

# AusLCI

The Australian Life Cycle Inventory Database Initiative



# AusLCI database manual

Timothy Grant

Version 1.39

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Version	Date	Author/ Contributor	Comment
1.0	21 <sup>st</sup> November 2014	Timothy Grant	First official release document
1.1	4 <sup>th</sup> March 2015	Rob Rouwette, Suphunnika Ibbotson and Tim Grant	Edit of original document
1.2	4 <sup>th</sup> August 2015	Bharat Sharma and Tim Grant	Added concrete processes
1.3	20 <sup>th</sup> April 2016	Tim Grant	Added Asphalt and geopolymers data
1.26	30 <sup>th</sup> September 2016	Tim Grant	Corrections to Ecoinvent documented. Report numbering changed to match database numbering
1.27	05 May 2017	Timothy Grant	Minor fixes to waste treatment landfill processes
2.27	24 <sup>th</sup> March 2017	Paul-Antoine Bontinck	Update of the shadow database to ecoinvent 3.3
X.28	March 2019	Timothy Grant	400 new agriculture processes Updated electricity, warm asphalt
X.29	19 <sup>th</sup> June 2019	Timothy Grant	Recalibrate electricity processes to be NGA compliant
X.30	16 <sup>th</sup> Sept 2019	Timothy Grant	Diesel and Natural Gas Energy processes added based on NGGI and NPI workbooks
X.31	10 Dec 2019	Timothy Grant	Future electricity grids and NGA compliant natural gas energy processes added.
X.32	18 <sup>th</sup> May 2020	Timothy Grant	232 processes for Australian cattle added including prime beef, culled beef and weaners.
X.33	23 <sup>rd</sup> June 2020	Timothy Grant	Corrected nitrogen balance in broad acre cropping which over estimated N requirements
x.34	26 <sup>th</sup> September 2020	Timothy Grant	Corrected phosphate emission formulae in broad acre crops.
x.35	17 <sup>th</sup> November 2020	Jeremy Macdonald Grant	Corrected heavy metal parameter formulae. Calibrated natural gas supply and electricity generation to 2020 NGA factors.
x.36	26 <sup>th</sup> March 2021	Timothy Grant	Updates and corrections for asphalt data
X.37	16 <sup>th</sup> October 2021	Jeremy Macdonald Grant	Updated electricity to NGA factors results.

X.38	20 <sup>th</sup> May 2022	Timothy Grant	Minor correction to beef inventory data. Fix to incorrect transport unit in waste tyre input to electricity.
X.39	23 <sup>rd</sup> July 2022	Tim Grant Jeremy Macdonald Grant	Silica and silica fume production added. Changes to adjustment approach for electricity inventories being aligned to AusLCI – for South Australia used to be based on changes to efficiency of gas generation – change now to mix between gas and wind to achieve NGA factor alignment.

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# 1 Introduction

## 1.1 Purpose of this document

The purpose of this document is to provide information to users of the database. It will describe the source of data and methodology behind the development of the datasets contained in AusLCI. It also contains a description of how gaps in the AusLCI database have been filled with a shadow database developed fromecoinvent data.

## 1.2 AusLCI project

The Australian National Life Cycle Inventory Database (AusLCI) is a major initiative delivered by the Australian Life Cycle Assessment Society (ALCAS). The aim is to provide and maintain a national, publicly accessible database with easy access to authoritative, comprehensive and transparent environmental information on a wide range of Australian products and services, covering a range of life cycle stages. It is an invaluable tool for those involved in environmental assessment and particularly life cycle assessment (LCA), as it provides consistent guidelines, principles and methodologies for the collection of life cycle inventory (LCI) data, along with protocols for LCA processes for different sectors.

The project has brought together stakeholders from industry, government and academia to develop a methodology to standardise the interpretation of ISO 14040 in Australia. The LCI database enables suppliers to use LCA to reduce environmental impacts and to appropriately promote the environmental attributes of their products and services to their clients and stakeholders.

The initiative delivers substantial benefits to manufacturers and retailers, who may be able to use it to demonstrate product credentials and increase sales, provide enhanced disclosure to consumers and obtain market advantage for individual products over competitors.

The database also provides a consistent source of information to support and provide benchmarks for eco-labelling and environmental product declarations (EPDs), and underpin the development of LCA-based policies and design tools for buildings and infrastructure.

AusLCI assists with:

- setting metrics and processes for comparing the environmental impact of products and services
- levelling the playing field for LCA-based product comparison
- fostering innovation in design and manufacturing
- promoting education and consensus-building processes
- providing LCA processes that can integrate with existing environmental tools and applications.

It enables industry users to:

- benchmark process and product performance against industry standards
- make informed decisions in driving process efficiencies, new purchases, furthering environmental goals and quantifying impacts
- proactively assess, mitigate and quantify the effort required to offset CO<sub>2</sub> emissions
- demonstrate product credentials and increase sales

- provide enhanced disclosure to consumers and the ability to respond to public criticism of products
- obtain market advantage in the anticipated low impacts and carbon sequestering benefits for individual products over competitors.

It enables governments to:

- guide policy direction and promote sustainable practices within the Australian economy
- provide a strong platform for funding, education, policy-making and legislation
- assist in decision-making, such as analysis of investment or purchasing decisions
- provide enhanced educational resources.

### 1.3 AusLCI data collection, review and publication process

The AusLCI data collection, review and publication process has been broken down into seven stages, as shown in Figure 1 overleaf and described below.

1. Different organisations and companies (data owner or data supplier) contribute data for a variety of reasons. Sometimes the company that produces the material or service develops the data, but third parties also develop data for other purposes. AusLCI has been structured to utilise data from a variety of initial sources.
2. All data submitted to AusLCI is expected to be reviewed for technical quality prior to submission. This may be a formal peer review or can be other types of review, for instance via journal publication.
3. Data is then submitted to the ALCAS AusLCI Database Committee to consider for inclusion in the AusLCI database. Information provided is checked against the ALCAS document *“Requirements for the Development of AusLCI Data sets”*. If the information provided does not meet the requirements, the data owner will be advised of the identified concerns.
4. If the data meets the requirements, the ALCAS AusLCI database manager then works with the data owner to connect their data to relevant upstream processes (and where relevant to determine average industry data for that sector).
5. The ALCAS AusLCI Database Committee formally seeks approval from the data owner for publishing.
6. The data is published in the AusLCI national database.
7. It is expected that software suppliers continue to integrate AusLCI data into their tools, providing integrated unit process view of the data.

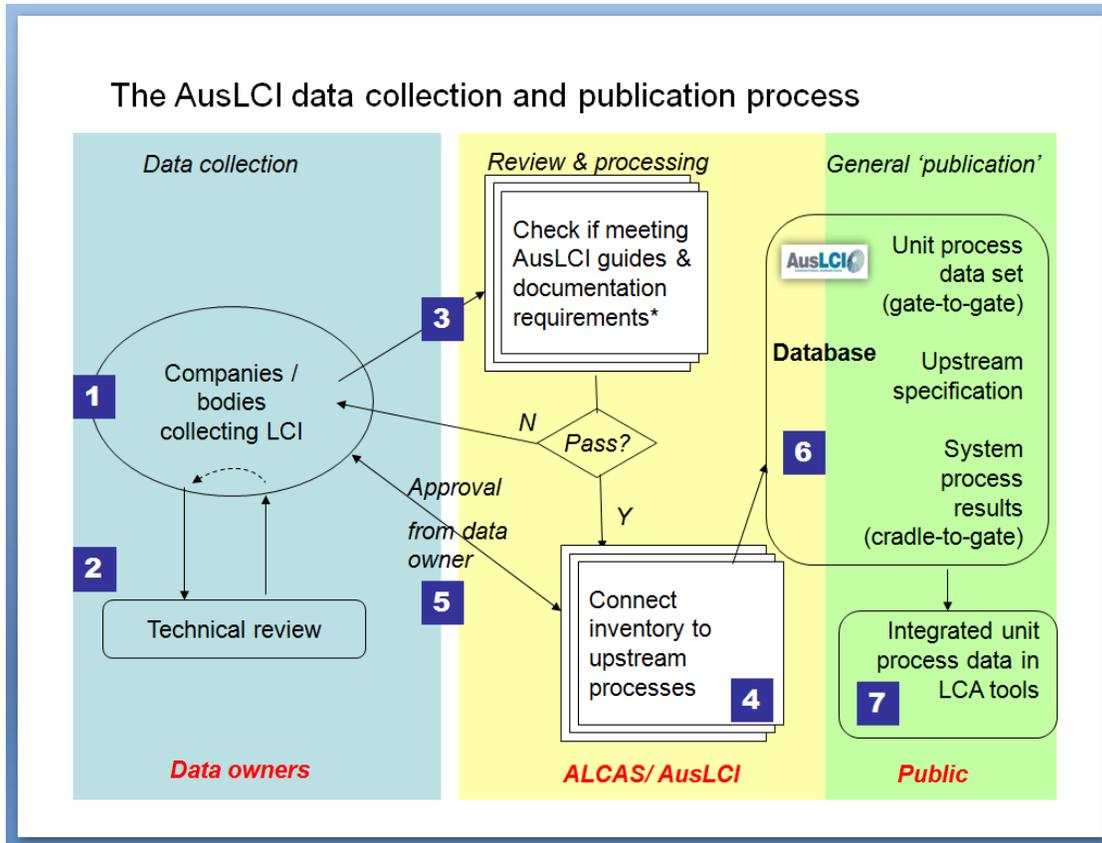


Figure 1: Summary process/flowchart for AusLCI data publication

## 1.4 Structure of the AusLCI database

The AusLCI database is effectively one fully connected unit process database made of four different types of data:

1. Submitted and verified AusLCI unit processes – This is referred to as AusLCI data, which are published on the AusLCI website.
2. Unit processes from the “shadow database”. The shadow database is a modified version of an international LCI database – ecoinvent (currently version 3.3) – into which key background processes (e.g. energy and transport) have been substituted with Australian data. To produce the shadow database, each unique process is duplicated – meaning that when ecoinvent cover several geographies for one process, only one is duplicated (in most case ‘GLO’ or ‘RoW’). This creates a self-sufficient ‘regionalised’ database, which uses about 7,300 of the 16,000 processes currently available in ecoinvent 3.3. The two databases are then linked by replacing ecoinvent processes with Australian data. Currently, 75 of the 7,300 regionalised processes are replaced. Readers are referred to Appendix B for a list detailing correspondence between ecoinvent and AusLCI processes used. While this represent a very small proportion of the ecoinvent database, it includes crucial processes such as electricity, fuels and transport.
3. External data sources that are used either because they represent the most appropriate supply, for example overseas product supply – vinyl chloride monomer from the United States into

Australian PVC production, or because they are considered the best approximation for Australian supply. Any missing upstream processes for this data are taken from AusLCI or the shadow database.

4. Unreviewed supporting processes used for minor flows. Where a process contributes less than 5% of the environmental significance of a verified AusLCI process, the flow can be estimated with an unreviewed AusLCI process.

Shadow data, external data and unreviewed data are designed to be temporary, with the expectation that they will gradually be replaced as stakeholders submit more verified AusLCI data, driving an inherent continuous improvement procedure.

## 1.5 Constructing the AusLCI database

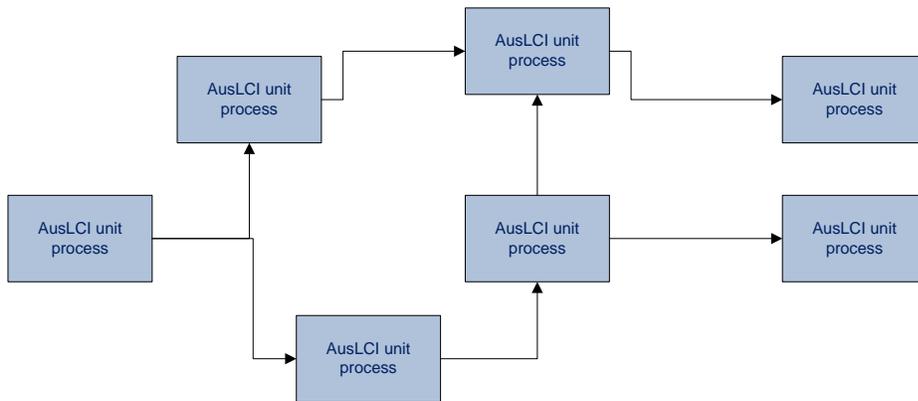
AusLCI data comes in different forms, covering different parts of the supply chain, because some organisations only have access to their own production data, while others may control or have studied the full supply chain. Thus, the database must be flexible enough to accommodate different level of complexity in the data provided. Figure 2 depicts different level of connections between unit processes, and shows variation in the level of complexity of the datasets. In some case, almost complete supply chains can be captured – for instance in the case of electricity. There, the only missing flows would generally be capital equipment, for instance the physical power plant construction. In other case a single supply chain is provided, but data for a significant number of ancillary materials is also required, or even for one of the main input (for example, vinyl chloride monomer used in the production of PVC). For other materials, only a single unit process is available. This is for instance the case for polypropylene, where the data collected is only representative of the facilities under the control of the data provider.

Figure 3 demonstrates how upstream gaps in the database are filled with external data from the ecoinvent database. Existing AusLCI datasets are linked to a total of 275 individual ecoinvent processes. Developed in Switzerland, ecoinvent is the largest inventory database available with over 16,000 individual processes in its latest iteration. Although it started as a European database, it increasingly has a global scope, and thus include more and more global data (currently about 4,000 individual processes represent global average production processes).

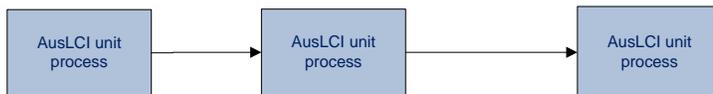
Figure 4 shows the final step where AusLCI data are linked back into the ecoinvent database where appropriate. When this is done, the original input of the ecoinvent processes are deleted and the links are replaced by AusLCI data. Currently, there are about 75 linkages back into ecoinvent, including critical datasets such as electricity, fuels and transport. These are specified in Appendix B. This is limited to ecoinvent dataset published as unit processes. Parts of the ecoinvent database is strictly available as system processes. This is for instance the case for the inventory for polycarbonate production. In these particular instances it won't be possible to produce a linkage with AusLCI and the output will not change from the original version of the data.

If data from other external databases are identified as a better fit for AusLCI inputs, these may be used instead of ecoinvent, with the underlying condition that their scope and boundary conditions are compatible with AusLCI database, as is shown in Figure 5.

Complex data sets where most of the supply chain has been collected – e.g. electricity supply



Simple data sets when one supply chain has been collected – e.g. PVC



Single data sets where data is collected for one process – e.g. Polypropylene



Figure 2: Different forms of AusLCl datasets

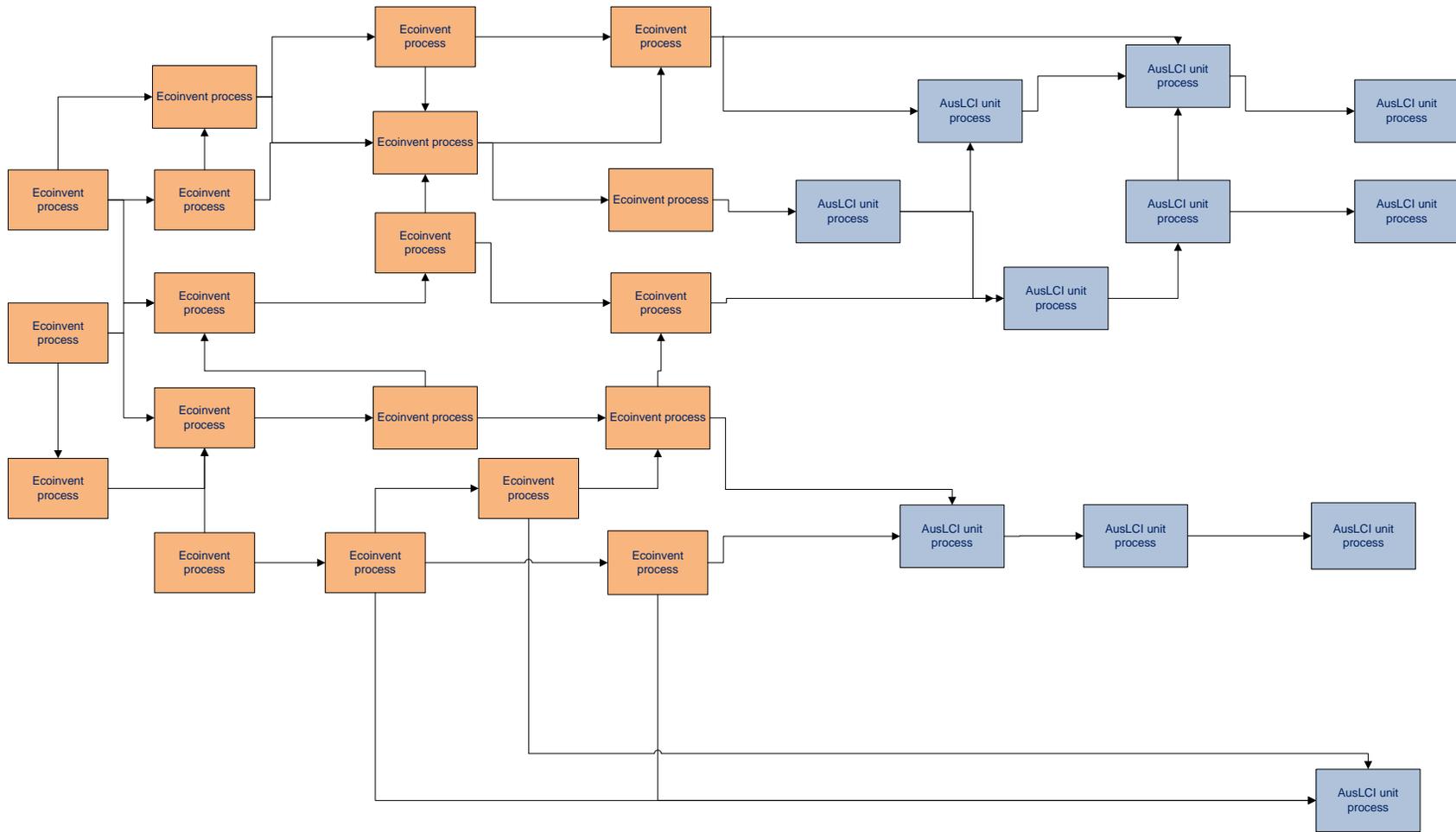


Figure 3: Ecoinvent (brown processes) is used to fill upstream gaps in AusLCI (Blue processes)

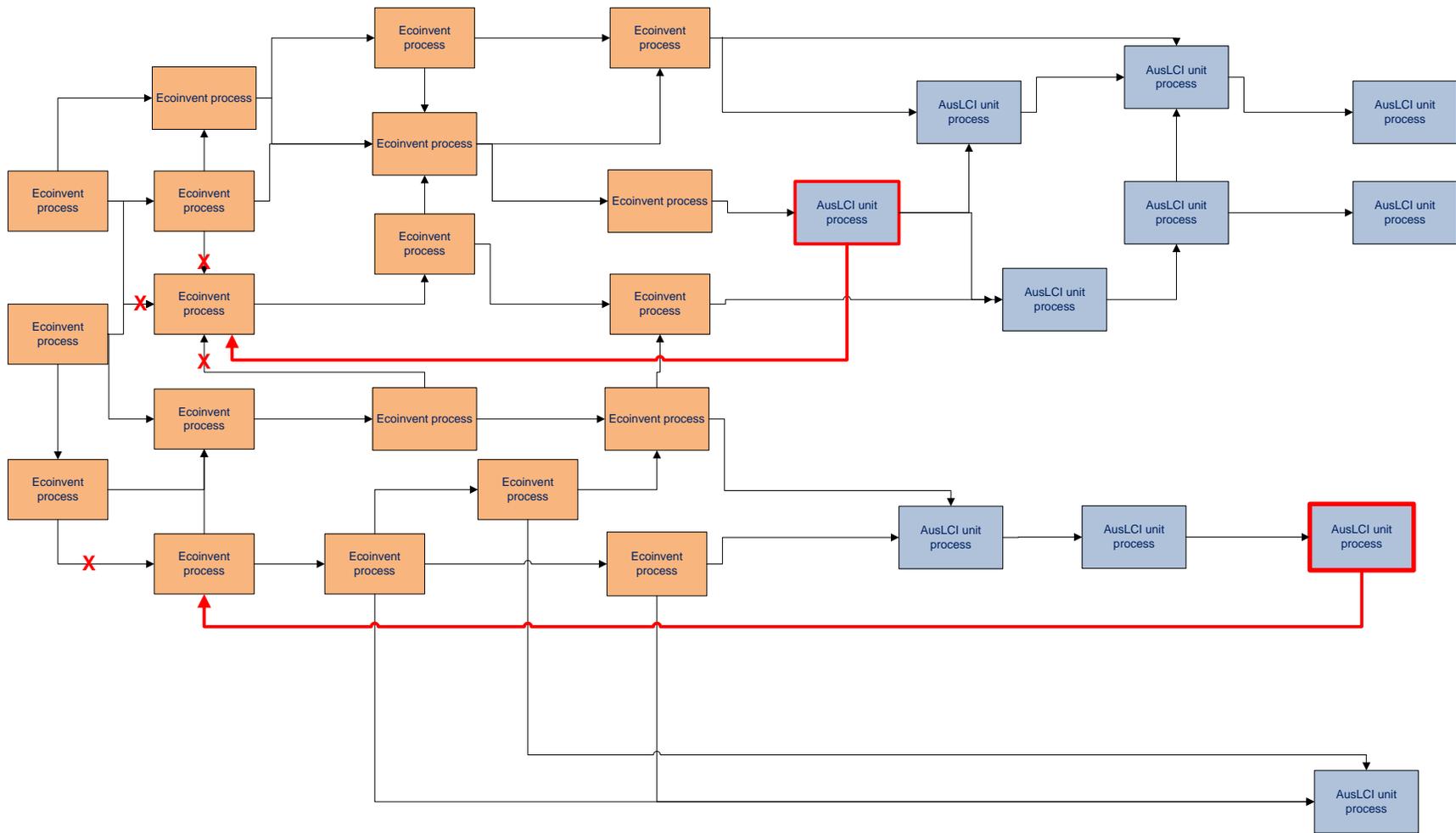


Figure 4: The red arrows show how AusLCl is linked back into key processes in ecoinvent, which are unlinked from their original inputs (red crosses)

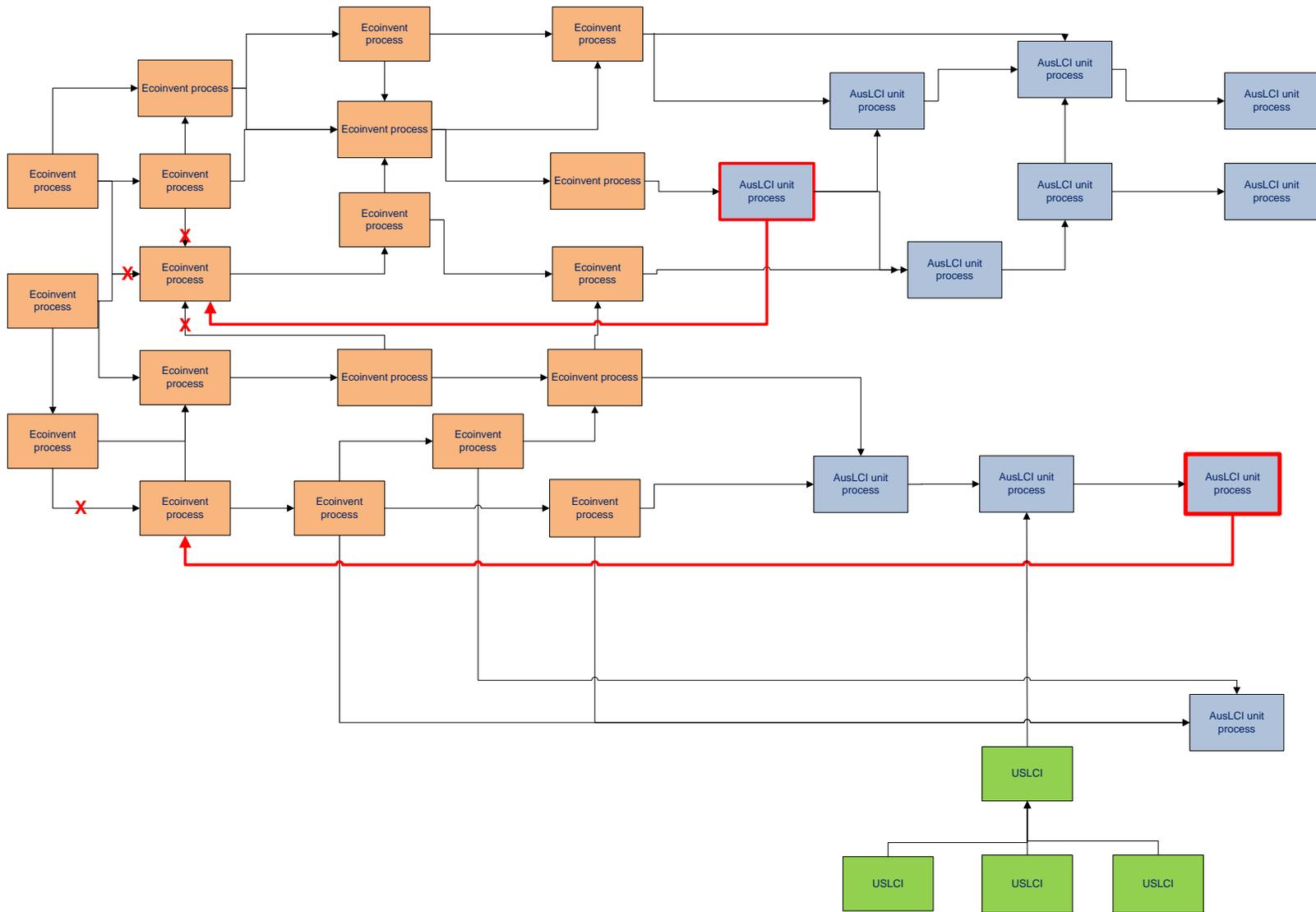


Figure 5: Other external databases (e.g. USLCI in green) may be used when they are more appropriate than ecoinvent

## 1.6 Publication of the AusLCI database

Only the first group of data outlined in the previous section are published under the AusLCI banner as:

- standalone unit process data
- system process (aggregated) results through calculation of elementary flows along the supply chain using data from the second and third categories.

Because the shadow database contains licensed datasets it cannot be published as such. However, a complete specification on how it is to be constructed (every alteration to the original datasets documented) is published. This allows licensed users to reconstruct it. External unmodified datasets will simply be referenced so that they can be linked to again by licensed users.

For users without access to these licensed databases, fully calculated, cradle to gate system process LCIs will be published providing the complete elementary flow LCI results but without the full disaggregation of the underlying unit process structure.

For transparency, the unreviewed AusLCI processes are published on the AusLCI website but are labelled as unreviewed AusLCI data.

This structure maintains usefulness for both professional and casual users while respecting data licensing rights.

The management of the AusLCI database and the shadow database is the responsibility of the AusLCI data manager under direction of the AusLCI Database Committee.

Data owners can update their data at any point and its suggested that data is check for currency every 5 years.

## 1.7 Attributional and consequential modelling

The data developed in a generic inventory are modelled based on an “attributional” approach, which seeks to establish the burdens associated with the production and use of a product, or with a specific service or process, at a point in time (typically in the recent past). The modules will not be developed as “consequential” LCAs, which seek to identify the environmental consequences of a decision or a proposed change in a system under study. However, through the development of disaggregated and transparent models, the data will support consequential LCA.

## 2 Summary of datasets

Below, in Table 1, is a brief description of the data sectors for the AusLCI dataset. Some data has separate reports, which describe the data collection and modelling, while other data have all the documentation embedded into the data format. A full list of unit processes in AusLCI is shown in Appendix A.

Table 1: Overview of data in AusLCI

Sector	
Agriculture	173
Transport	28
Energy	49
Fuels	36
Materials	91
Chemicals	5
Waste treatment	33
Total	379

### 2.1 Agricultural data

The agricultural datasets were developed as part of an AusAgLCI project. AusAgLCI was financially supported by industry via the Rural Industries Research and Development Corporation (RIRDC) in conjunction with the Cotton Research and Development Corporation (CRDC); Dairy Australia (DA); Grains Research and Development Corporation (GRDC); Forest and Wood Products Australia (FWPA); Horticulture Australia Limited (HAL); Meat and Livestock Australia (MLA); Sugar Research Australia (SRA); and project partners Department of Agriculture Fisheries and Forestry, Queensland (DAFF Qld); University of Southern Queensland (USQ); CSIRO; and Life Cycle Strategies Pty Ltd.

The datasets developed are shown in Table 2 and the methodology is available from the RIRDC <https://rirdc.infoservices.com.au/items/14-046>.

Additional Agriculture data on maize production and the production of residues including bagasse, cotton seed and wheat straw were developed as part of a bio-based materials project undertaken by Life Cycle Strategies for ALCAS with funding from the commonwealth government. The report for this project is available at <http://www.alcas.asn.au/AusLCI/index.php/Biobased>.

Updated broad acre inventories as well as beef production data are documented in

Table 2: Overview of agriculture data in AusLCI

Subcategory	Product inventory	Supporting processes	Author	Documentation
Cotton	5	15	AusAgLCI project	AusAgLCI methodology report
Sugar	7	10	AusAgLCI project	AusAgLCI methodology report
Grain	19	19	AusAgLCI project	AusAgLCI methodology report
Horticulture	14	16	AusAgLCI project	AusAgLCI methodology report
Irrigation	19	19	AusAgLCI project	AusAgLCI methodology report
Animal feeds/ processes	17	13	AusAgLCI project	AusAgLCI methodology report
Residues	3		Bio-based materials project	<a href="http://www.alcas.asn.au/AusLCI/Documents/Residues_LCI_V1.pdf">http://www.alcas.asn.au/AusLCI/Documents/Residues_LCI_V1.pdf</a>

## 2.2 Electricity data

Electricity data was developed based on the emission data reported (DIICSRTE 2013) and using specific information on grid mixes from Electricity Gas Australia (Energy Supply Association Australia 2012). Other air and water pollution data were taken from the National Pollutant Inventory (Department of Environment and Heritage and Water 2011). Table 3 lists the datasets for electricity.

Table 3: Electricity datasets

Subcategory	Unit processes	Author	Documentation
High voltage	10	Life Cycle Strategies	Contained in processes
Low voltage	10	Life Cycle Strategies	Contained in processes
Electricity by fuel	17	Life Cycle Strategies	Contained in processes
Electricity mixes at generation	10	Life Cycle Strategies	Contained in processes

## 2.3 Fuels

Fuel data was developed for coal mine reports from selected Australian coal mines and from National Greenhouse Gas data (DIICSRTE 2013). Natural gas inventories were developed using energy data from

ABARE (ABARE 2011) and emissions data from (DIICCSRTE 2013). Biofuels data on ethanol was developed as part of a bio-based materials project and the report is available on the AusLCI website. Coal seam methane data was taken from a report by Worley Parsons (Clark, Hynes et al. 2011). Table 4 lists the datasets for fuel.

**Table 4: Fuel datasets**

Subcategory	Unit processes	Author	Documentation
Coal	6	Life Cycle Strategies	Contained in processes
Natural gas	21	Life Cycle Strategies	Contained in processes
Biofuels	8	Life Cycle Strategies	Contained in processes
Coal seam gas	1	Life Cycle Strategies	Contained in processes

## 2.4 Materials

Polypropylene and PVC data were developed by the manufacturing companies in Australia. An inventory report is available for PVC on the Australian Vinyls website [http://vinyl.org.au/images/PVC\\_LCI/PVC\\_LCI\\_Reportv1\\_6.pdf](http://vinyl.org.au/images/PVC_LCI/PVC_LCI_Reportv1_6.pdf). The timber data was developed as part of the bio-based materials project based on published data by CSIRO (England, May et al. 2013) and the report on the inventory is on the AusLCI website. The textile data is based on cotton and cotton linters and are part of the AusAgLCI project. The only mineral process currently is vermiculite, which is an unreviewed process used in agriculture inventories. Table 5 lists the datasets for materials.

**Table 5: Datasets for materials**

Subcategory	Unit processes	Author	Documentation
Polypropylene	1	RMIT/ Lyondell Basel	Contained in processes
PVC	2	Australian vinyls	<a href="http://vinyl.org.au/images/PVC_LCI/PVC_LCI_Reportv1_6.pdf">http://vinyl.org.au/images/PVC_LCI/PVC_LCI_Reportv1_6.pdf</a>
Softwood	6	Life Cycle Strategies	<a href="http://www.alcas.asn.au/AusLCI/Documents/Timber_LCI_v1.pdf">http://www.alcas.asn.au/AusLCI/Documents/Timber_LCI_v1.pdf</a>
Hardwood	6	Life Cycle Strategies	<a href="http://www.alcas.asn.au/AusLCI/Documents/Timber_LCI_v1.pdf">http://www.alcas.asn.au/AusLCI/Documents/Timber_LCI_v1.pdf</a>
Textiles	2	AusAgLCI project	AusAgLCI methodology report
Minerals	1	AusAgLCI project	Unreviewed processes

## 2.5 Chemicals

The organic chemicals included in the database are starch production, starch waste and gluten from wheat, which are adapted unreviewed processes. The inorganic chemical is zinc oxide, which is also an unreviewed process used in fertiliser mixes in the agricultural inventories. Table 6 lists the datasets for chemicals.

Table 6: Datasets for chemicals

Subcategory	Unit processes	Author	Documentation
Organic	4	Life Cycle Strategies	Unreviewed processes
Inorganic	1	AusAgLCI project	Unreviewed processes

## 2.6 Waste treatment

Waste treatment processes are for organic waste treatment and are based on organic degradation models published in the National Greenhouse Gas Accounts (DIICCS RTE 2013) with supplementary data on landfill operation from waste treatment LCA studies (Grant, James et al. 2003). A report of this data is provided on the AusLCI website [http://www.alcas.asn.au/AusLCI/Documents/Landfill\\_LCI\\_V1.pdf](http://www.alcas.asn.au/AusLCI/Documents/Landfill_LCI_V1.pdf). Two recycling and waste collection processes are unreviewed processes used for metal recycling of agricultural infrastructure. The incineration is methane gas combustion, which is adapted from ecoinvent with assumptions from the National Greenhouse Gas Accounts (DIICCS RTE 2013). The three other processes are to do with land application of materials from the sugar industry as part of the AusAgLCI project. Table 7 lists the datasets for waste treatment.

Table 7: Waste treatment datasets

Subcategory	Unit processes	Author	Documentation
Incineration	9	Life Cycle Strategies	<a href="http://www.alcas.asn.au/AusLCI/Documents/Landfill_LCI_V1.pdf">http://www.alcas.asn.au/AusLCI/Documents/Landfill_LCI_V1.pdf</a>
Landfill	16	Life Cycle Strategies	<a href="http://www.alcas.asn.au/AusLCI/Documents/Landfill_LCI_V1.pdf">http://www.alcas.asn.au/AusLCI/Documents/Landfill_LCI_V1.pdf</a>
Others	3	AusAgLCI project	Part of AusAgLCI project
Recycling	2	Life Cycle Strategies	Unreviewed processes
Waste collection	2	Life Cycle Strategies	Unreviewed processes

## 2.7 Transport

Transport inventories on road, air and rail freight were developed based on National Transport Model data produced by Adam Pekol consulting (Adam Pekol Consulting Pty Ltd 2011) with emission data taken from ecoinvent and (DIICCS RTE 2013). Transport infrastructure was specifically developed for sugar cane transport, while infrastructure for all other transport is taken directly from the ecoinvent shadow

database. Given the international nature of shipping, Australian data were developed for general freight, however two inventories were developed for transport of vinyl chloride monomer as part of the PVC inventory because of the availability of primary data. Table 8 lists the datasets for transport.

**Table 8: Transport datasets**

Subcategory	Unit processes	Author	Documentation
Road	13	Life Cycle Strategies	Contained in processes
Infrastructure	4	Life Cycle Strategies	Contained in processes
Air	9	Life Cycle Strategies	Contained in processes
Water	2	Life Cycle Strategies	<a href="http://vinyl.org.au/images/PVC_LCI/PVC_LCI_Reportv1_6.pdf">http://vinyl.org.au/images/PVC_LCI/PVC_LCI_Reportv1_6.pdf</a>

## 2.8 Concrete

Concrete inventories have been developed based on data provided by Cement Industry Federation, Australia (CIF) and ecoinvent processes. The emissions have been adopted from National Pollutant Inventory database and ecoinvent wherever not available. Considerable amount of clinker is imported for making of cement therefore inventories have been developed keeping for cement made from domestic, imported and Australian average. The variation in transport modes and distance for the plants from mines have been considered. Concrete inventories have been modelled for various grades using cement quantity directly from BPIC. Table 9 lists the datasets for concrete.

**Table 9: Concrete datasets**

Subcategory	Unit processes	Author	Documentation
Concrete	15	Life Cycle Strategies	Concrete & Cement LCA report
Cement	6	Life Cycle Strategies	Concrete & Cement LCA report
Recycling	4	Life Cycle Strategies	Contained in processes
Others	11	Life Cycle Strategies	Contained in processes
Asphalt	6	Start-2-See	Contained in processes
Geopolymer	1	Start-2-See	Contained in processes

## 2.1 Water

Datasets on water supply have been developed by Lifecycles based on energy use data from CSIRO in 2002. Table 8 lists the datasets for transport.

**Table 10: Transport datasets**

Subcategory	Unit processes	Author	Documentation
State based	8	Life Cycle Strategies	Contained in processes
Catchment based	35	Life Cycle Strategies	Contained in processes

### 3 References

- ABARE (2011). Energy in Australia 2011. Canberra ACT, ABARE, Australian Bureau of Agricultural Research Economics.
- Adam Pekol Consulting Pty Ltd (2011). Australian Transport Facts 2011, Data tables.
- CIF. "Cement Industry Federation website." Retrieved 14 March 2015, from <http://www.cement.org.au/AustraliasCementIndustry/LocationofCementPlants.aspx>.
- Clark, T., R. Hynes, et al. (2011). Greenhouse Gas Emissions Study of Australian CSG to LNG, Worley Parsons.
- Department of Environment and Heritage and Water (2011). National Pollutant Inventory (NPI) data for year 2009/10. Canberra.
- DIICCSRTE (2013). National Greenhouse Accounts Factors. Canberra, Department of Industry Innovation Climate Change Science Research and Tertiary Education, Commonwealth of Australia.
- DIICCSRTE (2013). National Inventory Report (NIR) 2011; The Australian Government Submission to the United Nations Framework Convention on Climate Change April 2013. Canberra, Commonwealth of Australia, Department of Industry Innovation Climate Change Science Research and Tertiary Education.
- Energy Supply Association Australia (2012). Energy Gas Australia 2012. Canberra, Energy Supply Association Australia.
- England, J. R., B. May, et al. (2013). "Cradle-to-gate inventory of wood production from Australian softwood plantations and native hardwood forests: Carbon sequestration and greenhouse gas emissions." *Forest Ecology and Management* **302**(0): 295-307.
- Grant, T., K. James, et al. (2003). Life Cycle Assessment of Waste and Resource Recovery Options (including energy from waste) - Final Report for EcoRecycle Victoria. Melbourne, Victoria, Centre for Design at RMIT University ([www.cfd.rmit.edu.au](http://www.cfd.rmit.edu.au)).

## Appendix A : Full list of unit processes

Unit process	Category	Sub category
almond hulls and shells, at huller and sheller	Agriculture	Animal foods
cotton, seed, at gin	Agriculture	Animal foods
cottonseed hulls, at mill	Agriculture	Animal foods
dry season mix, 30% urea, 5,4% P, with protein meal, at production	Agriculture	Animal foods
dry season mix, 8% urea, 2,8% P, with protein meal, at production	Agriculture	Animal foods
forage sorghum, irrigated, Darling Downs QLD	Agriculture	Animal foods
forage sorghum, irrigated, northern Victoria	Agriculture	Animal foods
health treatment and growth promotant, per feeder steer, NT	Agriculture	Animal foods
lucerne hay establishment, dryland, northern zone NSW	Agriculture	Animal foods
lucerne hay, dryland, northern zone NSW	Agriculture	Animal foods
maize, silage irrigated, northern Victoria	Agriculture	Animal foods
maize, silage, average, on farm	Agriculture	Animal foods
mineral block, 30% urea 3,6% P, at production	Agriculture	Animal foods
molasses, from sugar, at sugar mill, QLD	Agriculture	Animal foods
oaten hay, export, medium rainfall zone SA	Agriculture	Animal foods
pasture establishment, SE QLD	Agriculture	Animal foods
pasture establishment, top end, NT	Agriculture	Animal foods
pre-mix trace element, ruminant mineral supplement, at production	Agriculture	Animal foods
straw, from wheat, central east, NSW, at farm	Agriculture	Animal foods
vaccination and anthelmintic, herd requirement per breeder, northern cattle	Agriculture	Animal foods
weaner Block, 7,1% Urea 0,5% P, at production	Agriculture	Animal foods
wet season mix, 0% N 21% P, at production	Agriculture	Animal foods
bran, wheat, conventional	Agriculture	Food
cottonseed oil, at oil mill	Agriculture	Food
flour milling, wheat, conventional	Agriculture	Food
flour, wheat, conventional	Agriculture	Food
germ, wheat, conventional	Agriculture	Food
sugar cane milling, QLD	Agriculture	Food
sugar, raw, at mill, QLD	Agriculture	Food
peat, imported	Agriculture	Infrastructure
plastic bag, banana bunch cover	Agriculture	Infrastructure
plastic mulch, 25micron, at plant	Agriculture	Infrastructure
potting mix production and application, for seedlings	Agriculture	Infrastructure
shed, bare floor	Agriculture	Infrastructure
water pump, irrigation, 25kg	Agriculture	Infrastructure

Unit process	Category	Sub category
wire, for fencing, trellis, gates, at regional storehouse	Agriculture	Infrastructure
irrigation, centre pivot irrigation system	Agriculture	Irrigation
irrigation, drip irrigation system	Agriculture	Irrigation
irrigation, hose move sprinkler system	Agriculture	Irrigation
irrigation, pipe irrigation system	Agriculture	Irrigation
irrigation, solid set irrigation system	Agriculture	Irrigation
irrigation, travel spray boom irrigation system	Agriculture	Irrigation
irrigation, under tree irrigation system	Agriculture	Irrigation
irrigation, flood or furrow irrigation	Agriculture	Irrigation
irrigation, travelling gun irrigation system	Agriculture	Irrigation
centre pivot irrigation system, production, per ha	Agriculture	Irrigation infrastructure
drip irrigation system (sugarcane), production, per ha	Agriculture	Irrigation infrastructure
drip irrigation system, production, per ha	Agriculture	Irrigation infrastructure
hose move sprinkler irrigation system, production, per ha	Agriculture	Irrigation infrastructure
pipe irrigation system, production, per ha	Agriculture	Irrigation infrastructure
solid set sprinkler irrigation system, production, per ha	Agriculture	Irrigation infrastructure
travel spray boom irrigation system (sugarcane), production, per ha	Agriculture	Irrigation infrastructure
travel spray boom irrigation system, production, per ha	Agriculture	Irrigation infrastructure
travelling gun irrigation system (sugarcane), production, per ha	Agriculture	Irrigation infrastructure
under tree irrigation system, production, per ha	Agriculture	Irrigation infrastructure
pumping, irrigation, 10m pumping depth, 100% electricity, QLD	Agriculture	Irrigation pumping
pumping, irrigation, 10m pumping depth, 50% electricity, NSW	Agriculture	Irrigation pumping
pumping, irrigation, 15m pumping depth, 100% diesel	Agriculture	Irrigation pumping
pumping, irrigation, 15m pumping depth, 100% electricity, SA	Agriculture	Irrigation pumping
pumping, irrigation, 15m total pumping head, 100% diesel	Agriculture	Irrigation pumping
pumping, irrigation, 20m pumping depth, 100% electricity, QLD	Agriculture	Irrigation pumping
pumping, irrigation, 25m total pumping head, 100% diesel	Agriculture	Irrigation pumping
pumping, irrigation, 40m total pumping head, 100% diesel	Agriculture	Irrigation pumping
pumping, irrigation, 40m total pumping head, 100% electricity	Agriculture	Irrigation pumping
pumping, irrigation, 40m total pumping head, 100% electricity, QLD	Agriculture	Irrigation pumping
pumping, irrigation, 40m total pumping head, 100% electricity, SA	Agriculture	Irrigation pumping
pumping, irrigation, 45m pumping depth, 0% electricity, NSW	Agriculture	Irrigation pumping
pumping, irrigation, 45m total pumping head, 100% electricity, SA	Agriculture	Irrigation pumping
pumping, irrigation, 50m total pumping head, 100% electricity, QLD	Agriculture	Irrigation pumping
pumping, irrigation, 5m total pumping head, 100% diesel	Agriculture	Irrigation pumping
pumping, irrigation, 65m total pumping head, 100% electricity, QLD	Agriculture	Irrigation pumping
pumping, irrigation, 70m total pumping head, 100% diesel	Agriculture	Irrigation pumping
pumping, irrigation, 80m total pumping head, 100% electricity, NSW	Agriculture	Irrigation pumping
air blast spraying, orchards	Agriculture	Operations
bed forming, cotton	Agriculture	Operations
bed forming, horticulture	Agriculture	Operations

Unit process	Category	Sub category
boom spraying, cotton	Agriculture	Operations
boom spraying, horticulture	Agriculture	Operations
bulldozer operation, medium load factor	Agriculture	Operations
cattle transport, km per head, prime mover + b-double	Agriculture	Operations
control of brigalow suckers, Graslan aerial application	Agriculture	Operations
cotton, ginning	Agriculture	Operations
cultivating, broadacre crop	Agriculture	Operations
cultivating, cotton	Agriculture	Operations
cultivating, large implement, horticulture	Agriculture	Operations
cultivating, medium implement, horticulture	Agriculture	Operations
Dipping cattle for external parasites, per head through plunge dip	Agriculture	Operations
disc ploughing, broadacre crop	Agriculture	Operations
discing, cotton	Agriculture	Operations
fertiliser application, cotton	Agriculture	Operations
fertiliser side dressing, horticulture	Agriculture	Operations
fertiliser spreading, cotton	Agriculture	Operations
fertiliser spreading, horticulture	Agriculture	Operations
fertilizing, broadacre crop, pre & post-emergence	Agriculture	Operations
grader operation, broadacre crop, medium load factor	Agriculture	Operations
grain collection, broadacre, in-field with tractor and bin	Agriculture	Operations
harrowing, horticulture	Agriculture	Operations
harvest and haulout, burnt cane	Agriculture	Operations
harvest and haulout, green cane	Agriculture	Operations
harvesting, broadacre crop, combine less than 200kW	Agriculture	Operations
harvesting, cotton	Agriculture	Operations
harvesting, specialised machine, horticulture, 150kW combine	Agriculture	Operations
hay baling, large square bales, broadacre crop	Agriculture	Operations
hay baling, round bales, broadacre crop	Agriculture	Operations
hay baling, small square bales, broadacre crop	Agriculture	Operations
hay mowing, broadacre crop	Agriculture	Operations
hay raking, broadacre crop	Agriculture	Operations
inter-row cultivation, horticulture	Agriculture	Operations
inter-row tractor, horticulture	Agriculture	Operations
levelling, cotton	Agriculture	Operations
liming, broadacre crop, pre & post-emergence	Agriculture	Operations
mulching, cotton	Agriculture	Operations
offset disc harrowing, horticulture	Agriculture	Operations
picking, cotton	Agriculture	Operations
planting, broadacre crop, soil clay content greater than 20%	Agriculture	Operations
planting, broadacre crop, soil clay content 0 to 10%	Agriculture	Operations
planting, broadacre crop, soil clay content 10 to 20%	Agriculture	Operations
planting, cotton	Agriculture	Operations

Unit process	Category	Sub category
precision planting, horticulture	Agriculture	Operations
ripping, large implement, horticulture	Agriculture	Operations
ripping, medium implement, horticulture	Agriculture	Operations
rolling, cotton	Agriculture	Operations
root cutting, cotton	Agriculture	Operations
rotary hoeing, medium implement, horticulture	Agriculture	Operations
savanna burning, northern Australia woodland, QLD & NT	Agriculture	Operations
savanna burning, open eucalypt woodland, late dry season, QLD & NT	Agriculture	Operations
scarifying, broadacre crop	Agriculture	Operations
seedling transplanting, horticulture	Agriculture	Operations
spraying, aerial, broadacre crop	Agriculture	Operations
spraying, aerial, cotton	Agriculture	Operations
spraying, broadacre crop, pre & post-emergence	Agriculture	Operations
windrowing, broadacre crop	Agriculture	Operations
bagasse, at mill	Agriculture	Others
canola meal, at oil mill	Agriculture	Plant oils
canola oil pressing, at oil mill	Agriculture	Plant oils
canola oil, at oil mill	Agriculture	Plant oils
cottonseed meal, at oil mill	Agriculture	Plant oils
cottonseed oil production, at oil mill	Agriculture	Plant oils
almond kernels, at huller and sheller	Agriculture	Plant production
almonds, unshelled, South Australia	Agriculture	Plant production
avocado, hass, Brisbane Moreton, growing	Agriculture	Plant production
avocado, hass, Brisbane Moreton, harvested, at farm	Agriculture	Plant production
avocado, hass, Brisbane Moreton, orchard establishment	Agriculture	Plant production
banana, cavendish, wet tropics, harvested, at farm	Agriculture	Plant production
banana, cavendish, wet tropics, plant cycle	Agriculture	Plant production
banana, cavendish, wet tropics, ratoon cycle	Agriculture	Plant production
barley, feed grade, no-till, northern east NSW, at farm	Agriculture	Plant production
barley, malt grade, short fallow, no-till, central west NSW, at farm	Agriculture	Plant production
broccoli, winter, Lockyer Valley, harvested, at farm	Agriculture	Plant production
canola, average, at farm	Agriculture	Plant production
canola, no-till, great southern WA, at farm	Agriculture	Plant production
canola, no-till, north east NSW, at farm	Agriculture	Plant production
capsicum, Burdekin, harvested, at farm	Agriculture	Plant production
chickpeas, no-till, north east NSW, at farm	Agriculture	Plant production
cotton, seed cotton, Australia, at farm	Agriculture	Plant production
cotton, seed cotton, dryland, central zone, at farm	Agriculture	Plant production
cotton, seed cotton, irrigated, central zone, at farm	Agriculture	Plant production
cotton, seed cotton, irrigated, northern zone, at farm	Agriculture	Plant production
cotton, seed cotton, irrigated, southern zone, at farm	Agriculture	Plant production

Unit process	Category	Sub category
lettuce, winter, Lockyer Valley, harvested, at farm	Agriculture	Plant production
lupins, medium rainfall zone SA, at farm	Agriculture	Plant production
maize, grain, average, on farm	Agriculture	Plant production
maize, grain, irrigated, northern NSW, on farm	Agriculture	Plant production
maize, grain irrigated, Darling Downs QLD, on farm	Agriculture	Plant production
maize, grain, dryland, QLD, on farm	Agriculture	Plant production
maize, grain, irrigated, northern Victoria, at farm	Agriculture	Plant production
maize, silage irrigated, Darling Downs QLD	Agriculture	Plant production
potato, Lockyer Valley, harvested, at farm	Agriculture	Plant production
seedling, for transplant, at nursery	Agriculture	Plant production
sorghum, dryland north west NSW, on farm	Agriculture	Plant production
sorghum, irrigated, northern zone NSW, on farm	Agriculture	Plant production
sorghum, no-till, north east NSW, at farm	Agriculture	Plant production
strawberry, Brisbane Moreton, harvested, at farm	Agriculture	Plant production
sugarcane, harvested, at mill, average QLD	Agriculture	Plant production
sugarcane, harvested, at mill, Bundaberg	Agriculture	Plant production
sugarcane, harvested, at mill, Burdekin	Agriculture	Plant production
sugarcane, harvested, at mill, Herbert	Agriculture	Plant production
sugarcane, harvested, at mill, Mackay	Agriculture	Plant production
sugarcane, harvested, at mill, wet tropics	Agriculture	Plant production
sweet corn, Lockyer Valley, harvested, at farm	Agriculture	Plant production
tomato, trellis, Burdekin, harvested, at farm	Agriculture	Plant production
wheat, central east, NSW, at farm	Agriculture	Plant production
wheat, Darling Downs, QLD, at farm	Agriculture	Plant production
wheat, grain, average, at farm	Agriculture	Plant production
wheat, high rainfall zone, SA, at farm	Agriculture	Plant production
wheat, Kellerberrin region, WA, at farm	Agriculture	Plant production
wheat, low rainfall zone, SA, at farm	Agriculture	Plant production
wheat, medium rainfall zone, SA, at farm	Agriculture	Plant production
wheat, Narrogin region, WA, at farm	Agriculture	Plant production
wheat, North West NSW, at farm	Agriculture	Plant production
wheat, no-till, Central QLD, at farm	Agriculture	Plant production
zinc nitrate	Chemicals	Inorganic
gluten, from wheat starch production	Chemicals	Organic
starch plant operation, from wheat flour	Chemicals	Organic
starch waste, from wheat starch production	Chemicals	Organic
starch, from wheat	Chemicals	Organic
electricity brown coal SA, at power plant	Electricity	Electricity by fuel
electricity brown coal VIC, at power plant	Electricity	Electricity by fuel
electricity from bagasse, at mill	Electricity	Electricity by fuel
electricity, black coal NSW, at power plant	Electricity	Electricity by fuel
electricity, black coal QLD, at power plant	Electricity	Electricity by fuel

Unit process	Category	Sub category
electricity, black coal WA, at power plant	Electricity	Electricity by fuel
electricity, coal seam methane, at power plant	Electricity	Electricity by fuel
electricity, natural gas, CC, at power plant	Electricity	Electricity by fuel
electricity, natural gas, CC, NT, at power plant	Electricity	Electricity by fuel
electricity, natural gas, CC, SA, at power plant	Electricity	Electricity by fuel
electricity, natural gas, CC, TAS, at power plant	Electricity	Electricity by fuel
electricity, natural gas, CC, WA, at power plant	Electricity	Electricity by fuel
electricity, natural gas, GT, at power plant	Electricity	Electricity by fuel
electricity, natural gas, GT, NT, at power plant	Electricity	Electricity by fuel
electricity, natural gas, GT, WA, at power plant	Electricity	Electricity by fuel
electricity, natural gas, steam, at power plant	Electricity	Electricity by fuel
electricity, natural gas, steam, SA, at power plant	Electricity	Electricity by fuel
electricity mix, Australia	Electricity	Electricity mixes at generation
electricity mix, coal and lignite	Electricity	Electricity mixes at generation
electricity mix, eastern Australian	Electricity	Electricity mixes at generation
electricity mix, New South Wales	Electricity	Electricity mixes at generation
electricity mix, Northern Territory	Electricity	Electricity mixes at generation
electricity mix, Queensland	Electricity	Electricity mixes at generation
electricity mix, South Australia	Electricity	Electricity mixes at generation
electricity mix, Tasmania	Electricity	Electricity mixes at generation
electricity mix, Victoria	Electricity	Electricity mixes at generation
electricity mix, western Australia	Electricity	Electricity mixes at generation
electricity, high voltage, Australian	Electricity	High voltage
electricity, high voltage, coal Australian average	Electricity	High voltage
electricity, high voltage, eastern Australian	Electricity	High voltage
electricity, high voltage, New South Wales	Electricity	High voltage
electricity, high voltage, Northern Territory	Electricity	High voltage
electricity, high voltage, Queensland	Electricity	High voltage
electricity, high voltage, South Australia	Electricity	High voltage
electricity, high voltage, Tasmania	Electricity	High voltage
electricity, high voltage, Victoria	Electricity	High voltage
electricity, high voltage, Western Australia	Electricity	High voltage
electricity, low voltage, Australian	Electricity	Low voltage
electricity, low voltage, coal Australian average	Electricity	Low voltage
electricity, low voltage, eastern Australia	Electricity	Low voltage
electricity, low voltage, New South Wales	Electricity	Low voltage
electricity, low voltage, Northern Territory	Electricity	Low voltage

Unit process	Category	Sub category
electricity, low voltage, Queensland	Electricity	Low voltage
electricity, low voltage, South Australia	Electricity	Low voltage
electricity, low voltage, Tasmania	Electricity	Low voltage
electricity, low voltage, Victoria	Electricity	Low voltage
electricity, low voltage, Eastern Australia	Electricity	Low voltage
DDGS, from soghum, at plant	Fuels	Biofuels
DDGS, from wheat and starch waste, at plant	Fuels	Biofuels
ethanol, average, at plant	Fuels	Biofuels
ethanol, from molasses, at plant	Fuels	Biofuels
ethanol, from sorghum, at plant	Fuels	Biofuels
ethanol, from wheat and starch waste	Fuels	Biofuels
sorghum to ethanol distillery operation	Fuels	Biofuels
wheat and starch waste to ethanol distillery operation	Fuels	Biofuels
black coal, average, at mine	Fuels	Coal
black coal, NSW, at mine	Fuels	Coal
black coal, QLD, at mine	Fuels	Coal
black coal, WA, at mine	Fuels	Coal
lignite, South Australia, at mine	Fuels	Coal
lignite, Victoria, at mine	Fuels	Coal
coal seam methane production and compression	Fuels	Coal seam gas
natural gas products, at separation plant	Fuels	Natural gas
natural gas products, at separation plant, bass strait	Fuels	Natural gas
natural gas products, at separation plant, central Australia	Fuels	Natural gas
natural gas products, at separation plant, Queensland	Fuels	Natural gas
natural gas products, at separation plant, Western Australia	Fuels	Natural gas
natural gas, high pressure, Australia	Fuels	Natural gas
natural gas, high pressure, New South Wales	Fuels	Natural gas
natural gas, high pressure, Northern Territory	Fuels	Natural gas
natural gas, high pressure, Queensland	Fuels	Natural gas
natural gas, high pressure, South Australia	Fuels	Natural gas
natural gas, high pressure, Tasmania	Fuels	Natural gas
natural gas, high pressure, Victoria	Fuels	Natural gas
natural gas, high pressure, Western Australia	Fuels	Natural gas
natural gas, low pressure, Australia	Fuels	Natural gas
natural gas, low pressure, New South Wales	Fuels	Natural gas
natural gas, low pressure, Northern Territory	Fuels	Natural gas
natural gas, low pressure, Queensland	Fuels	Natural gas
natural gas, low pressure, South Australia	Fuels	Natural gas
natural gas, low pressure, Tasmania	Fuels	Natural gas
natural gas, low pressure, Victoria	Fuels	Natural gas
natural gas, low pressure, Western Australia	Fuels	Natural gas
asphalt, 2% virgin bitumen, at plant/AU U	Materials	Asphalt

Unit process	Category	Sub category
asphalt, 3% virgin bitumen, at plant/AU U	Materials	Asphalt
asphalt, 4% virgin bitumen, at plant/AU U	Materials	Asphalt
asphalt, 5% virgin bitumen, at plant/AU U	Materials	Asphalt
asphalt, Recycled Asphalt Product (RAP), at point of origin/AU U	Materials	Asphalt
asphalt, standard mix, 5.5% virgin bitumen, at plant/AU U	Materials	Asphalt
concrete 20 MPa 30% fly ash, at batching plant/AU U	Materials	Concrete
concrete 20 MPa 30% GGBFS, at batching plant/AU U	Materials	Concrete
concrete 20 MPa, at batching plant/AU U	Materials	Concrete
concrete 25 MPa 30% fly ash, at batching plant/AU U	Materials	Concrete
concrete 25 MPa 30% GGBFS, at batching plant/AU U	Materials	Concrete
concrete 25 MPa, at batching plant/AU U	Materials	Concrete
concrete 32 MPa 30% fly ash, at batching plant/AU U	Materials	Concrete
concrete 32 MPa 30% GGBFS, at batching plant/AU U	Materials	Concrete
concrete 32 MPa, at batching plant/AU U	Materials	Concrete
concrete 40 MPa 30% fly ash, at batching plant/AU U	Materials	Concrete
concrete 40 MPa 30% GGBFS, at batching plant/AU U	Materials	Concrete
concrete 40 MPa, at batching plant/AU U	Materials	Concrete
concrete 50 MPa 30% fly ash, at batching plant/AU U	Materials	Concrete
concrete 50 MPa 30% GGBFS, at batching plant/AU U	Materials	Concrete
concrete 50 MPa, at batching plant/AU U	Materials	Concrete
concrete pipes, geopolymer, at plant, AU U	Materials	Concrete
fly ash, delivered to plant/AU U	Materials	Cement
general purpose cement, at plant/AU U	Materials	Cement
general purpose cement, Australian average/AU U	Materials	Cement
general purpose cement, imported clinker/AU U	Materials	Cement
ground granulated blast furnace slag, at cement plant/AU U	Materials	Cement
ordinary portland cement, at plant/AU U	Materials	Cement
ordinary portland cement, Australian average/AU U	Materials	Cement
ordinary portland cement, imported clinker/AU U	Materials	Cement
blast furnace slag allocation, at steel plant/AU U	Materials	Cement
expanded vermiculite, at plant	Materials	Minerals
polypropylene, PP, at factory gate	Materials	Plastics
cotton, lint, at gin	Materials	Textiles
cottonseed linters, at mill	Materials	Textiles
hardwood poles	Materials	Wood
hardwood pulp log, low quality	Materials	Wood
hardwood sawlog, high quality	Materials	Wood
hardwood sawlog, low quality	Materials	Wood
hardwood timber production	Materials	Wood
hardwood veneer log	Materials	Wood
softwood pole	Materials	Wood
softwood pulp log	Materials	Wood

Unit process	Category	Sub category
softwood sawlog, high quality	Materials	Wood
softwood sawlog, low quality	Materials	Wood
softwood timber production	Materials	Wood
softwood, woodchips	Materials	Wood
air freight domestic	Transport	Air
air freight, general aviation	Transport	Air
air freight, international	Transport	Air
air passenger travel, domestic	Transport	Air
air passenger travel, international	Transport	Air
air passenger, general aviation	Transport	Air
aircraft engine, domestic	Transport	Air
aircraft engine, domestic, aviation gasoline	Transport	Air
aircraft engine, international	Transport	Air
locomotive, cane train	Transport	Infrastructure
rail bins, cane transport	Transport	Infrastructure
railway track, cane transport	Transport	Infrastructure
transport, cane, rail	Transport	Infrastructure
operation, freight train	Transport	Rail
transport, freight, rail	Transport	Rail
operation, truck 16 to 28t, fleet average	Transport	Road
operation, truck 28t, fleet average	Transport	Road
operation, truck 3,5 to 16t, fleet average	Transport	Road
operation, van, diesel less than 3,5t	Transport	Road
operation, van, LPG less than 3,5t	Transport	Road
operation, van, petrol less than 3,5t	Transport	Road
transport, truck, 16 to 28t with 11t load	Transport	Road
transport, truck, 16 to 28t, fleet average	Transport	Road
transport, truck, 28t, fleet average	Transport	Road
transport, truck, 3,5 to 16t with 12t load	Transport	Road
transport, truck, 3,5 to 16t, fleet average	Transport	Road
transport, truck, 40t load	Transport	Road
transport, van 3,5t	Transport	Road
operation, VCM freight ship	Transport	Water
transport, VCM freight ship	Transport	Water
combustion, bagasse, in mill, QLD	Waste treatment	Incineration
methane, combustion for power generation	Waste treatment	Incineration
methane, combustion for power generation, NSW	Waste treatment	Incineration
methane, combustion for power generation, NT	Waste treatment	Incineration
methane, combustion for power generation, QLD	Waste treatment	Incineration
methane, combustion for power generation, SA	Waste treatment	Incineration
methane, combustion for power generation, TAS	Waste treatment	Incineration
methane, combustion for power generation, VIC	Waste treatment	Incineration

Unit process	Category	Sub category
methane, combustion for power generation, WA	Waste treatment	Incineration
waste treatment, coated paper, at landfill	Waste treatment	Landfill
waste treatment, corrugated containers, at landfill	Waste treatment	Landfill
waste treatment, cotton oil production waste, at landfill	Waste treatment	Landfill
waste treatment, food, at landfill	Waste treatment	Landfill
waste treatment, garden and green, at landfill	Waste treatment	Landfill
waste treatment, inert waste, at landfill	Waste treatment	Landfill
waste treatment, mixed paper, at landfill	Waste treatment	Landfill
waste treatment, municipal waste average, at landfill	Waste treatment	Landfill
waste treatment, nappies, at landfill	Waste treatment	Landfill
waste treatment, newsprint, at landfill	Waste treatment	Landfill
waste treatment, office paper, at landfill	Waste treatment	Landfill
waste treatment, rubber and leather, at landfill	Waste treatment	Landfill
waste treatment, sludge, at landfill	Waste treatment	Landfill
waste treatment, textiles, at landfill	Waste treatment	Landfill
waste treatment, wood and wood-waste, at landfill	Waste treatment	Landfill
waste treatment, wood and wood-waste, low degradation assumption, at landfill	Waste treatment	Landfill
disposal, silage from molasses fermentation	Waste treatment	Others
land application of bagasse boiler ash to cane fields	Waste treatment	Others
land application of mill mud to cane fields	Waste treatment	Others
recycling aluminium	Waste treatment	Recycling
recycling steel	Waste treatment	Recycling
collection and processing of aluminium scrap	Waste treatment	Waste collection
collection and processing of steel scrap	Waste treatment	Waste collection
tap water, at user, Australia/AU U	Water supply	State averages
tap water, at user, New South Wales/AU U	Water supply	State averages
tap water, at user, Northern Territory/AU U	Water supply	State averages
tap water, at user, Queensland/AU U	Water supply	State averages
tap water, at user, South Australia/AU U	Water supply	State averages
tap water, at user, Tasmania/AU U	Water supply	State averages
tap water, at user, Victoria/AU U	Water supply	State averages
tap water, at user, Western Australia/AU U	Water supply	State averages
tap water, at user, Barwon-Darling, NSW/AU U	Water supply	By catchment
tap water, at user, Border Rivers, NSW and QLD/AU U	Water supply	By catchment
tap water, at user, Burdekin River, QLD/AU U	Water supply	By catchment
tap water, at user, Burnett and Brisbane River, QLD/AU U	Water supply	By catchment
tap water, at user, Campaspe, VIC/AU U	Water supply	By catchment
tap water, at user, Condamine-Balonne, NSW and QLD/AU U	Water supply	By catchment
tap water, at user, Eastern Mount Lofty Ranges, SA/AU U	Water supply	By catchment
tap water, at user, Esperance Coast, WA/AU U	Water supply	By catchment
tap water, at user, Fitzroy River, QLD/AU U	Water supply	By catchment

Unit process	Category	Sub category
tap water, at user, Goulburn-Broken, VIC/AU U	Water supply	By catchment
tap water, at user, Gulf of Carpentaria, NT and QLD/AU U	Water supply	By catchment
tap water, at user, Gwydir, NSW/AU U	Water supply	By catchment
tap water, at user, Indian Ocean, WA/AU U	Water supply	By catchment
tap water, at user, Lachlan, NSW/AU U	Water supply	By catchment
tap water, at user, Lake Eyre, NSW, QLD, NT and SA/AU U	Water supply	By catchment
tap water, at user, Loddon-Avoca, VIC/AU U	Water supply	By catchment
tap water, at user, Macquarie-Castlereagh, NSW/AU U	Water supply	By catchment
tap water, at user, Moonie, QLD/AU U	Water supply	By catchment
tap water, at user, Moore Hill rivers, WA/AU U	Water supply	By catchment
tap water, at user, Murray, NSW, VIC and SA/AU U	Water supply	By catchment
tap water, at user, Murrumbidgee, NSW/AU U	Water supply	By catchment
tap water, at user, Namoi, NSW/AU U	Water supply	By catchment
tap water, at user, NE Coast other than Burd., Fitz.,..., QLD/AU U	Water supply	By catchment
tap water, at user, North Western Plateau, WA and NT/AU U	Water supply	By catchment
tap water, at user, Ovens, VIC/AU U	Water supply	By catchment
tap water, at user, Paroo, NSW and QLD/AU U	Water supply	By catchment
tap water, at user, South Australian Gulf, SA/AU U	Water supply	By catchment
tap water, at user, South East Coast, NSW, VIC and SA/AU U	Water supply	By catchment
tap water, at user, South Western Plateau, WA/AU U	Water supply	By catchment
tap water, at user, SW Coast other than Esp., Avon, ..., WA/AU U	Water supply	By catchment
tap water, at user, Swan Coast, WA/AU U	Water supply	By catchment
tap water, at user, Tasmania, TAS/AU U	Water supply	By catchment
tap water, at user, Timor Sea, NT and WA/AU U	Water supply	By catchment
tap water, at user, Warrego, NSW and QLD/AU U	Water supply	By catchment
tap water, at user, Wimmera, VIC/AU U	Water supply	By catchment

## Processes removed from AusLCI

The following processes have been removed from the database as PVC is no longer produced in Australia

polyvinylchloride, granulate, at plant	Materials	Plastics
ethylene dichloride-vinyl chloride monomer, at plant	Chemicals	Organic

## Appendix B : Modifications applied to ecoinvent 3.3 to produce the shadow database

The following is a list of ecoinvent processes which have been replaced by AusLCI data. Unless otherwise specified the link is on a one to one basis.

ecoinvent 3.3 process	AusLCI process(es)
Barley grain {AU REG}  market for   Alloc Def, U	barley, feed grade, no-till, northern east NSW, at farm/AU U
Barley grain, feed {AU REG}  market for   Alloc Def, U	barley, feed grade, no-till, northern east NSW, at farm/AU U
Barley grain, Swiss integrated production {AU REG}  market for   Alloc Def, U	barley, malt grade, short fallow, no-till, central west NSW, at farm/AU U
Cement, Portland {AU REG}  market for   Alloc Def, U	general purpose cement, at plant/AU U
Cement, unspecified {AU REG}  market for   Alloc Def, U	general purpose cement, Australian average/AU U
Cement, unspecified {AU REG}  market for cement, unspecified   Alloc Def, U	general purpose cement, Australian average/AU U
Clinker {AU REG}  market for   Alloc Def, U	clinker, at plant/AU U
Clinker {AU REG}  market for clinker   Alloc Def, U	clinker, at plant/AU U
Concrete, for de-icing salt contact {AU REG}  market for   Alloc Def, U	concrete 25 MPa, at batching plant/AU U
Concrete, high exacting requirements {AU REG}  market for   Alloc Def, U	concrete 32 MPa, at batching plant/AU U
Concrete, normal {AU REG}  market for   Alloc Def, U	concrete 25 MPa, at batching plant/AU U
Concrete, sole plate and foundation {AU REG}  market for   Alloc Def, U	concrete 25 MPa 30% GGBFS, at batching plant/AU U
Cotton seed, for sowing {AU REG}  market for   Alloc Def, U	cotton, seed cotton, Australia, at farm/AU U
Electricity, low voltage {AU REG}  market for   Alloc Def, U	electricity, low voltage, Australian/AU U
Electricity, low voltage {AU REG}  market group for   Alloc Def, U	electricity, low voltage, Australian/AU U
Electricity, medum voltage {AU REG}  market for   Alloc Def, U	electricity, low voltage, Australian/AU U
Electricity, medum voltage {AU REG}  market group for   Alloc Def, U	electricity, low voltage, Australian/AU U
Electricity, high voltage {AU REG}  market for   Alloc Def, U	electricity, high voltage, Australian/AU U
Electricity, high voltage {AU REG}  market group for   Alloc Def, U	electricity, high voltage, Australian/AU U
Ethanol, without water, in 99.7% solution state, from fermentation {AU REG}  market for   Alloc Def, U	ethanol, average, at plant/AU U
Ethylene, average {AU REG}  production   Alloc Def, U	ethylene, average, at plant /AU U
Ground granulated blast furnace slag {AU REG}  market for   Alloc Def, U	ground granulated blast furnace slag, at cement plant/AU U
Hard coal {AU REG}  market for   Alloc Def, U	black coal, NSW, at mine/AU U, (56.2%) black coal, QLD, at mine/AU U, (38.3%) black coal, WA, at mine/AU U (5.43%)
Lignite {AU REG}  market for   Alloc Def, U	lignite, Victoria, at mine/AU U
Maize grain, feed {AU REG}  market for   Alloc Def, U	maize, grain, average, on farm/AU U
Maize grain, feed, Swiss integrated production {AU REG}  market for   Alloc Def, U	maize, grain, average, on farm/AU U

Maize silage {AU REG}  market for   Alloc Def, U	maize, silage, average, on farm/AU U
Maize silage, Swiss integrated production {AU REG}  market for   Alloc Def, U	maize, silage, average, on farm/AU U
Natural gas, high pressure {AU REG}  market for   Alloc Def, U	natural gas, high pressure, Australia/AU U
Natural gas, high pressure {AU REG}  market group for   Alloc Def, U	natural gas, high pressure, Australia/AU U
Polyethylene, high density, granulate {AU REG}  production   Alloc Def, U	high density polyethylene, average, at plant /AU U
Polyethylene, linear low density, granulate {AU REG}  production   Alloc Def, U	linear low density polyethylene, at plant /AU U
Polyethylene, low density, granulate {AU REG}  production   Alloc Def, U	low density polyethylene, at plant /AU U
Polypropylene, granulate {AU REG}  market for   Alloc Def, U	polypropylene, PP, at factory gate/AU U
Propylene {AU REG}  production   Alloc Def, U	propylene, average, at plant /AU U
Rape meal {AU REG}  market for   Alloc Def, U	canola meal, at oil mill/AU U
Rape oil, crude {AU REG}  market for   Alloc Def, U	canola oil, at oil mill/AU U
Rape seed {AU REG}  market for   Alloc Def, U	canola, average, at farm/AU U
Rape seed, for sowing {AU REG}  market for   Alloc Def, U	canola, average, at farm/AU U
Rape seed, Swiss integrated production {AU REG}  market for   Alloc Def, U	canola, average, at farm/AU U
Roundwood, eucalyptus ssp. from sustainable forest management, under bark {AU REG}  market for   Alloc Def, U	hardwood pulp log, low quality/AU U
Sawlog and veneer log, hardwood, debarked, measured as solid wood {AU REG}  market for   Alloc Def, U	hardwood sawlog, high quality/AU U
Sawlog and veneer log, hardwood, measured as solid wood under bark {AU REG}  market for   Alloc Def, U	hardwood sawlog, high quality/AU U
Sawlog and veneer log, softwood, debarked, measured as solid wood {AU REG}  market for   Alloc Def, U	softwood sawlog, high quality/AU U
Straw {AU REG}  market for   Alloc Def, U	straw, from wheat, central east, NSW, at farm/AU U
Sugar, from sugar beet {AU REG}  market for   Alloc Def, U	sugar, raw, at mill, QLD/AU U
Tap water {AU REG}  market for   Alloc Def, U	tap water, at user, Australia/AU U
Tap water {AU REG}  market group for   Alloc Def, U	tap water, at user, Australia/AU U
Transport, freight train {AU REG}  market for   Alloc Def, U	transport, freight, rail/AU U
Transport, freight train {AU REG}  market group for   Alloc Def, U	transport, freight, rail/AU U
Transport, freight, aircraft {AU REG}  intercontinental   Alloc Def, U	air freight, international/AU U
Transport, freight, aircraft {AU REG}  intracontinental   Alloc Def, U	air freight domestic/AU U
Transport, freight, light commercial vehicle {AU REG}  market for   Alloc Def, U	transport, van 3,5t/AU U
Transport, freight, lorry >32 metric ton, EURO3 {AU REG}  market for   Alloc Def, U	transport, truck, 28t, fleet average/AU U
Transport, freight, lorry >32 metric ton, EURO4 {AU REG}  market for   Alloc Def, U	transport, truck, 28t, fleet average/AU U
Transport, freight, lorry >32 metric ton, EURO5 {AU REG}  market for   Alloc Def, U	transport, truck, 28t, fleet average/AU U
Transport, freight, lorry >32 metric ton, EURO6 {AU REG}  market for   Alloc Def, U	transport, truck, 28t, fleet average/AU U
Transport, freight, lorry 16-32 metric ton, EURO3 {AU REG}  market for   Alloc Def, U	transport, truck, 16 to 28t, fleet average/AU U
Transport, freight, lorry 16-32 metric ton, EURO4 {AU REG}  market for   Alloc Def, U	transport, truck, 16 to 28t, fleet average/AU U
Transport, freight, lorry 16-32 metric ton, EURO5 {AU REG}  market for   Alloc Def, U	transport, truck, 16 to 28t, fleet average/AU U

Transport, freight, lorry 16-32 metric ton, EURO6 {AU REG}  market for   Alloc Def, U	transport, truck, 16 to 28t, fleet average/AU U
Transport, freight, lorry 3.5-7.5 metric ton, EURO3 {AU REG}  market for   Alloc Def, U	transport, truck, 3,5 to 16t, fleet average/AU U
Transport, freight, lorry 3.5-7.5 metric ton, EURO4 {AU REG}  market for   Alloc Def, U	transport, truck, 3,5 to 16t, fleet average/AU U
Transport, freight, lorry 3.5-7.5 metric ton, EURO5 {AU REG}  market for   Alloc Def, U	transport, truck, 3,5 to 16t, fleet average/AU U
Transport, freight, lorry 3.5-7.5 metric ton, EURO6 {AU REG}  market for   Alloc Def, U	transport, truck, 3,5 to 16t, fleet average/AU U
Transport, freight, lorry 7.5-16 metric ton, EURO3 {AU REG}  market for   Alloc Def, U	transport, truck, 3,5 to 16t, fleet average/AU U
Transport, freight, lorry 7.5-16 metric ton, EURO4 {AU REG}  market for   Alloc Def, U	transport, truck, 3,5 to 16t, fleet average/AU U
Transport, freight, lorry 7.5-16 metric ton, EURO5 {AU REG}  market for   Alloc Def, U	transport, truck, 3,5 to 16t, fleet average/AU U
Transport, freight, lorry 7.5-16 metric ton, EURO6 {AU REG}  market for   Alloc Def, U	transport, truck, 3,5 to 16t, fleet average/AU U
Transport, passenger, aircraft {AU REG}  intercontinental   Alloc Def, U	air passenger travel, international/AU U
Transport, passenger, aircraft {AU REG}  intracontinental   Alloc Def, U	air passenger travel, domestic/AU U
Wheat grain {AU REG}  market for   Alloc Def, U	wheat, grain, average, at farm/AU U
Wheat grain, feed {AU REG}  market for   Alloc Def, U	wheat, grain, average, at farm/AU U
Wheat grain, Swiss integrated production {AU REG}  market for   Alloc Def, U	wheat, grain, average, at farm/AU U

## Appendix C : AusLCI releases

Version No.	Date released	Content/ Comments
<b>0.9</b>	3 Mar 2011	29 Processes
<b>1.0</b>	8 Oct 2013	156 processes
<b>1.01</b>	7 Nov 2013	159 processes
<b>1.1</b>	17 July 2014	326 processes
<b>1.13</b>	31 July-2014	355 processes
<b>1.16</b>	21 Sep 2014	359 processes
<b>1.17</b>	06 Feb 2015	359 processes
<b>1.23</b>	08 April 2016	461 processes
<b>1.25</b>	20 Sep 2016	Fix to Eco invent epoxy inventory
<b>1.26</b>	26 Sep 2016	Fix to heat from LPG
<b>1.27</b>	5 June 2017	Fix to Landfill inventories, calibration of electricity to NGA factors
<b>2.27</b>	24 March 2017	Update shadow database to ecoinvent 3.3
<b>1.27</b> <b>2.28</b>	30 <sup>th</sup> March 2019	400 new agriculture processes Updated electricity, warm asphalt