbchBurl	Broadbeach - Burleigh
x30902	Coolangatta	Coolangatta
x30903	GoldCstNQld	Gold Coast - North
x30904	GldCstHntQld	Gold Coast Hinterland
x30905	MudgrabaTall	Mudgeeraba - Tallebudgera
x30906	NerangQld	Nerang
x30907	OrmeauOxnfrd	Ormeau - Oxenford
x30908	RobinaQld	Robina
x30909	SouthportQld	Southport
x30910	SurfersPrQld	Surfers Paradise
x31001	ForestLkOxly	Forest Lake - Oxley
x31002	IpswchHintld	Ipswich Hinterland
x31003	IpswichInner	Ipswich Inner
x31004	SprngfldRdbk	Springfield - Redbank
x31101	Beauesert	Beauesert
x31102	BeenleighQld	Beenleigh
x31103	BrownsPlains	Browns Plains

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x31104	Jimboomba	Jimboomba
x31105	LgnleaCarbrk	Loganlea - Carbrook
x31106	SprngwdKgstn	Springwood - Kingston
x31201	BowenBasQld	Bowen Basin - North
x31202	MackayQld	Mackay
x31203	WhitsundyQld	Whitsunday
x31301	BribieBchmre	Bribie - Beachmere
x31302	CabooltureQld	Caboolture
x31303	CabltureHint	Caboolture Hinterland
x31304	NarangbaBrp	Narangba - Burpengary
x31305	RedcliffeQld	Redcliffe
x31401	HillsMBSQld	Hills District
x31402	NthLakeQld	North Lakes
x31403	StrthpineQld	Strathpine
x31501	FarNorthQld	Far North
x31502	OutbackNQld	Outback - North
x31503	OutbackSQld	Outback - South
x31601	BuderimQld	Buderim
x31602	CaloundraQld	Caloundra
x31603	MaroochyQld	Maroochy
x31605	NoosaQld	Noosa
x31606	SunCstHntQld	Sunshine Coast Hinterland
x31607	NambourQld	Nambour
x31608	NoosaHntQld	Noosa Hinterland
x31701	ToowoombaQld	Toowoomba
x31801	ChrTowAyrQld	Charters Towers - Ayr - Ingham
x31802	TownsvillQld	Townsville
x31901	BundabergQld	Bundaberg
x31902	BurnettQld	Burnett
x31903	GympiCoolQld	Gympie - Cooloola
x31904	HerveyBayQld	Hervey Bay
x31905	MarybrghQld	Maryborough
x40101	AdelaideSA	Adelaide City
x40102	AdelaideHill	Adelaide Hills
x40103	BurnsideSA	Burnside
x40104	CampbltwnSA	Campbelltown (SA)
x40105	NwdPayneham	Norwood - Payneham - St Peters
x40106	PrspctWklvSA	Prospect - Walkerville
x40107	UnleySA	Unley
x40201	GawlerSA	Gawler - Two Wells
x40202	PlayfordSA	Playford
x40203	PtAdelaideE	Port Adelaide - East
x40204	SalisburySA	Salisbury
x40205	TeaTreeGlySA	Tea Tree Gully
x40301	HoldfastBay	Holdfast Bay
x40302	MarionSA	Marion
x40303	MitchamSA	Mitcham
x40304	Onkaparinga	Onkaparinga
x40401	CharlesSrtSA	Charles Sturt
x40402	PtAdelaideW	Port Adelaide - West
x40403	WestTorrnsSA	West Torrens
x40501	BarossaSA	Barossa

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x40502	LwrNorthSA	Lower North
x40503	MidNorthSA	Mid North
x40504	YorkePenSA	Yorke Peninsula
x40601	EyrePeninSA	Eyre Peninsula and South West
x40602	OutbackSA	Outback - North and East
x40701	FleurieuKISA	Fleurieu - Kangaroo Island
x40702	LimestnCstSA	Limestone Coast
x40703	MurMalleeSA	Murray and Mallee
x50101	AugustaMarg	Augusta - Margaret River - Busselton
x50102	BunburyWA	Bunbury
x50103	ManjimupWA	Manjimup
x50201	Mandurah	Mandurah
x50301	CottesloeClr	Cottesloe - Claremont
x50302	PerthCity	Perth City
x50401	BaysBssndean	Bayswater - Bassendean
x50402	Mundaring	Mundaring
x50403	SwanWA	Swan
x50501	Joondalup	Joondalup
x50502	StirlingWA	Stirling
x50503	Wanneroo	Wanneroo
x50601	ArmadaleWA	Armadale
x50602	BelmntVicPWA	Belmont – Victoria Park
x50603	Canning	Canning
x50604	Gosnells	Gosnells
x50605	KalamundaWA	Kalamunda
x50606	SerpentinJa	Serpentine - Jarrahdale
x50607	SouthPerth	South Perth
x50701	CockburnWA	Cockburn
x50702	FremantleWA	Fremantle
x50703	KwinanaWA	Kwinana
x50704	MelvilleWA	Melville
x50705	RockinghamWA	Rockingham
x50901	AlbanyWA	Albany
x50902	WheatBltnWA	Wheat Belt - North
x50903	WheatBltnSWA	Wheat Belt - South
x51001	KimberleyWA	Kimberley
x51002	EastPilbara	East Pilbara
x51003	PilbaraWA	Pilbara
x51101	EsperanceWA	Esperance
x51102	GascoyneWA	Gascoyne
x51103	GoldfieldsWA	Goldfields
x51104	MidWestWA	Mid West
x60101	Brighton	Brighton
x60102	HobartNEast	Hobart - North East
x60103	HobartNWest	Hobart - North West
x60104	HobartSthWst	Hobart - South and West
x60105	HobartInner	Hobart Inner
x60106	SorellDodges	Sorell - Dodges Ferry
x60201	Launceston	Launceston
x60202	MeanderTamar	Meander Valley - West Tamar
x60203	NorthEastTas	North East
x60301	CentHighTas	Central Highlands (Tas.)

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x60302	HuonBruny	Huon - Bruny Island
x60303	SECoastTas	South East Coast
x60401	BurnieUlvers	Burnie - Ulverstone
x60402	Devonport	Devonport
x60403	WestCoastTas	West Coast
x70101	DarwinCity	Darwin City
x70102	DarwinSuburb	Darwin Suburbs
x70103	Litchfield	Litchfield
x70104	Palmerston	Palmerston
x70201	AliceSprings	Alice Springs
x70202	Barkly	Barkly
x70203	DalyTiwiWArn	Daly - Tiwi - West Arnhem
x70204	EastArnhem	East Arnhem
x70205	Katherine	Katherine
x80101	Belconnen	Belconnen
x80103	CanberraEast	Canberra East
x80104	Gungahlin	Gungahlin
x80105	NthCanberra	North Canberra
x80106	SthCanberra	South Canberra
x80107	Tuggeranong	Tuggeranong
x80108	WestonCreek	Weston Creek
x80109	Woden	Woden
x80110	Molonglo	Molonglo
x80111	UrriarNamdgi	Urriara - Namadgi

Maps of VU-TERM master database regions

Figure 8.6: Map of SA3 regions excluding detail in metropolitan areas

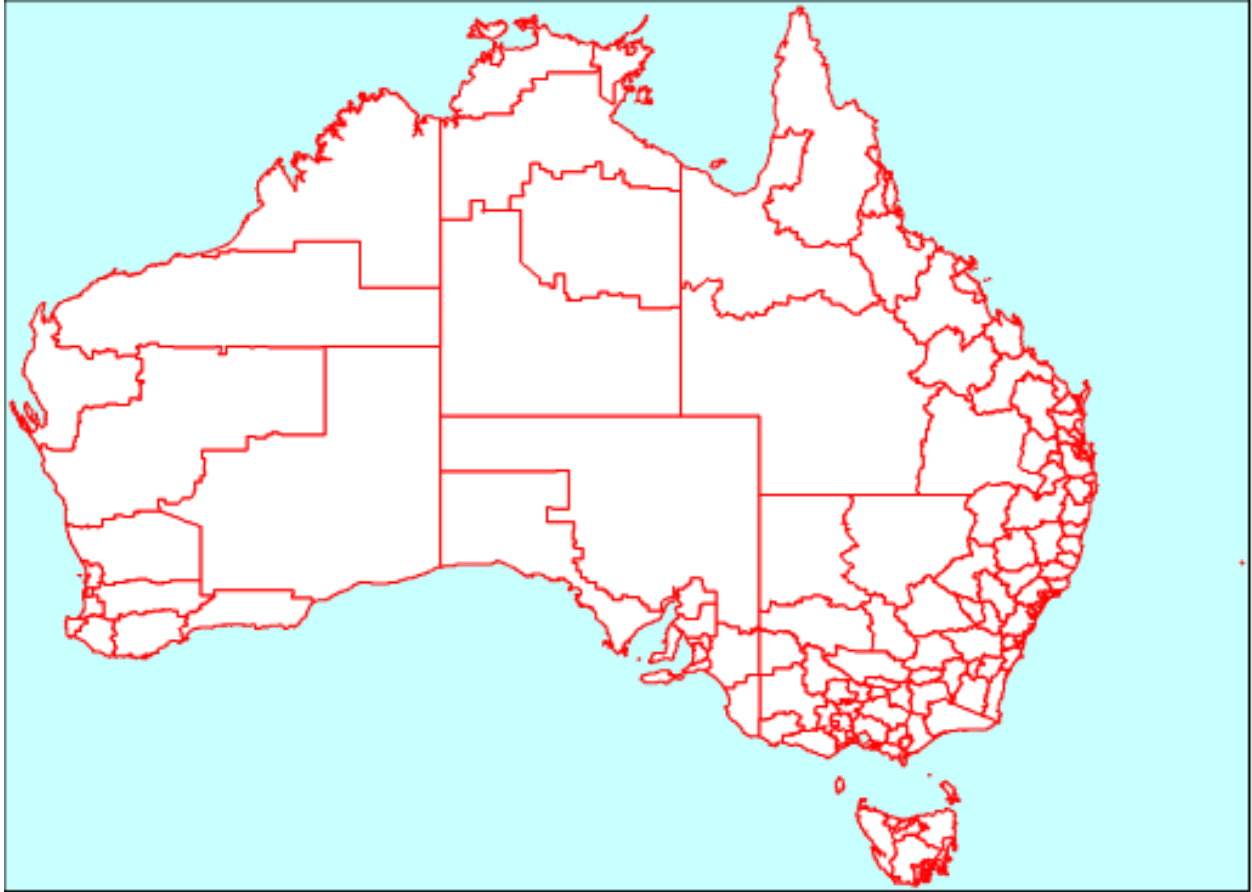
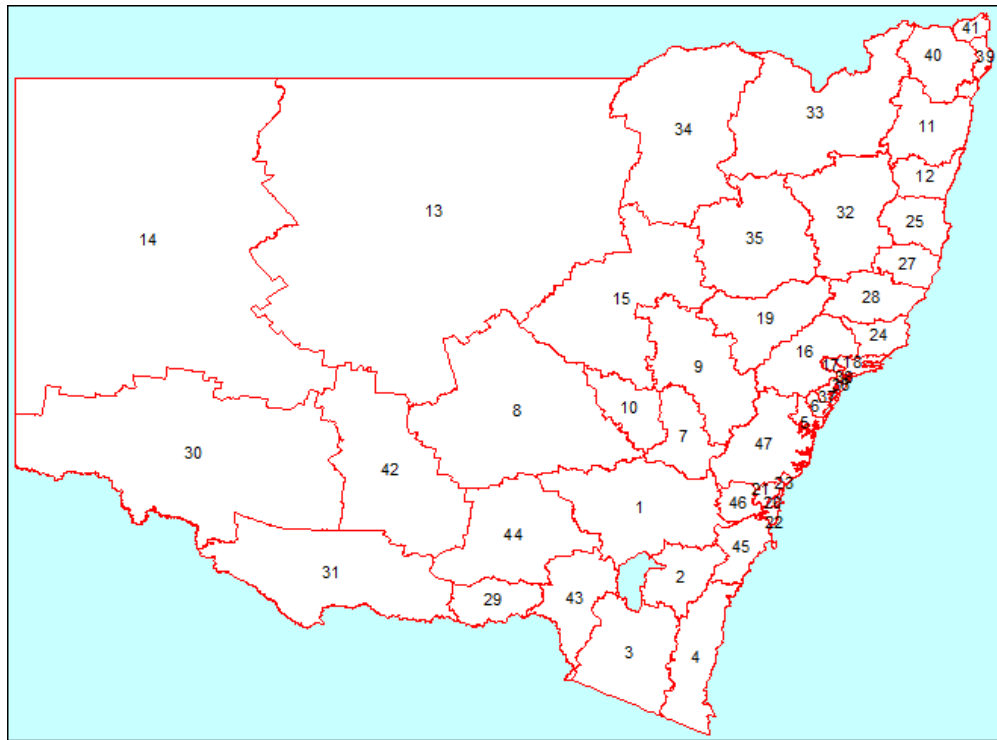


Figure 8.7: Map of NSW SA3 regions excluding metropolitan detail



SA3 regions in NSW

1	GoulburnYass	17	MaitlandNSW	33	InvrlTntrNSW
2	Queanbeyan	18	PtStephnsNSW	34	MreeNaribNSW
3	SnowyMnts	19	UprHunterNSW	35	TamworthNSW
4	SouthCoast	20	DaptoPtKmbla	36	LakeMacqENSW
5	Gosford	21	IllaCatchNSW	37	LakeMacqWNSW
6	Wyong	22	KiamaShlHNSW	38	NewcastleNSW
7	Bathurst	23	Wollongong	39	RichValCsNSW
8	LachlanVlley	24	GrtLakesNSW	40	RichValHnNSW
9	LithgwMudgee	25	KmpsyNmbsNSW	41	TweedValNSW
10	Orange	26	LordHoweIs	42	GrffthMrmNSW
11	ClarenceVlly	27	PtMcquarieNSW	43	TumutNSW
12	CoffsHrbrNSW	28	TreeGlstrNSW	44	WaggaNSW
13	BrkCbrCnbNSW	29	AlburyNSW	45	Shoalhaven
14	BrokenHilNSW	30	LwrMurrayNSW	46	SthHighldNSW
15	DubboNSW	31	UprMurrayNSW	47	SydneyALL (composite)
16	LwrHunterNSW	32	ArmidaleNSW		

Figure 8.8: Map of Sydney's SA3 regions



* Blue Mountains South is combined with Blue Mountains in VU-TERM, as the region only had 6 residential workers in the 2016 census.

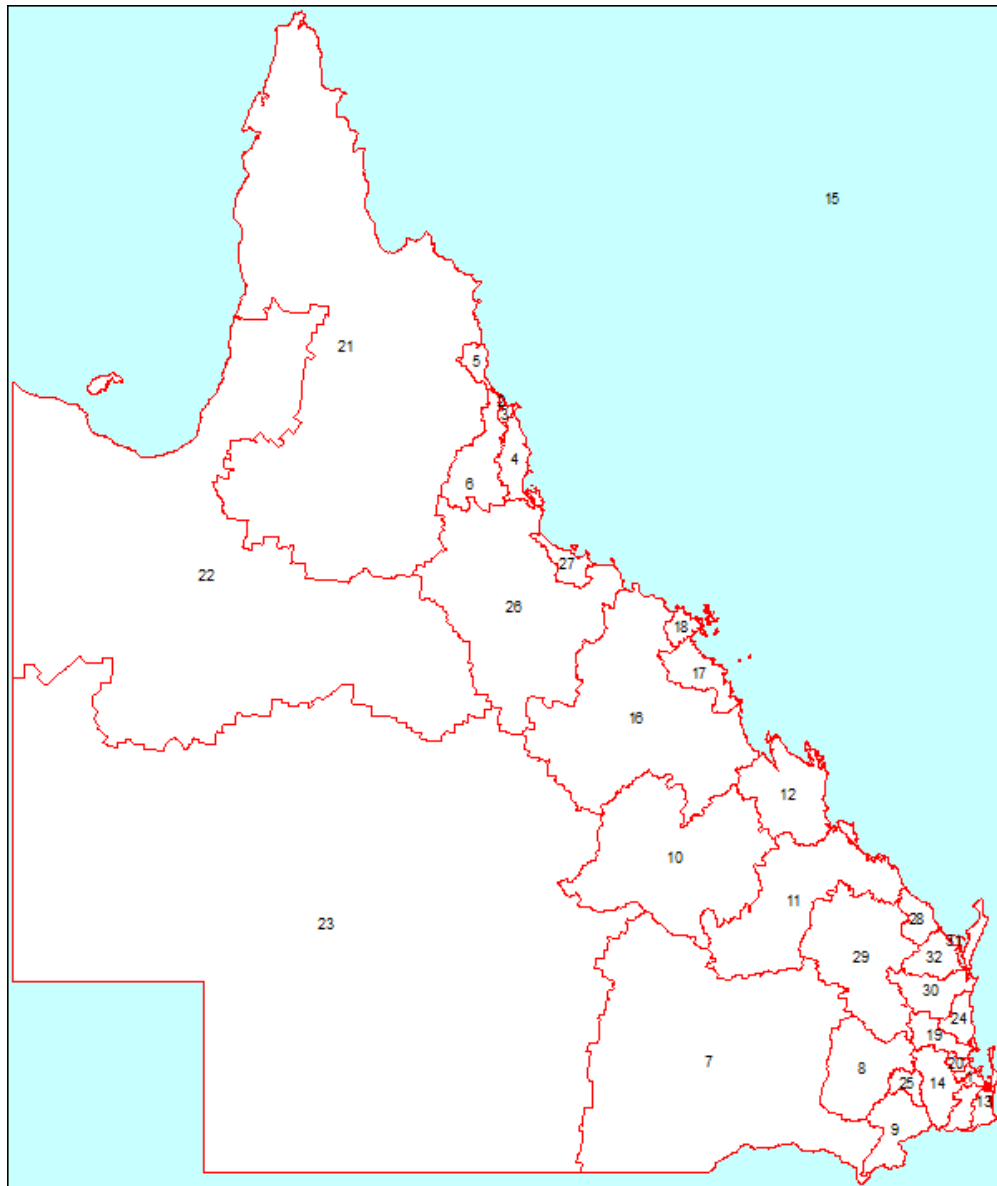
Figure 8.9: Map of Victoria's SA3 regions excluding metropolitan detail



Figure 8.10: Melbourne's SA3 regions



Figure 8.11: Map of Queensland's SA3 regions excluding metropolitan detail & selected SA4s



1	BrisbaneALL	9	GranitBltQld	17	MackayQld	25	ToowoombaQld
2	CairnsNthQld	10	CentHlndQld	18	WhitsundyQld	26	ChrTowAyrQld
3	CairnsSthQld	11	GladstnBIQld	19	MoretonNSA4	27	TownsvillQld
4	InnsCasCsQld	12	RockhmptnQld	20	MoretonSSA4	28	BundabergQld
5	PtDougDaintr	13	GoldCoastSA4	21	FarNorthQld	29	BurnettQld
6	TablndEQld	14	IpswichSA4	22	OutbackNQld	30	GympiCoolQld
7	DarlDMrnoQld	15	LoganBeaDSA4	23	OutbackSQld	31	HerveyBayQld
8	DarlDwnEQld	16	BowenBasQld	24	SunshnCstSA4	32	MarybrghQld

Figure 8.12: Brisbane's SA3 regions



Figure 8.13: Gold Coast's SA3 regions

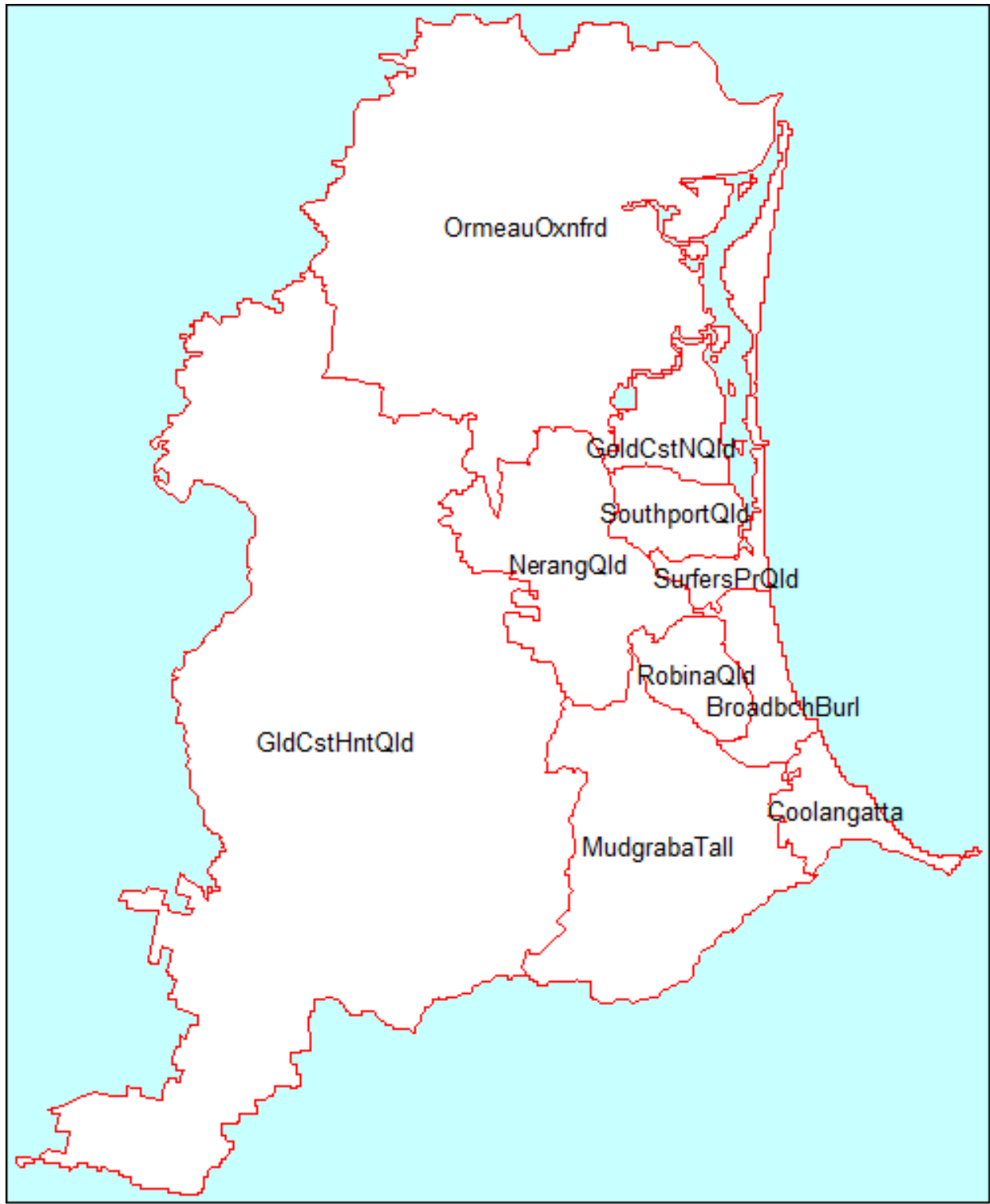


Figure 8.14: SE Queensland's SA3 regions

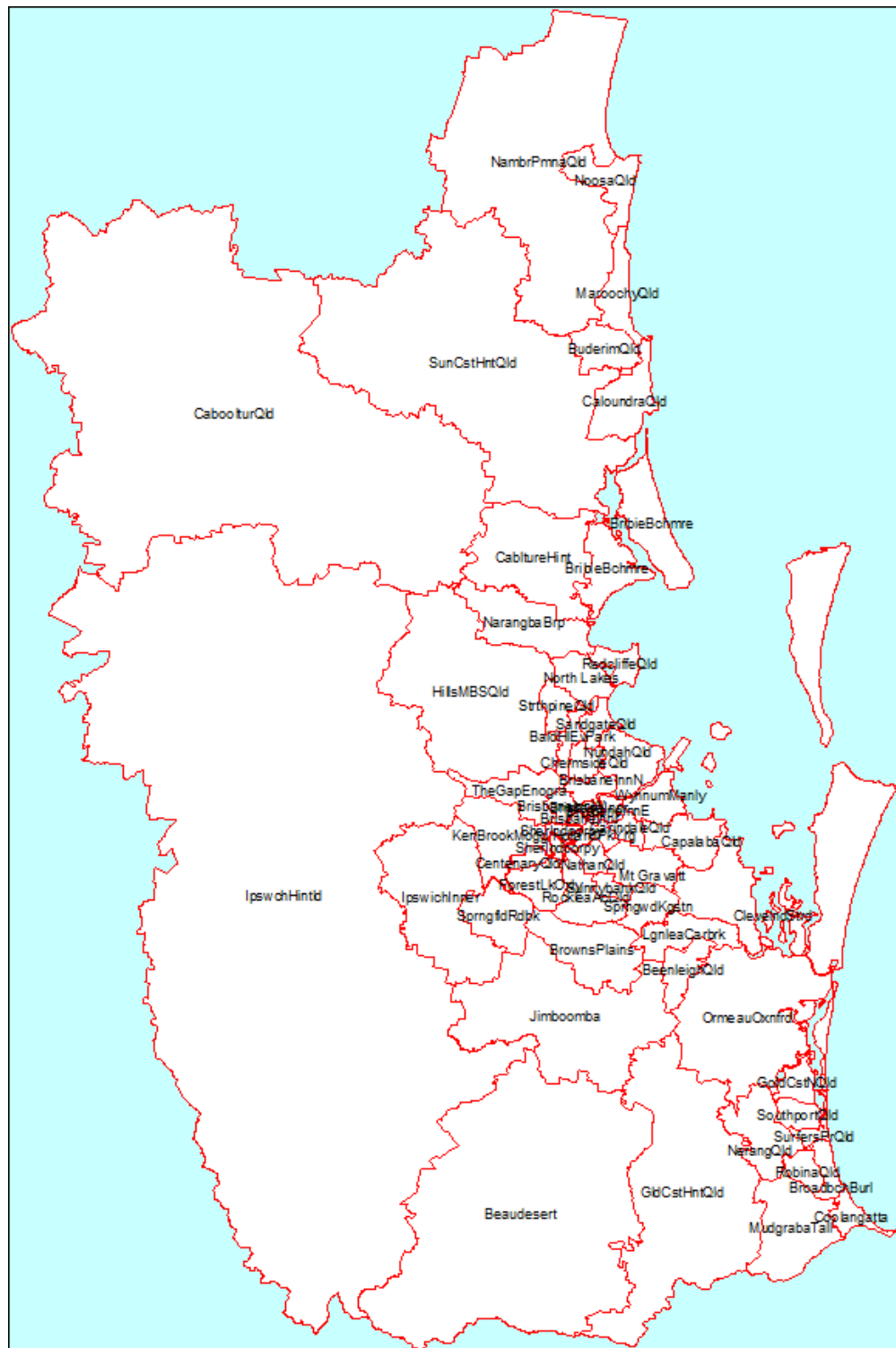


Figure 8.15: Map of South Australia's SA3 regions excluding metropolitan detail



Figure 8.16: Adelaide’s SA3 regions



Figure 8.17: Map of Western Australia's SA3 regions excluding metropolitan detail

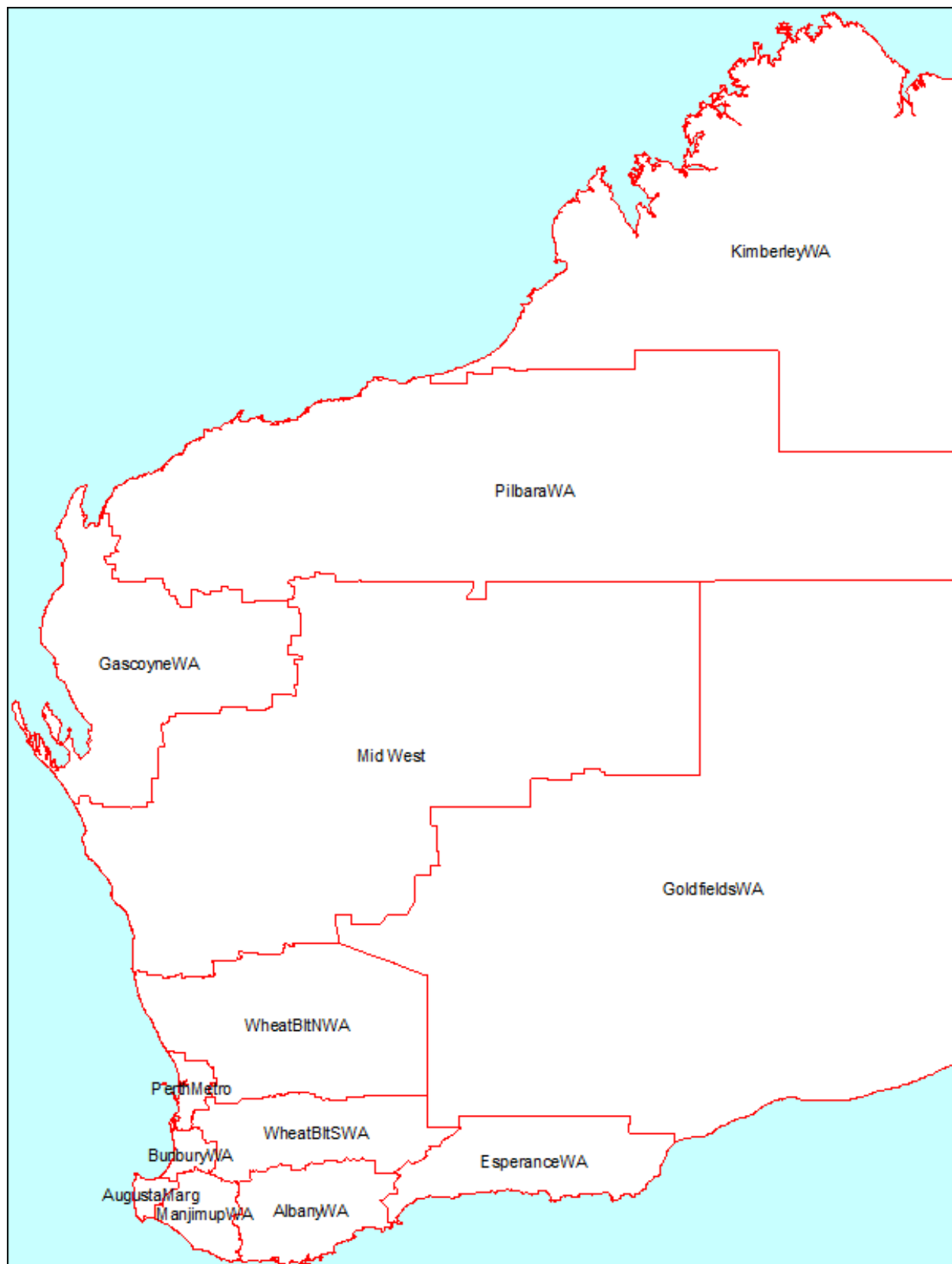


Figure 8.19: Map of Tasmania's SA3 regions

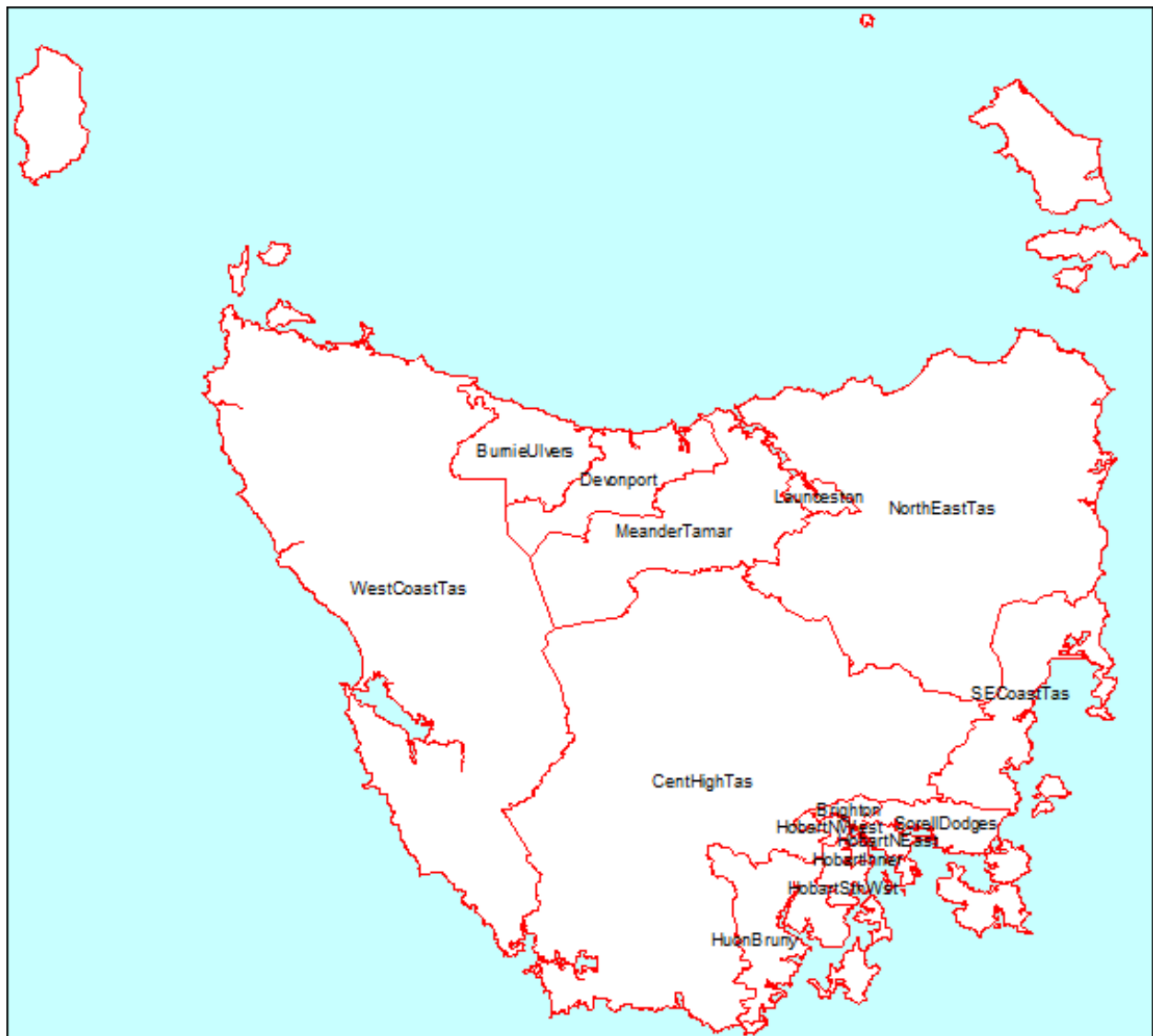
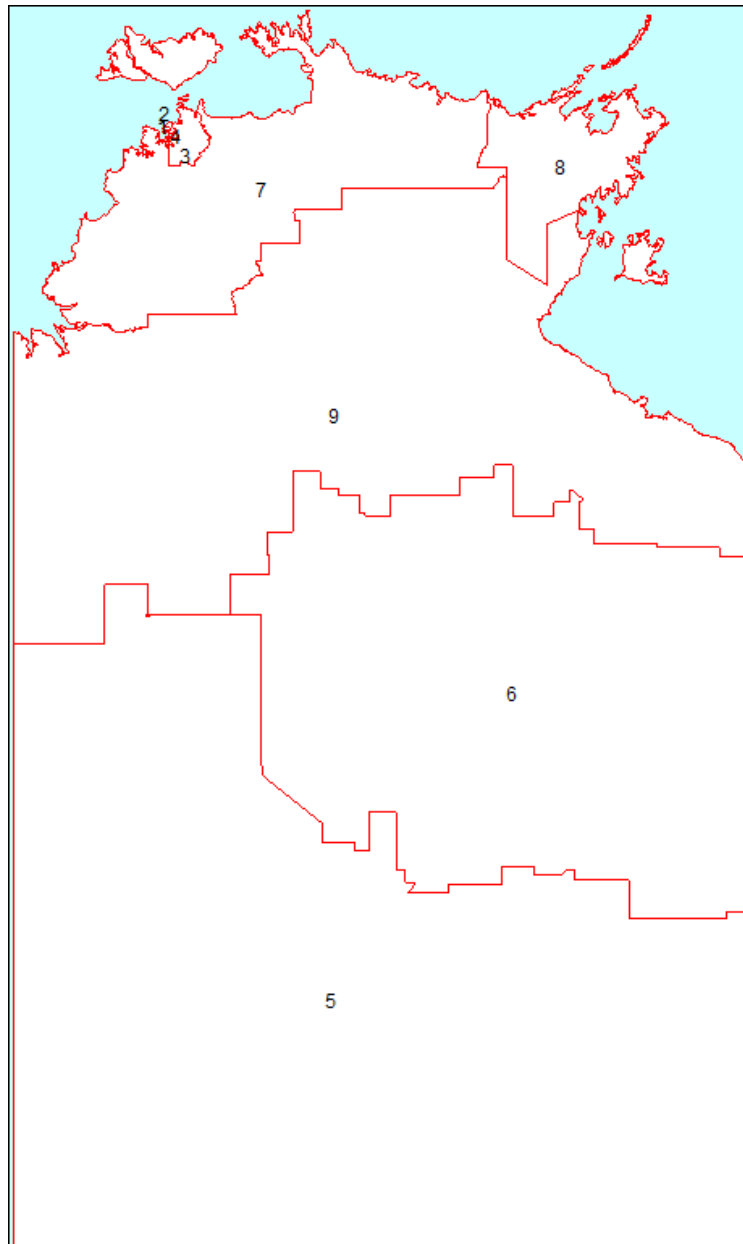


Figure 8.20: Map of Northern Territory's SA3 regions



1	DarwinCity	6	Barkly
2	DarwinSuburb	7	DalyTiwiWArn
3	Litchfield	8	EastArnhem
4	Palmerston	9	Katherine
5	AliceSprings		