UNIVERSITY OF TASMANIA

GREENHOUSE GAS INVENTORY

2017

Infrastructure Services and Development
http://www.utas.edu.au/infrastructure-services-development
University of Tasmania
TAS 7000 Australia
CRICOS provider number 00586B

CONTENTS

1 INTRODUCTION

The University of Tasmania is committed to undertaking measures to reduce greenhouse gas emissions including behavioural changes in resource use, infrastructure improvements and the installation of renewable energy infrastructure and to identify carbon offset opportunities for emissions that cannot be reduced or eliminated. The University of Tasmania also recognises the responsibility that it holds within the Tasmanian community to reduce greenhouse gas emissions in line with State Government goals.

This document follows the initial University of Tasmania Greenhouse Gas (GHG) Inventory developed in 2015, which was defined as the baseline year. The University GHG Inventory 2017 provides the technical underpinnings of the University GHG emissions measurement and emission reduction measures. In 2017 the total organisational emissions were calculated as 28,749 t CO_2-e. A summary of the University carbon emissions for 2017, as well as the percentage change in emissions compared to the previous GHG Inventory, is provided in Appendices A and B.

The University is legally required to report greenhouse gas emissions under the National Greenhouse and Energy Reporting (NGER) scheme. This scheme covers scope 1 emissions (direct release of greenhouse gases from sources that are owned or controlled by the University; e.g., the University vehicle fleet) and scope 2 emissions (emissions released to the atmosphere from the indirect consumption of an energy commodity; e.g., indirect emissions from the generation of purchased electricity). The University reported 8,780 t CO_2-e under NGER in the 2016/2017 reporting year. Reporting of scope 3 emissions (indirect emissions from sources not owned or controlled by the University; e.g., business travel) is not compulsory; however, the University will continue building its capability to internally report on selected (material) emissions. The development of this greenhouse gas inventory is a step towards regular and consistent reporting to support emissions reduction efforts.

2 MAJOR UPDATES

This section aims to highlight any major changes to the inventory boundaries, data management and quantification methods from the University GHG inventory in 2017. This section also demonstrates changes such as the use of different emission factors and new ways of collecting data.

2.1 Organisational boundary changes

The following changes to the University's organisational boundary occurred during 2017

Table 1. Changes to the University's organisational boundary in 2017

Facility Name	Services	Meters	Dates Reported
106 Boundary St, Paddington, NSW	Electricity	5049; 64945	01/01/17-31/12/17
64 Derwentwater St, Hobart	Electricity Water	800148760 470018039	01/01/17-27/01/17
70 Queen St, Hobart	Electricity Water	8000144474 470020158	01/01/17-27/01/17
50 Regent St, Hobart	Electricity Water	8000150053 470020624	01/01/17-11/08/17
40 Melville St, Hobart	Electricity	Unknown	30/01/17-28/07/17
Mt Quoin Microwave Tower	Electricity	8000246151	01/01/17-01/09/17
Vincents Hill Microwave Tower	Electricity	8000245869	01/01/17-01/09/17
Abels Hill Microwave Tower	Electricity	8000245824	01/01/17-01/09/17
Epping Forest Microwave Tower	Electricity	8000245870	01/01/17-01/09/17
8 Church St, West Hobart (scope 3 facility)	Electricity	Unknown	10/04/17-31/12/17
16/1 Castray Esplanade, Battery Point (scope 3 facility)	Electricity	8000253088	24/02/17-31/12/17

2.1.1 Operational control review

A review of the facilities under operational control and scope 3 facilities was conducted for this GHG Inventory and the following decisions were made:

Table 2. Changes to the University's facilities operational control assessment in 2017

Facility Name	2016 status	2017 status
Mt Dazzler Microwave Tower	Operational control	Scope 3 facility
Round Hill Microwave Tower	Operational control	Scope 3 facility
Muddy Plains Melton Mowbray Tower	Operational control	Out of boundary
Olinda Grove Storeroom	Operational control	Out of boundary
Olinda Grove Clubrooms	Operational control 100%	Operational control 20%
NRAS Apartments Melville St	Scope 3 facility (construction)	Operational control (completed)
ABC Centre Stone Building, Hobart	Out of boundary	Scope 3 facility
The Queen Victoria Home Inc, Lindisfarne	Out of boundary	Scope 3 facility
Clarence Integrated Care Centre	Out of boundary	Scope 3 facility

2.2 Data management changes

2.2.1 Farm fuels

A review of the use of bulk purchased fuel for Elliot Dairy Farm and Forth Vegetable Farm was conducted in 2017. The majority of fuel (diesel and gasoline) purchased for the farms is used for farm vehicles. All vehicles but one are registered (with full or restricted registration) and therefore the fuel used in these vehicles is considered to be for transport purposes.

Only a small amount of gasoline is used at Elliot Farm in mowers and other stationary equipment. Therefore, 300 L of gasoline (as indicated by the farm manager) of the bulk bills were assigned to non-transport fuels. The emission factor for gasoline for non-transport purposes is higher than for transport, therefore this is a more conservative approach. This methodology is also consistent with the approach taken in NGERS reporting by the University.

2.2.2 Transport fuels and hire cars

In November 2017, the University of Tasmania changed its vehicle fleet management system from owned vehicles to outsourced (hire) vehicles. For the purposes of this document and pending further analysis, these outsourced cars are considered to be under the University's operational control.

Fuel cards continued to be used as usual in both owned and outsourced vehicles during the transition period. However, outsourced cars registration appears as "HIRE ##" in the fuel card reports, and therefore it is not possible to differentiate between these and short-term hire cars. Hence, vehicle fleet, outsourced and short-term hire cars are reported together in the GHG Inventory 2017 under 4.1.3 Transport fuels. Hire cars are reportable as a scope 3 emissions source, but the emissions reported are calculated using scope 1 factors, thus the methodology used is the same in both cases.

2.3 Calculation methodology changes

For all significant changes in methodology for calculating GHG emissions in 2017, the University has recalculated the previous GHG inventories (when possible) to allow GHG emissions to be accurately compared between years. The revised 2016 GHG Inventory can be found in Appendix B. All the emission sources for which methodology has been changed are outlined below.

2.3.1 Waste to landfill and recycling

The National Carbon Offset Standard for Organisations (Department of the Environment and Energy 2017a), recommends to use the default emission factors for waste sent to recycling based on UK data (in the absence of more relevant emission factors; provided by UK Department of Business, Energy and Industrial Strategy, DBEIS). The factors consider transport to a materials reclamation facility only. This is in line with GHG Protocol Guidelines (WRI/WBCSD 2004). These emission factors were not used in previous GHG inventories.

2.3.2 Travel accommodation – international

The UK Department of Business, Energy and Industrial Strategy (DBEIS) now provides an emission factor for international overnight hotel stays. Different emission factors are provided for a range of countries on a 'room per night' basis. These emission factors are based on estimates for an overnight stay in an average hotel. The hotel stay conversion factors are taken from the Hotel Footprinting Tool, produced by the International Tourism Partnership and Greenview.

2.3.3 Staff commuting

The number of casual staff used in the GHG Inventory 2016 (for the extrapolation of the data collected in the UTAS Travel Behaviour Survey) was the total number of registered casual staff with no other position (fixed term or ongoing) at the University. However, a number of registered casual staff do not actually work for all or part of the year. In the GHG Inventory 2017, casual staff was calculated as the average number of staff who claimed working time in a month. This is a more representative figure for the purpose of calculating GHG emissions from commuting.

3 GHG INVENTORY DETAILS

The University of Tasmania GHG Inventory provides details of the boundary, data management and the methodology used to calculate the University's carbon footprint. The University's Infrastructure Services and Development (ISD) area collects, records and maintains the source data; ISD also prepares and calculates the GHG Inventory. Ultimate responsibility for these tasks within ISD is with the Sustainability Manager.

3.1 Standards used

Data is collected and emissions calculated according to the National Greenhouse and Energy Reporting (Measurement) Determination 2008, ("the Measurement Determination") the National Greenhouse Accounts (NGA) Factors workbooks (Department of the Environment and Energy 2016, 2017b) and the Australian Standard 14064.1:2006.

The GHG Inventory was completed in accordance with the Greenhouse Gas Protocol Corporate Accounting and Reporting Standard (WRI/WBCSD, 2004), ISO 14064.1: 2006 and the National Carbon Offset Standard for Organisations (Department of the Environment and Energy 2017a).

3.2 Base year

The first University GHG Inventory was calculated for the 2015 calendar year, which is used as the base year for comparison with the 2017 carbon footprint. Note that the GHG Inventory 2015 was externally audited and reasonable assurance of the annual report to the Department of Environment will be conducted every three years.

Data from preceding years will be recalculated as new methodologies, more accurate data and new emission sources become available to provide the most accurate comparison with following years.

3.3 Annual reporting process

The reporting process, carbon offset purchases and audit requirements for this and future GHG Inventories are set out in Figure 1 below. Participants in the program can choose to offset their emissions in advance or in arrears. The University of Tasmania will purchase offsets in arrears.

Figure 1: Annual Reporting Process under NCOS – offsetting in arrears of incurring emissions

3.4 Inventory boundaries

3.4.1 Organisational boundary

The University GHG Inventory 2017 includes the emissions associated with teaching and learning, research and operational activities located at all Australian properties occupied by University staff and students for which the University has operational control. Operational control of facilities at all sites was determined according to Section 11; NGER Act 2007 and was based on whether the University had the authority to introduce and implement operational, health and safety, and environmental policies for the activities undertaken on a site occupied by the University, irrespective of whether it is owned or leased, including those that are located outside physical campus boundaries.

The operational control assessment made for the GHG Inventory is consistent in all cases with the evaluation of the facilities reported under the NGER Act annually by the University. The determination of operational control assessment is documented in "DOC/17/14523 National Greenhouse & Energy Reporting (NGER) Decisions and Assessments Register 2016 - 2017". This register is updated annually prior to NGER reporting. An overall summary of the Australian sites included in the University's organisational boundary is provided in Appendix C.

Joint and co-operative ventures

Joint and co-operative ventures located in the University facilities are included in the organisational boundary.

Contractors

Contractors such as cleaners and security are within the organisational boundary, as the University has the greater authority regarding operational, health and safety, and environmental policies on its sites. This excludes green-field building sites where only building contractor staff can enter.

For the GHG Inventory 2017, all contracts were considered. However, as these emissions are immaterial against the full scope of the inventory, they have not been included.

Student accommodation

Where student accommodation is operated by the University, this has been included as part of the University's organisational boundary.

From December 2017, student accommodation residences operated by the University on and off campus were outsourced to a third party. However, the University still pays utility costs, is responsible for residents and retains control of infrastructure improvements that could affect energy use. Additionally, the third party will be subjected to the University's policies and procedures. Therefore, for the purposes of this document and pending further analysis, these facilities are considered to be under the University's operational control

3.4.1.1 Scope 3 facilities

For those facilities not under the University's operational control, a subsequent assessment as to whether the facility was relevant as a scope 3 facility was made. The assessment criteria applied is whether the facility would operate in the absence of the University as an organisation. Where the facility would independently operate, it was determined not to be a scope 3 facility for the University. Where a facility was determined to be a scope 3 facility for the University, all emissions associated with the facility (as available and further documented below) were included in the inventory.

This assessment was made in consultation between Corey Peterson (Sustainability Manager), Carmen Primo Perez (Sustainability Officer), Mark White (Manager, Engineering Services) and Rowena Zwart (Project Officer, Infrastructure Sustainability).

Staff accommodation

The University provides accommodation to select staff as part of the terms of their contract. The University receives and pays the invoices associated with these facilities. As the University has no operational control over these properties, they have been included as the University scope 3 facilities.

Work experience placements

In the course of their studies, the University students may be required to undertake a work experience placement (e.g., Rural Health rotation placements). The emissions associated with the work conducted by the students during these placements are considered to be the scope 3 emissions of the University.

As discussed in the GHG Inventory 2015, this emission source will not be estimated given the difficulty in getting data on the myriad of work placements conducted by students and the clear immateriality of these emissions in the context of the reported emissions for the University.

3.4.1.2 Exceptions to the organisational boundary

International campuses

The University offers services in Hong Kong, Oceans University and Shanghai University. The operations of the University in these countries is not included in this inventory as these campuses have been determined outside of the operational control of the University, whereby the University has no authority to introduce operational, health and safety, and environmental policies as guests of these respective universities.

On campus facilities

There are a number of separately metered sites at some campuses which were determined not to be under the operational control of the University. These sites are on-charged for their electricity use and they are not occupied by University staff.

- CSIRO (Sandy Bay Campus)
- AFRDI (Newnham Campus)
- Lady Gowrie Child Care Centre and After School Care (Sandy Bay and Newnham campuses)
- Community Health Clinic (Sandy Bay Campus)
- The following catering facilities: Lazenby's, Refectory, Trade Table, Law Café, University Staff Club, Source Wholefoods, (Sandy Bay Campus); Salutem (Medical Science Precinct); Centre for the Arts Cafeteria (Centre for the Arts); The Grove, The Walk, (Newnham Campus); Graze Café, and Makers' Workshop Café (Cradle Coast Campus)
- Tasmanian University Union leased facilities (Sandy Bay and Newnham campuses)
- Hair dressers (Sandy Bay and Newnham campuses)
- Doctor surgery (Sandy Bay Campus)
- Travel agent (Newnham Campus)

There are also facilities on leased land from the University which are excluded from the electricity boundary as they are not related to University operations. These include:

- Airservices Microwave Tower (Cambridge Farm). This is a beacon leased and operated by Airservices for air traffic control

These decisions on operational control are consistent with those made under NGER. The facilities listed above have also been considered in terms of scope 3 facilities and determined not to be scope 3 facilities.

Student accommodation

Where off campus accommodation is leased by the University and made available to students (e.g., Rural Health accommodation sites), this is not part of the defined organisational boundary for the University. In these properties the University acts as a standard tenant and thus does not have operational control of these facilities. These facilities have also been determined not to be scope 3 facilities.

3.4.2 Operational boundary

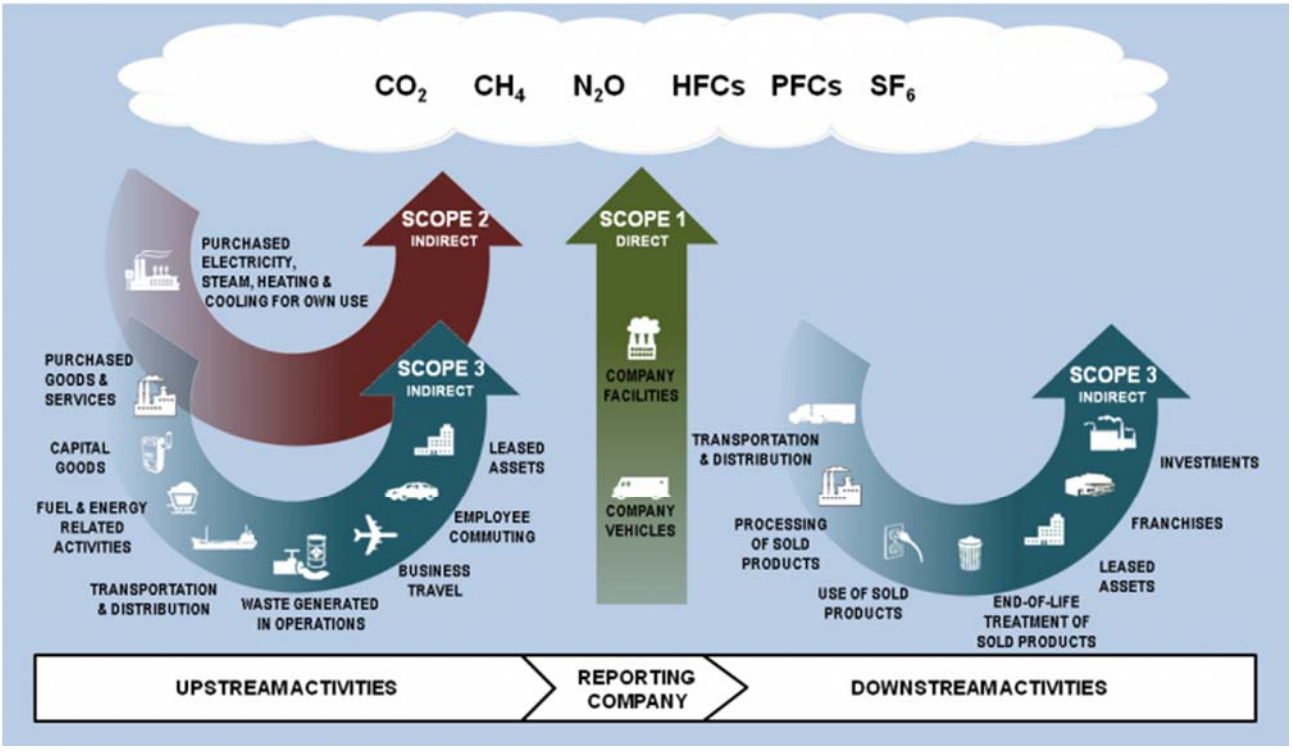
3.4.2.1 Greenhouse gases included

The emissions of all six greenhouse gases included in the Kyoto Protocol (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride) are included in this Inventory.

3.4.2.2 Emission sources

Emission sources are grouped in this inventory according to the definitions sourced from the NGA Factors workbooks (Department of the Environment and Energy 2017b). The following figure visually depicts what emission sources are included in the three scopes.

Figure 2. Emission sources classified by scopes. Source: http://www.ghgprotocol.org/



Scope 1 emissions

Scope 1 emissions are direct emissions which are produced from sources within the boundary of an organisation and as a result of that organisation's activities. The University's scope 1 emissions consistent with the Measurement Determination arise from the use of natural gas, transport and non-transport liquid fuels and petroleum based products.

Scope 2 emissions

Scope 2 emissions are indirect emissions associated with a purchased energy product. For the University of Tasmania the energy products purchased which have associated scope 2 emissions are limited to electricity. There are no purchases of heat or steam products within the organisational boundary.

Scope 3 emissions

Scope 3 emissions are other indirect emissions generated in the wider economy as a consequence of an organisation's activities, but which are physically produced by the activities of another organisation. Examples of scope 3 emissions include (but are not limited to) embodied emissions from extraction, production, and transportation of fuel and purchased goods, line loss from electricity transmission and distribution, business travel, waste disposal and outsourced activities (e.g. 'cloud' data storage).

Scope 3 emissions are included in this inventory as recommended by the National Carbon Offset Standard (Department of the Environment and Energy 2017a) and the GHG Protocol (WRI/WBCSD 2004). Emission sources are included where data of sufficient accuracy is available with relative ease of collection. The assessment of data availability, accuracy and relevance of each category of emissions is documented in Table 3 below.

Table 3: Assessment of relevant scope 3 emissions sources for the University of Tasmania

NCOS Guidelines / GHG Protocol	Assessment of potential for relevance for the University
Purchased goods and services	All goods and services purchased were considered for materiality and data availability. The following emissions sources have relatively easily available data and are likely to be a source of emissions: • Refrigerant gases • Cattle • Office paper • Tissue paper • Water All services purchased were also considered for whether they were likely to result in emissions and the availability of data under the relevant contracts. No contract in the top ten by expenditure was likely to include material emissions.
Capital goods	The University constructed the following facilities in 2017: • NRAS Apartments, Melville St (completed) • The Hedberg, Campbell St (ongoing) An estimate of the emissions associated with the construction of these facilities is included in this inventory.
Fuel and energy related activities (not included in scope 1 or scope 2)	For the fuels listed as scope 1 and 2, all scope 3 emissions for which emissions factors are available have been included. These include: electricity, natural gas, diesel, petrol, liquefied petroleum gas, kerosene, petroleum based oils and solvents.
Upstream transportation and distribution	Transportation and distribution of products and third-party transportation and distribution services purchased by the University were considered for whether they were likely to result in emissions and the availability of data. However, data was not available for considered products and services.
Waste generated in operations	For all waste collections paid for by the University and invoiced by JJ Richards (the sole waste contractor in Tasmania) emissions have been estimated. Sanitary waste collections and waste water have also been included.

NCOS Guidelines / GHG Protocol	Assessment of potential for relevance for the University
Business travel	Emissions associated with the following business travel have been included: • Air travel • Accommodation • Taxis • Hire cars
Employee commuting	The emissions associated with employee commuting were calculated based on the available data and assessed for materiality. Based on this assessment, the staff commuting emissions were found to be material and have been included in the inventory.
Upstream leased assets	All facilities occupied by University staff or students were considered in the assessment of operational control and scope 3 facilities. Where assessed as under the University's operational control or a scope 3 facility, upstream leased assets are included.
Downstream transportation and distribution	The University provides a service and thus there are no downstream transportation or distribution emissions associated with the organisation's activities.
Processing of sold products	The University provides a service, thus there is no processing of sold products that will produce emissions relevant for the organisation.
Use of sold products	The University provides a service, thus there is no use of sold products that will produce emissions relevant for the organisation.
End-of-life treatment of sold products	The University provides a service, thus there is no end-of-life treatment of sold products that will produce emissions relevant for the organisation.
Downstream leased assets	All University facilities leased by other entities where considered in the assessment of operational control and scope 3 facilities. Where assessed under the University's operational control or as a scope 3 facility, downstream leased assets are included.
Franchises	None
Investments	The University's investment portfolio includes managed products only. As the University does not have the ability to specify the individual components of these investments, these are outside of the operational control and scope 3 boundary for the University.

3.5 Roles and Responsibilities

Management

The Infrastructure Services and Development Section, and more specifically the Sustainability Manager, are responsible for managing the University's annual GHG Inventory. The Infrastructure Services and Development Section sits within the Division of the Chief Operating Officer.

Data provision

The following University departments and external organisations gather and provide data for the development of the GHG Inventory:

- Financial Services: invoices and credit card transactions
- Tasmanian Institute of Agriculture: livestock data
- Sustainability Team: staff commuting data

- Human Resources and Business Intelligence Unit: staff and student numbers
- Staples, Airmaster, JJ Richards and Corporate Travel Management: detailed data of office paper, refrigerant gases, waste and recycling, and business air travel and accommodation respectively.

Data collation and analysis

The Sustainability Team, in collaboration with the Infrastructure, Planning and Compliance Unit, collects data from all relevant sources and calculates emissions to develop the annual GHG Inventory in line with the GHG Protocol and the National Carbon Offset Standard.

Data storage

Financial Services is responsible for retaining the invoice and credit card transactions data utilised in calculating the annual emissions profile for the University. Finance Services uses TechnologyOne; the record keeping abilities of this software comply with all regulations for financial data (5 years retention).

The Sustainability team is responsible to gather provider reports and other documents used in the emissions calculation of some sources (e.g., air travel, office paper) and to store them in a University network drive utilising relevant security best practices and records management system controlling access.

Overview and approval

The University GHG Inventory is presented annually to the Sustainability Committee and the Senior Management Team for overview and approval. The Sustainability Committee is currently chaired by Professor Margaret Otlowski, Pro Vice-Chancellor (Culture and Wellbeing). Current membership includes representatives from all functional areas of the University as well as representatives for academic areas, students and the Education for Sustainability Community of Practice.

After approval, the Inventory is made available on the University Sustainability website (http://www.utas.edu.au/infrastructure-services-development/sustainability), which is open to the University community and to the public.

3.6 Reported emissions

A summary of emission sources included in the University GHG Inventory 2017 is provided in Appendix A. To be as comprehensive as possible, all sources are included for which data is reasonably available and that can be accurately estimated at the time (**Error! Reference source not found.**).

In 2017 the total organisational emissions were calculated as 28,749 t CO_2-e. The majority of emissions (60%) correspond to scope 3 emissions (**Error! Reference source not found.**). Electricity is the main greenhouse gas emissions source when looking at each source individually, followed by staff commuting and business travel (**Error! Reference source not found.**).

Note that there might be a slight variation between this total and the sum of amounts reported in all emission sources in this document due to the rounding associated with reported emissions. Emissions reported with a decimal of 0.5 and above were rounded up.

3.6.1 Emission reductions

The University of Tasmania reduced their 2017 carbon footprint by generating 132,824 kWh of electricity by on-site renewable energy production (solar photovoltaic), reducing GHG emissions by 17.5 t CO_2-e. Note that from 2011 to 2017, total generation from on-site renewable energy production (solar photovoltaic) was 365,835 kWh, reducing GHG emissions by 53.5 t CO_2-e.

Figure 3. Emission sources reported in the University GHG Inventory 2017

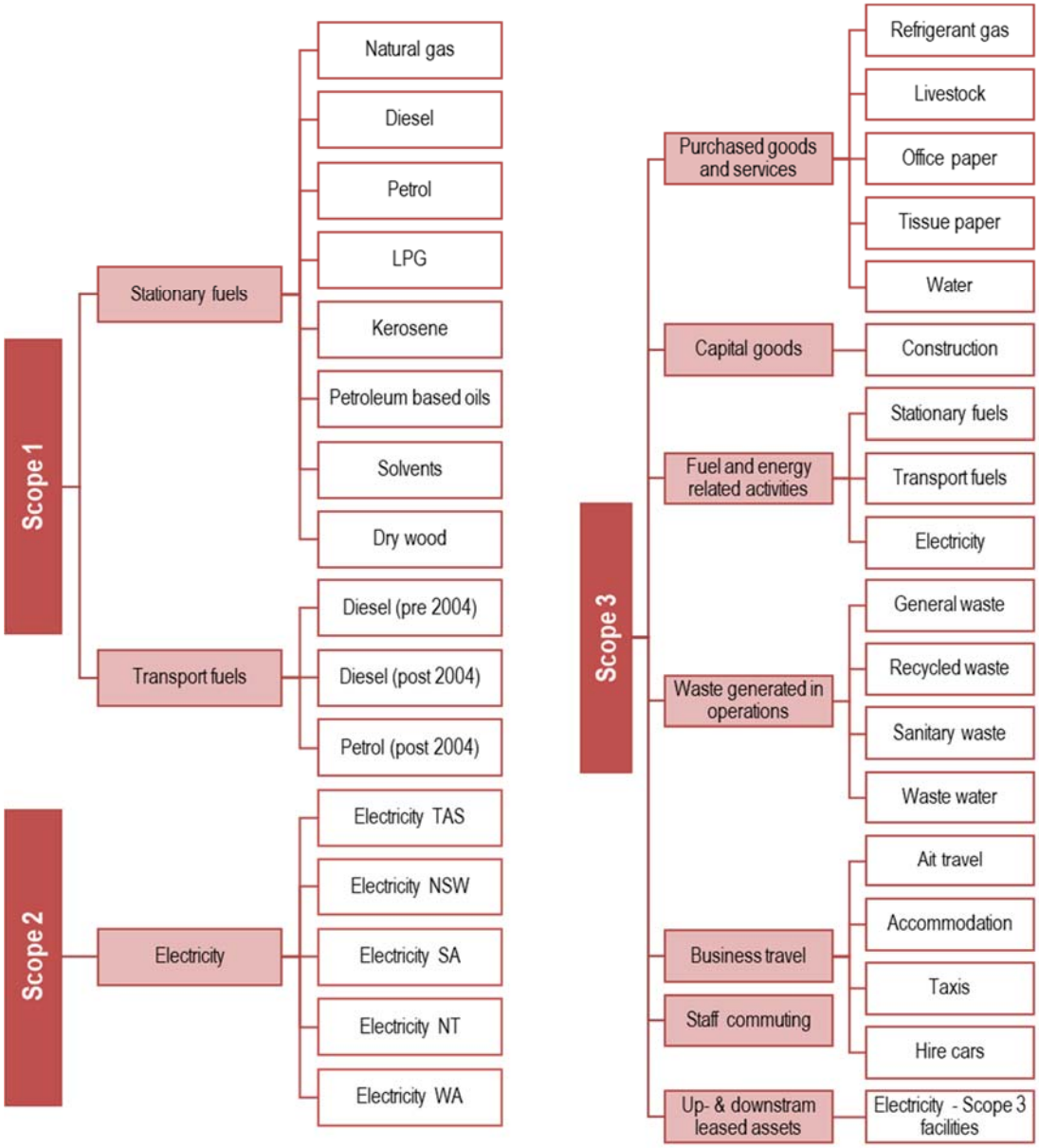


Figure 4. University emissions reported in 2017 by scope

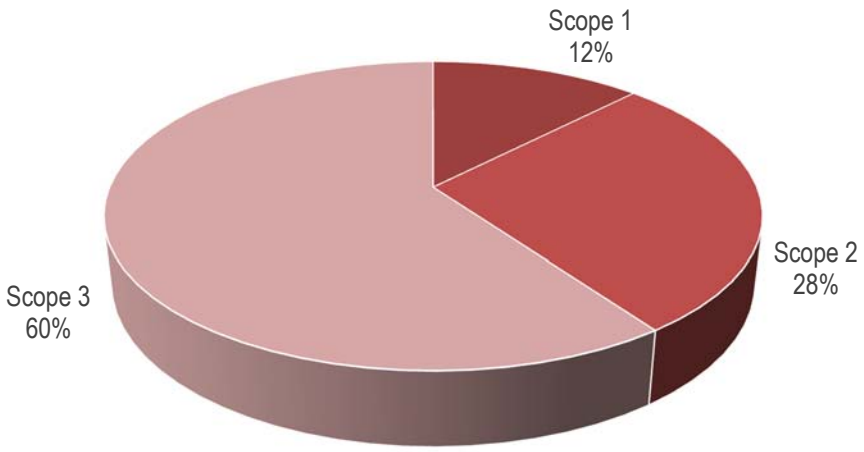
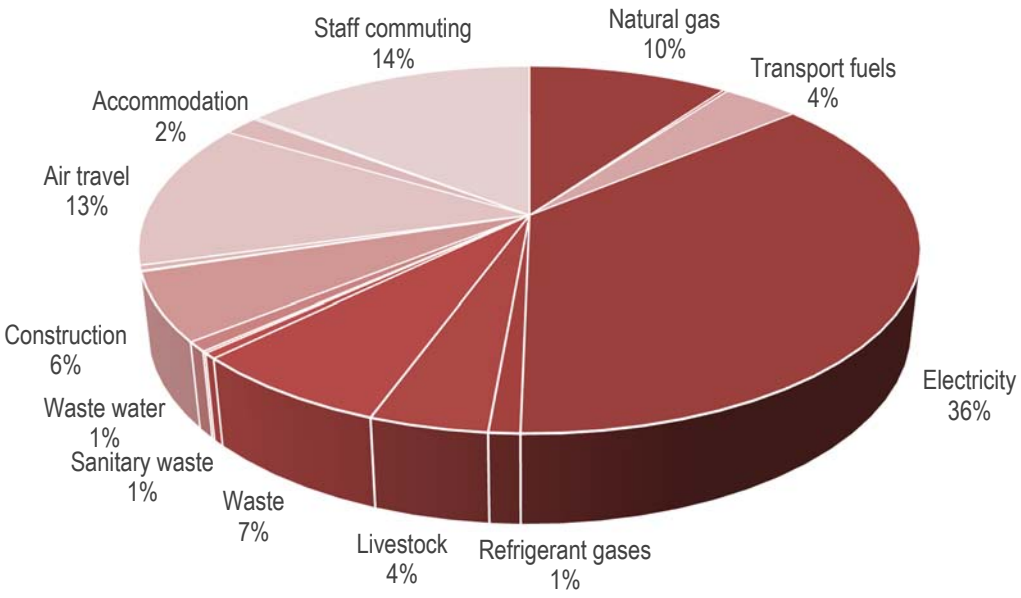


Figure 5. University emissions reported in 2017 by source



4 CALCULATION METHODOLOGY

This section provides the data sources, assumptions and emissions calculations procedures for each source of emissions identified as within the organisational boundary for the University based on the assessments made in Section3.4.2.2 Emission sources.

4.1 Scope 1

4.1.1 Natural gas

Natural gas at the University is used for heating, domestic hot water for buildings, high temperature hot water ring mains, cooking, and heating pool water.

Activity data

The University is supplied at all Tasmanian facilities by Tas Gas Retail. All activity data is based on direct invoices received from Tas Gas Retail for 2017.

The University on-charge the following facilities not under their operational control for their natural gas consumed:

- Tasmanian University Union leased facilities (Newnham Campus)
- The following catering facilities: Salutem (Medical Science Precinct); Centre for the Arts Cafeteria (Centre for the Arts); The Walk and The Grove (Newnham Campus)

The consumption associated with these facilities was deducted from the total reported consumption where available. Where this was not available it has been included in the reported total emissions, which is an overestimate of both the scope 1 and 3 emissions for the University. The natural gas on-charged total was 261 GJ, an inconsequential amount compared to the total reported natural gas within the University organisational boundary.

Assumptions

No assumptions were required in calculating this emissions source.

Calculation methodology

The GHG emissions resulting from natural gas are calculated using the total natural gas used, and the specific emission factor for each reporting period.

Scope	Reporting period	Emission source	Data source	Methodology reference	Energy content factor	Emission factor (kg CO_2-e/GJ)
1	01/01/17-30/06/17	Natural gas	Invoices	Measurement Determination	N/A	51.53
1	01/07/17-31/12/17	Natural gas	Invoices	Measurement Determination	N/A	51.53

$$E = TG * EF_G / 1000$$

Where:

E = GHG emissions (t CO_2-e)
TG = Total natural gas used (GJ)
EF_G = Emission factor for natural gas (kg CO_2-e/GJ)

Calculated emissions

Scope	Reporting period	Emission source	Activity data	Unit	GHG emissions	Unit
1	01/01/17-30/06/17	Natural gas	19,130	GJ	986	t CO_2-e
1	01/07/17-31/12/17	Natural gas	28,442	GJ	1,466	t CO_2-e
Total for source			47,572	GJ	2,451	t CO_2-e

4.1.2 Non-transport fuels

Fuels and other petroleum based products (unleaded petrol, diesel, liquefied petroleum gas, petroleum based oils, solvents, kerosene, dry wood) are used on the University campuses for purposes other than transport, mainly in generators and as lubricants.

Activity data

The amount of fuel used for non-transport purposes is obtained from invoices provided by suppliers (BP Australia, Bennetts, Origin and Tas Petroleum). Fuel delivered by Bennetts is either to Bell Bay (where it is used in firefighting training) or to the Conservatorium of Music (used in a diesel generator for heating). Part of the fuel delivered by BP Australia to the Elliot Dairy Farm facility is for non-transport purposes (as indicated by farm managers). Liquefied petroleum gas is delivered by Origin to several campuses for different uses in cafes and research facilities. Only the petroleum based oils and solvents delivered by Tas Petroleum are reported in this category of emissions. Dry wood is also purchased and the quantity is reported directly by the staff at the Bell Bay Campus.

Additionally, expenditure data on non-transport fuels from other transactions (business and personal credit cards) is obtained from Financial Services reports, which are coded per natural accounts. The only natural account code relevant for stationary fuel is 36112 Fuel – Equipment.

Assumptions

It is assumed that all fuel in this category is for non-transport use only. A minor quantity may be used in non-registered vehicles.

The Financial Services reports do not always specify fuel type or purpose. When fuel type is unknown, it is assumed to be ULP91. When fuel purpose is unknown (i.e., not clearly specified in the 'narrative' field), it is assumed that it is intended for the default natural code purpose. In the GHG Inventory 2015, where it could not be determined what proportion of fuel was used for stationary versus transportation purposes, the fuel was reported for transportation purposes given that the emissions factor is higher and thus a more conservative assumption. However, an analysis to test this assumption further was conducted and no difference in total emissions was found, therefore this assumption is considered to not materially affect the reported emissions

Dry wood is not a material emissions source and is included for completeness only.

Calculation methodology

The GHG emissions resulting from non-transport fuel used are calculated using the total fuel of each type used, and the specific emission factor for each fuel and reporting period.

In cases where fuel amount is not available (Financial Services reports), an estimated quantity of fuel is calculated from fuel cost using average monthly pump prices for each fuel type in Tasmania (obtained from Caltex reports). Data is screened to ensure that only transactions related to non-transport fuels are

considered in the calculation. Transactions identified as transport fuels (wrongly coded in the reports) are included in Section 4.1.3 Transport fuels.

Part of the liquefied petroleum gas (LPG) used at the University is purchased in cylinders, the weight of which is provided in kilograms on invoices. The weight is converted to volume using the density of LPG provided by the supplier (1.96L/kg).

Scope	Reporting period	Emission source	Data source	Methodology reference	Energy content (GJ/kL or t)	Emission factor (t CO_2-e/GJ)
1	01/01/17-30/06/17	Stationary diesel	Invoices; Financial reports	Measurement Determination	38.6	70.20
1	01/07/17-31/12/17	Stationary diesel	Invoices; Financial reports	Measurement Determination	38.6	70.20
1	01/01/17-30/06/17	Stationary gasoline	Invoices; Financial reports	Measurement Determination	34.2	67.80
1	01/07/17-31/12/17	Stationary gasoline	Invoices; Financial reports	Measurement Determination	34.2	67.80
1	01/01/17-30/06/17	Stationary liquefied petroleum gas	Invoices	Measurement Determination	25.7	60.60
1	01/07/17-31/12/17	Stationary liquefied petroleum gas	Invoices	Measurement Determination	25.7	60.60
1	01/01/17-30/06/17	Stationary kerosene (not for aircraft)	Invoices	Measurement Determination	37.5	69.10
1	01/07/17-31/12/17	Stationary kerosene (not for aircraft)	Invoices	Measurement Determination	37.5	69.10
1	01/01/17-30/06/17	Stationary petroleum based oils	Invoices	Measurement Determination	38.8	13.90
1	01/07/17-31/12/17	Stationary petroleum based oils	Invoices	Measurement Determination	38.8	13.90
1	01/07/17-31/12/17	Stationary solvents	Invoices	Measurement Determination	34.4	69.92
1	01/07/17-31/12/17	Stationary solvents	Invoices	Measurement Determination	34.4	69.92
1	01/01/17-30/06/17	Dry wood	Estimate	Measurement Determination	16.2	1.30
1	01/07/17-31/12/17	Dry wood	Estimate	Measurement Determination	16.2	1.30

$$E = \sum_{nt} TF_{nt} * EC_{nt} * EF_{nt}/1000$$

Where:

E = GHG emissions (t CO_2-e)
TF_{nt} = Total fuel used of fuel of type nt (kL; t for dry wood)
EC_{nt} = Energy content factor for fuel of type nt (GJ/kL; GJ/t for dry wood)
EF_{nt} = Emission factor for fuel of type nt (kg CO_2-e/GJ)

Calculated emissions

Scope	Reporting period	Emission source	Activity data	Unit	GHG emissions	Unit
1	01/01/17-30/06/17	Stationary diesel	4,298	L	12	t CO_2-e
1	01/07/17-31/12/17	Stationary diesel	8,354	L	23	t CO_2-e
1	01/01/17-30/06/17	Stationary gasoline	1,639	L	4	t CO_2-e
1	01/07/17-31/12/17	Stationary gasoline	1,649	L	4	t CO_2-e
1	01/01/17-30/06/17	Stationary liquefied petroleum gas	4,978	L	8	t CO_2-e
1	01/07/17-31/12/17	Stationary liquefied petroleum gas	10,376	L	16	t CO_2-e
1	01/01/17-30/06/17	Stationary kerosene (not for aircraft)	0	L	0	t CO_2-e
1	01/07/17-31/12/17	Stationary kerosene (not for aircraft)	4,095	L	11	t CO_2-e
1	01/01/17-30/06/17	Stationary petroleum based oils	580	L	0	t CO_2-e
1	01/07/17-31/12/17	Stationary petroleum based oils	576	L	0	t CO_2-e
1	01/07/17-31/12/17	Stationary solvents	20	L	0	t CO_2-e
1	01/07/17-31/12/17	Stationary solvents	0	L	0	t CO_2-e
1	01/01/17-30/06/17	Dry wood	3	t	0	t CO_2-e
1	01/07/17-31/12/17	Dry wood	3	t	0	t CO_2-e
Total for source (excluding dry wood)					77	t CO_2-e

4.1.3 Transport fuels

University staff and postgraduate students used University-owned cars and boats to carry out their teaching, research and administrative activities in 2017. On 21st November 2017, the University changed its vehicle fleet management system from owned vehicles to outsourced (hire) vehicles. Because of the difficulty to differentiate between outsourced and short-term hire cars, both are reported in this section together with vehicle fleet fuels (see 2.2.2 Transport fuels and hire cars).

Fuels used in these vehicles include unleaded petrol and diesel.

Activity data

Custom fleet cards are used to purchase fuel by staff for University vehicles (including boats). The total amount of each fuel purchased by type of fuel and the quantity supplied is determined from reports from each of the three suppliers (Caltex, BP and Shell). Additionally, the amount of fuel used by the training vessel MV Bluefin is obtained from invoices provided by the supplier (Tas Petroleum).

When petrol stations for the University preferred supplier are not readily available, or when using personal or short-term hire cars, fuel is purchased with business or personal credit cards. Data for fuel expenses paid by credit card is then obtained from Financial Services reports; these are coded per natural account. Relevant natural account codes for transport fuel are:

- 31030 Fuel – Tasmania
- 31031 Fuel – Australia excl Tasmania
- 36109 Fuel – Vessels
- 39110 Other energy fuels (no relevant data was recorded against this natural account code in 2017).

Assumptions:

All vehicles have been assumed to be post-2004 with the exception of the vessel MV Bluefin, for which pre-2004 emissions factors were used. Whilst for the farm vehicles this may not be true, using the higher transport emissions factor is a more conservative estimate and thus minimises any potential impact of this assumption.

The Financial Services reports do not always specify fuel type or purpose. When fuel type is unknown, it is assumed to be ULP91. When fuel purpose is unknown (i.e., not clearly specified in the 'narrative' field), it is assumed that it is intended for the default natural code purpose.

Some of the fuel used in these vehicles may be in non-road registered vehicles. It has been assumed that this fuel is combusted as transport fuel given that this is a higher emissions factor and thus a conservative estimate.

Calculation methodology

The GHG emissions resulting from the fuel used in pool fleet vehicles and boats are calculated using the total fuel of each type used (unleaded petrol and diesel), and the specific emission factor for each fuel. Hire cars are reportable as a scope 3 emissions source, but the emissions reported are calculated using scope 1 factors, thus the methodology used is the same in both cases.

The Financial Services reports do not provide fuel quantity, thus an estimated quantity is calculated from fuel cost using average monthly pump prices for each fuel type in Tasmania (obtained from Caltex fuel card reports), and the national annual average as published by the Australian Institute of Petroleum (2018) for mainland transactions.

Additionally, data from Financial Services reports is screened to ensure that only transactions related to the use of vehicles are considered in the calculation. Transactions identified as non-transport fuels (wrongly coded in the reports) are included in Section 4.1.2 Non-transport fuels.

Scope	Reporting period	Emission source	Data source	Methodology reference	Energy content (GJ/kL)	Emission factor (kg CO_2-e/GJ)
1	01/01/17-30/06/17	Transport (pre 2004) diesel	Invoices	Measurement Determination	38.60	70.50
1	01/07/17-31/12/17	Transport (pre 2004) diesel	Invoices	Measurement Determination	38.60	70.50
1	01/01/17-30/06/17	Transport (post 2004) diesel	Invoices; Financial reports	Measurement Determination	38.60	70.51
1	01/07/17-31/12/17	Transport (post 2004) diesel	Invoices; Financial reports	Measurement Determination	38.60	70.51
1	01/01/17-30/06/17	Transport (post 2004) gasoline	Invoices; Financial reports	Measurement Determination	34.20	67.62
1	01/07/17-31/12/17	Transport (post 2004) gasoline	Invoices; Financial reports	Measurement Determination	34.20	67.62

$$E = \sum_t TF_t * EC_t * EF_t/1000$$

Where:

E = GHG emissions (t CO_2-e)
TF_t = Total fuel used of fuel of type t (kL)
EC_t = Energy content factor for fuel of type t (GJ/kL)
EF_t = Emission factor for fuel of type t (kg CO_2-e/GJ)

Calculated emissions

Scope	Reporting Period	Emission source	Activity data	Unit	GHG emissions	Unit
1	01/01/17-30/06/17	Transport (pre 2004) diesel	20,004	L	54	t CO_2-e
1	01/07/17-31/12/17	Transport (pre 2004) diesel	62,243	L	169	t CO_2-e
1	01/01/17-30/06/17	Transport (post 2004) diesel	55,917	L	152	t CO_2-e
1	01/07/17-31/12/17	Transport (post 2004) diesel	55,633	L	151	t CO_2-e
1	01/01/17-30/06/17	Transport (post 2004) gasoline	113,630	L	263	t CO_2-e
1	01/07/17-31/12/17	Transport (post 2004) gasoline	111,048	L	257	t CO_2-e
Total for source			418,474	L	1,047	t CO_2-e

4.2 Scope 2

4.2.1 Electricity

Electricity at the University is used for HVAC (heating, ventilation and cooling), building mechanics (e.g. lifts, fire detection), lighting (including security), domestic hot water (DHW), and power for appliances and equipment for teaching, research and administrative activities.

Activity data

For all facilities under University operational control, directly billed invoice data from Aurora (TAS), ERM Energy (TAS), AGL Energy (SA) and Jacana Energy (NT) was used to calculate the emissions. Where invoices were not provided for the complete reporting period, the average daily electricity consumption was used to fill the data gaps. Additionally, electricity use in Rozelle Campus (NSW) and Yarragadee Observatory (WA) was estimated as no invoices are available for these sites (see assumptions below).

The University on-charge the following facilities not under their operational control for their electricity consumed:

- CSIRO (Sandy Bay Campus)
- AFRDI (Newnham Campus)
- Lady Gowrie Child Care Centre and After School Care (Sandy Bay and Newnham campuses)
- Community Health Clinic (Sandy Bay Campus)
- The following catering facilities: Lazenby's, Refectory, Trade Table, Law Café, University Staff Club, Source Wholefoods (Sandy Bay campus); Salutem (Medical Science Precinct); Centre for the Arts Cafeteria; The Grove, The Walk, (Newnham Campus); Graze Café, and Makers' Workshop Café (Cradle Coast Campus)
- Tasmanian University Union leased facilities (Sandy Bay and Newnham campuses)
- Hair dressers (Sandy Bay and Newnham campuses)
- Doctor surgery (Sandy Bay Campus)
- Travel agent (Newnham Campus)

The consumption associated with these facilities was deducted from the total reported consumption where available. Where this was not available it has been included in the reported total emissions, which is an overestimate of both the scope 2 and 3 emissions for the University. The electricity consumption on-charged to these facilities during 2017 was 1,415,965 kWh, representing 3% of the total electricity consumption across all facilities determined to be within the University organisational boundary.

Assumptions

Rozelle Campus

For the Rozelle Campus (NSW), as electricity billing information was not available, the average electricity consumed at the Hobart, Launceston and Cradle Coast campuses per Equivalent Full Time Student Load ("EFTSL") was used to calculate the consumed electricity. Note that only specifically campus identified emissions were included in this assessment. EFTSL students for 2017 was obtained from the University Management Information, Analysis and Planning system (IBM Cognos Connection).

Campus	Total electricity (kWh)	EFTSL	Consumption per student (kWh/EFTSL)
Hobart	27,996,162	12,864	2,176
Launceston	13,094,834	6,820	1,920
Cradle Coast	1,436,722	285	5,035
Average			3,044

The calculation for the Rozelle Campus is below. Note that this is annual electricity use, therefore the total consumption was divided by two for the respective half year periods. This will slightly increase the uncertainty associated with this reported total assumption.

Campus	EFTSL	Consumption per student (kWh/EFTSL)	Total electricity (kWh)
Rozelle	663	3,044	2,017,129

Yarragadee Observatory

Electricity use at Yarragadee Observatory (WA) was estimated from meter readings provided by staff at the site. The meter readings provided for the reporting year were used for the calculation of average electricity use per day, and the total electricity use was estimated for the reporting period.

Only 30% of the OBSHUT electricity use is charged to the University.

Period	Days	OBSHUT electricity use (kWh)	DISH electricity use (kWh)	Average electricity use (kWh/day)
16/02/17-04/07/17	139	5,080	2,412	53.90
04/07/17-02/01/18	183	6,605	3,154	53.33

Staff accommodation and office space

For temporary staff office space in 40 Melville Street, Hobart, no electricity consumption data is available. In the absence of any other information, it has been assumed to be equivalent to a 4 person Tasmanian household, as estimated by the Australian Energy Regulator (n.d.).

Sites with no electricity

It is known that no electricity is supplied to Proctors Quarry and thus no estimates have been made for this facility.

Calculation methodology

The GHG emissions resulting from electricity use are calculated using the total electricity used at different states/territories, and the specific emission factor for each state/territory and reporting period.

Scope	Reporting period	Emission source	Data Source	Methodology reference	Energy content factor	Emission factor (kg CO_2-e/kWh)
2	01/01/17-30/06/17	Electricity - TAS	Invoices	Measurement Determination	N/A	0.12
2	01/07/17-31/12/17	Electricity - TAS	Invoices	Measurement Determination	N/A	0.14
2	01/01/17-30/06/17	Electricity - NSW and ACT	Estimation	Measurement Determination	N/A	0.84
2	01/07/17-31/12/17	Electricity - NSW and ACT	Estimation	Measurement Determination	N/A	0.83
2	01/01/17-30/06/17	Electricity - SA	Invoices	Measurement Determination	N/A	0.53
2	01/07/17-31/12/17	Electricity - SA	Invoices	Measurement Determination	N/A	0.49
2	01/01/17-30/06/17	Electricity - NT	Invoices	Measurement Determination	N/A	0.67
2	01/07/17-31/12/17	Electricity - NT	Invoices	Measurement Determination	N/A	0.64
2	01/01/17-30/06/17	Electricity - WA	Estimation	Measurement Determination	N/A	0.72
2	01/07/17-31/12/17	Electricity - WA	Estimation	Measurement Determination	N/A	0.70

$$E = \sum_s TE_s * EF_{es}/1000$$

Where:

E = GHG emissions (t CO_2-e)

TE_S = Total electricity used in state/territory s (kWh)

EF_E = Emission factor for electricity in state/territory s (kg CO_2-e/kWh)

Calculated emissions

Scope	Reporting period	Emission source	Activity data	Unit	GHG emissions	Unit
2	01/01/17-30/06/17	Electricity - TAS	22,124,332	kWh	2,655	t CO_2-e
2	01/07/17-31/12/17	Electricity - TAS	25,656,845	kWh	3,592	t CO_2-e
2	01/01/17-30/06/17	Electricity - NSW	1,009,602	kWh	848	t CO_2-e
2	01/07/17-31/12/17	Electricity - NSW	1,011,086	kWh	839	t CO_2-e

Scope	Reporting period	Emission source	Activity data	Unit	GHG emissions	Unit
2	01/01/17-30/06/17	Electricity - SA	26,466	kWh	14	t CO_2-e
2	01/07/17-31/12/17	Electricity - SA	35,248	kWh	17	t CO_2-e
2	01/01/17-30/06/17	Electricity - NT	18,883	kWh	13	t CO_2-e
2	01/07/17-31/12/17	Electricity - NT	21,406	kWh	14	t CO_2-e
2	01/01/17-30/06/17	Electricity - WA	9,755	kWh	7	t CO_2-e
2	01/07/17-31/12/17	Electricity - WA	9,813	kWh	7	t CO_2-e
Total for source			49,923,437	kWh	8,006	t CO_2-e

4.3 Scope 3

The latest version of the National Greenhouse Accounts Factors Workbook was published on July 2017. The factors in this version have been used exclusively in calculating the scope 3 emissions sources. Additional references for emissions factors are specifically noted in each section.

4.3.1 Natural gas

Activity data

As per Section 4.1.1.

Assumptions

There is no published scope 3 factor for Tasmania in the NGA Factors Workbook to protect the confidentiality of Tas Gas. Therefore, an average scope 3 emissions factor was calculated using the data available from the Department of the Environment and Energy (2017b) in other states/territories.

Average metro and non –metro factors are relatively similar. Therefore, the University has applied the highest factor (metro) across both financial years in calculating the scope 3 emissions from natural gas.

State or territory	Natural gas EF for scope 3 (kg CO_2-e/GJ)	
	Metro	Non-metro
New South Wales and ACT	12.8	13.6
Victoria	3.9	3.9
Queensland	8.7	7.8
South Australia	10.4	10.3
Western Australia	4.0	3.9
Tasmania	NA	NA
Northern Territory	NA	NA
Calculated Average	7.96	7.90

Calculation methodology

Scope	Reporting period	Emission source	Data source	Methodology reference	Energy content factor	Emission factor (kg CO_2-e/GJ)
3	01/01/17-30/12/17	Natural gas	Invoices	Measurement Determination	N/A	7.96

$$E = TG * EF_{G3}/1000$$

Where:

E = GHG emissions (t CO_2-e)
TG = Total natural gas used (GJ)
EF_{G3}= Calculated scope 3 emission factor for natural gas (kg CO_2-e/GJ)

Calculated emissions

Scope	Reporting period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-31/12/17	Natural gas	47,572	GJ	379	t CO_2-e
Total for source			47,572	GJ	379	t CO_2-e

4.3.2 Non-transport fuels

Activity data

As per Section 4.1.2. Note that the scope 3 emissions factors are applicable irrespective of whether the fuel was used for stationary or transportation purposes. These are presented separately however for consistency with the relevant sections.

Assumptions

Note that the National Greenhouse Accounts Factors Workbook does not provide a scope 3 factor for dry wood and therefore it has not been included in the inventory. Given that scope 1 emissions for this source are virtually zero, this is considered inconsequential.

Calculation methodology

The scope 3 GHG emissions resulting from non-transport fuel use are calculated using the total fuel of each type used, and the specific scope 3 emission factor for each fuel.

Scope	Reporting period	Emission source	Data source	Methodology reference	Energy content (GJ/kL or t)	Emission factor (t CO_2-e/GJ)
3	01/01/17-31/12/17	Stationary diesel	Invoices; Financial reports	Measurement Determination	38.6	3.60
3	01/01/17-31/12/17	Stationary gasoline	Invoices; Financial reports	Measurement Determination	34.2	3.60
3	01/01/17-31/12/17	Stationary liquefied petroleum gas	Invoices	Measurement Determination	25.7	3.60
3	01/01/17-31/12/17	Stationary kerosene (not for aircraft)	Invoices	Measurement Determination	37.5	3.60
3	01/01/17-31/12/17	Stationary petroleum based oils	Invoices	Measurement Determination	38.8	3.60
3	01/01/17-31/12/17	Stationary solvents	Invoices	Measurement Determination	34.4	3.60

$$E = \sum_n TS_n * EC_n * EF_{n3}/1000$$

Where:

E = GHG emissions (t CO_2-e)
TS_n = Total energy source used of type n (kL)
EC_n = Energy content factor for fuel of type n, if applicable (GJ/kL)
EF_{n3} = Scope 3 emission factor for energy source n (kg CO_2-e/kL)

Calculated emissions

Scope	Reporting period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-31/12/17	Stationary diesel	12,652	L	2	t CO_2-e
3	01/01/17-31/12/17	Stationary gasoline	3,289	L	0	t CO_2-e
3	01/01/17-31/12/17	Stationary liquefied petroleum gas	15,354	L	1	t CO_2-e
3	01/01/17-31/12/17	Stationary kerosene (not for aircraft)	4,095	L	1	t CO_2-e
3	01/01/17-31/12/17	Stationary petroleum based oils	1,156	L	0	t CO_2-e
3	01/01/17-31/12/17	Stationary solvents	20	L	0	t CO_2-e
Total for source			36,570	L	4	t CO_2-e

4.3.3 Transport fuels

Activity data

As per Section 4.1.3.

Assumptions

No additional assumptions for scope 3 emissions from transport fuels were made.

Calculation methodology

The scope 3 GHG emissions resulting from non-transport fuel use are calculated using the total fuel of each type used, and the specific scope 3 emission factor for each fuel.

Scope	Reporting period	Emission source	Data source	Methodology reference	Energy content (GJ/kL)	Emission factor (kg CO_2-e/GJ)
1	01/01/17-31/12/17	Transport (pre 2004) diesel	Invoices	Measurement Determination	38.60	3.60
1	01/01/17-31/12/17	Transport (post 2004) diesel	Invoices; Financial reports	Measurement Determination	38.60	3.60
1	01/01/17-31/12/17	Transport (post 2004) gasoline	Invoices; Financial reports	Measurement Determination	34.20	3.60

$$E = \sum_n TS_n * EC_n * EF_{n3}/1000$$

Where:

E = GHG emissions (t CO_2-e)
TS_n = Total energy source used of type n (kL)
EC_n = Energy content factor for fuel of type n, if applicable (GJ/kL)
EF_{n3} = Scope 3 emission factor for energy source n (kg CO_2-e/kL)

Calculated emissions

Scope	Reporting period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-31/12/17	Transport (pre 2004) diesel	82,247	kL	11	t CO_2-e
3	01/01/17-31/12/17	Transport (post 2004) diesel	111,549	kL	16	t CO_2-e
3	01/01/17-31/12/17	Transport (post 2004) gasoline	224,678	kL	28	t CO_2-e
Total for source			418,474	kL	55	t CO_2-e

4.3.4 Electricity: Facilities under operational control

Activity data

The activity data is consistent with that provided in Section 4.2.1. This category of emissions relates to the distribution and transmission of electricity in the relative state for the electricity already reported as a scope 2 emissions source.

Assumptions

The "Latest Estimate" of the scope 3 emissions for each state has been applied for the full reporting year for each state/territory.

Calculation methodology

The scope 3 greenhouse gas emissions resulting from electricity use at facilities under University operational control are calculated using the total electricity used, and the specific scope 3 emission factor for each state/territory.

Scope	Reporting Period	Emission source	Data Source	Methodology reference	Energy content factor	Emission factor (kg CO_2-e/kWh)
3	01/01/17-31/12/17	Electricity - TAS	Invoices	Measurement Determination	N/A	0.03
3	01/01/17-31/12/17	Electricity - NSW and ACT	Estimation	Measurement Determination	N/A	0.12
3	01/01/17-31/12/17	Electricity - SA	Invoices	Measurement Determination	N/A	0.09
3	01/01/17-31/12/17	Electricity - NT	Invoices	Measurement Determination	N/A	0.09
3	01/01/17-31/12/17	Electricity - WA	Invoices	Measurement Determination	N/A	0.06

$$E = \sum_s TE_s * EF_{es3}/1000$$

Where:

E = GHG emissions (t CO_2-e)

TE_S = Total electricity used in state/territory s (kWh)

EF_{es3} = Scope 3 emission factor for electricity in state/territory s (kg CO_2-e/kWh)

Calculated emissions

Scope	Reporting Period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-31/12/17	Electricity - TAS	47,781,177	kWh	1,433	t CO_2-e
3	01/01/17-31/12/17	Electricity - NSW	2,020,688	kWh	242	t CO_2-e
3	01/01/17-31/12/17	Electricity - SA	61,714	kWh	6	t CO_2-e
3	01/01/17-31/12/17	Electricity - NT	40,289	kWh	4	t CO_2-e
3	01/01/17-31/12/17	Electricity - WA	19,568	kWh	1	t CO_2-e
Total for source			49,923,437	kWh	1,686	t CO_2-e

4.3.5 Electricity: Scope 3 facilities

Activity data

For facilities considered to be scope 3 facilities (see Appendix C), directly billed invoice data from Aurora and ERM Energy (TAS) was used to calculate the emissions. In some cases invoices were not provided for the complete reporting period; for these sites the average daily electricity consumption has been used to fill the data gaps. Additionally, electricity use in Round Hill microwave tower (TAS), Darlinghurst (NSW), Launceston and Latrobe clinical schools (TAS), and a number of staff accommodation and office space in non-University buildings (TAS), was estimated as no invoices are available for these sites (see assumptions below).

Assumptions

Microwave towers

Electricity consumption was available from invoices for all microwave towers but one (Round Hill), for which the electricity consumption for the largest towers was used (see table). This is a conservative approach.

Microwave Tower	NMI	Total electricity (kWh)
Mt Nelson	8000245815	4,063
Abels Hill	8000245824	1,882
Epping Forest	8000245870	7,929
Mt Quoin	8000246151	1,444
Vincents Hill	8000245869	6,239
Notley Hill	8000232493	2,490

Darlinghurst Campus

The same methodology used for Rozelle Campus (see Section 4.2.1) was applied to calculate electricity use at the Darlinghurst facility

Campus	EFTSL	Consumption per student (kWh/EFTSL)	Total electricity (kWh)
Darlinghurst	203	3,044	616,411

Clinical schools

The Royal Hobart Hospital on-charges the University for the electricity consumed in its operations for the areas occupied by University staff. These values have been used in the calculation of scope 3 emissions

associated with this facility. For the Launceston Clinical School, in the absence of any better data, the electricity consumption is assumed to be equivalent to the Hobart clinical school. This is a reasonable assumption as both have a similar number of staff and students.

The Mersey Rural Clinical School (Latrobe) was assumed to have an electricity consumption equivalent to the Burnie Rural Clinical School. Both schools share the same staff and students, who move between campuses during the year.

Staff accommodation and office space

For some staff accommodation and office space in non-University buildings, no electricity consumption data is available. In the absence of any other information, these have been assumed to be equivalent to a 4 person Tasmanian household, as estimated by the Australian Energy Regulator (n.d.).

Sites with no electricity

It is known that no electricity is supplied to Bushy Park and Wedge Island and thus no estimates have been made for these facilities.

Calculation methodology

For facilities judged to be outside the operational control of the University but within the organisation reporting boundary (see Section 3.4.1.1 Scope 3 facilities for criteria used in the assessment), associated emissions were calculated and reported as scope 3 emissions. For these scope 3 facilities, total electricity consumed and the NGER Measurement Determination scope 2 factors have been used to calculate emissions.

Scope	Reporting Period	Emission source	Data Source	Methodology reference	Energy content factor	Emission factor (kg CO_2-e/kWh)
3	01/01/17-30/06/17	Electricity - TAS	Invoices / estimation	Measurement Determination	N/A	0.12
3	01/07/17-31/12/17	Electricity - TAS	Invoices / estimation	Measurement Determination	N/A	0.14
3	01/01/17-30/06/17	Electricity - NSW and ACT	Estimation	Measurement Determination	N/A	0.84
3	01/07/17-31/12/17	Electricity - NSW and ACT	Estimation	Measurement Determination	N/A	0.83

$$E = \sum_s TE_s * EF_{es}/1000$$

Where:

E = GHG emissions (t CO_2-e)
TE_S = Total electricity used in state/territory s (kWh)
EF_{es} = Scope 2 emission factor for electricity in state/territory s (kg CO_2-e/kWh)

Calculated emissions

Scope	Reporting Period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-30/06/17	Electricity - TAS	1,008,209	kWh	121	t CO_2-e
3	01/07/17-31/12/17	Electricity - TAS	1,151,542	kWh	161	t CO_2-e

Scope	Reporting Period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-30/06/17	Electricity – NSW	308,206	kWh	259	t CO_2-e
3	01/07/17-31/12/17	Electricity - NSW	308,206	kWh	256	t CO_2-e
Total for source			2,776,162	kWh	797	t CO_2-e

4.3.6 Refrigerant gas

Refrigerant gases are used at the University of Tasmania for building and vehicle air conditioning, and for kitchen and laboratory refrigerators. In this GHG Inventory we include only refrigerants for building air conditioning.

This is considered to be a scope 3 emissions source for the University as UTAS does not perform the ANZSIC codes that relate to reporting refrigerant gases as scope 1 emissions source in the Measurement Determination.

Activity data

Data is obtained from reports supplied by the University's provider (Airmaster) which include amount of refrigerant recharge purchased during the year per gas type.

Assumptions

Refrigerant gas composition of gases used is as follows:

Refrigerant gas	HFC-32 (%)	HFC-125 (%)	HFC-134a (%)	HFC-143a (%)
R134a	-	-	100	-
R404a	-	44	4	52
R407c	23	25	52	-
R410	50	50	-	-

The refrigerant gas R22 has not been included as it is not considered to be a greenhouse gas

Calculation methodology

Global Warming Potentials (GWPs) for FY17 were used in this case. GWPs for FY17 are consistent with the NGER Regulations as made in March 2017.

Scope	Reporting period	Emission source	Data source	Methodology reference	GWP (kg CO_2-e/kg)
3	01/01/17-31/12/17	Refrigerant gas R134a	Supplier summary	NGER Regulations and Measurement Determination	1,430
3	01/01/17-31/12/17	Refrigerant gas R404a	Supplier summary	NGER Regulations and Measurement Determination	3,922
3	01/01/17-31/12/17	Refrigerant gas R407c	Supplier summary	NGER Regulations and Measurement Determination	1,774
3	01/01/17-31/12/17	Refrigerant gas R410	Supplier summary	NGER Regulations and Measurement Determination	2088

The same methodology has been applied as the Measurement Determination. The GHG emissions resulting from each type of refrigerant were calculated using the recharged gas quantities and global warming potentials.

$$E = \sum_n RG_n * GWP_n / 1000$$

Where:

E = GHG emissions (t CO_2-e)
RG_n = Total amount of refrigerant gas type n recharged (kg)
GWP_n = Global warming potential of refrigerant type n (kg CO_2-e/ kg refrigerant)

Calculated emissions

Scope	Reporting Period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-31/12/17	Refrigerant gas R134a	17	kg	24	t CO_2-e
3	01/01/17-31/12/17	Refrigerant gas R404a	56	kg	220	t CO_2-e
3	01/01/17-31/12/17	Refrigerant gas R407c	14	kg	25	t CO_2-e
3	01/01/17-31/12/17	Refrigerant gas R410	22	kg	45	t CO_2-e
Total for source			109	kg	314	t CO_2-e

4.3.7 Livestock

Cattle (dairy cows, bulls and heifers) are used in teaching and research activities at the University at the Elliot Dairy Farm. During digestion of feed, cattle produce methane (CH_4), a greenhouse gas.

Activity data

The Tasmanian Institute of Agriculture (TIA) Dairy Research Facility provides data on the date of birth or entry of each head of cattle, as well as the date in which each head is sold or die (if relevant). The data delineated dairy cows and other (including heifers, calves and bulls).

Assumptions

The 2006 International Panel for Climate Change Good Practice Guidance for the agricultural, forestry and other land use provides tier 1 enteric fermentation emissions factors for Oceania cattle (IPCC 2006) as per the table below:

Regional characteristics	Cattle category	Emission factor (kg CH_4 $head^{-1}$ yr^{-1})	Comments
Oceania: Commercialised dairy sector based on grazing. Separate beef cow herd, primarily grazing rangelands of widely varying quality. Growing amount of feedlot feeding with grains. Dairy cows are a small part of the population	Dairy	90	Average milk production of 2,200 kg $head^{-1}$ yr^{-1}
	Other	60	Includes beef cows, bulls and young

The GWP of methane has been applied in consistency with the NGER Regulations which came into force in March 2017.

Calculation methodology

The data provided by farm managers was analysed to determine the total number of days each animal was held on site. The total number of days per livestock category (dairy cows and other) was divided by the

number of days in the year to obtain an equivalent numbers of heads per year. The GHG emissions resulting from cattle were calculated using the emission factor calculated from the methane production rates listed above and the methane global warming potential:

Scope	Reporting period	Emission source	Data source	Methodology reference	Emission factor (kg CH_4 $head^{-1}$ yr^{-1})	GWP CH_4	Emission factor (t CO_2-e $head^{-1}$ yr^{-1})
3	01/01/17-31/12/17	Dairy cows	Farm summary	IPCC GPG 2006	90	25	2.25
3	01/01/17-31/12/17	Other	Farm Summary	IPCC GPG 2006	60	25	1.50

$$E = \sum_C N_C * EF_C/1000$$

Where:

E = GHG emissions (t CO_2-e)
N_C = Equivalent number of cattle of type C on the farm for one year
EF_C = Calculated emission factor for cattle of type C (kg CO_2-e $head^{-1}$ $year^{-1}$)

Calculated emissions

Scope	Reporting period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-31/12/17	Dairy Cows	359	Equivalent head yr^{-1}	808	t CO_2-e
3	01/01/17-31/12/17	Other	254	Equivalent head yr^{-1}	381	t CO_2-e
Total for source			613	Equivalent head yr^{-1}	1,188	t CO_2-e

4.3.8 Waste to landfill and recycling

The University produces different types of waste as a result of its research, learning and teaching and administrative activities.

Activity data

The activity data for waste to landfill and recycled waste is supplied in electronic reports by the waste contractor (JJ Richards, previously ToxFree) for Tasmanian campuses.

Waste emissions are not estimated for Rozelle Campus (NSW) given there is no available data or estimates for this location.

JJ Richards also reported waste for the Lady Gowrie Child Care centre. This has been removed from the emissions calculations in accordance with the organisational boundary assessment.

Assumptions

JJ Richards records weights from the scales on some trucks at the time of service. However, if there are technical difficulties with the scales or communications with the truck, and where trucks do not have scales, JJ Richards provides the volume of each bin and considers bins to be full. In these instances, the total volume was corrected for partly full bins (75% of total volume). An audit conducted in 2012 showed that bins prior to collection were 55% full in average across three campuses, therefore this is a conservative approach.

JJ Richards provides an industry average density conversion factor weight for some waste types, which was applied to calculate weight. When a conversion factor was not provided, government sources were used (see table below). The following assignations have been made for the waste based on ToxFree's categories of waste.

Waste type	Destination	Waste stream	Conversion factor (t/m^3)	Source
General waste	Landfill	Domestic waste to landfill	0.080	ToxFree reports
General bulk waste	Landfill	Domestic waste to landfill	0.149	ToxFree reports
Animal removal	Landfill	Domestic waste to landfill	0.300	WA Waste Authority
Medical	Landfill	Domestic waste to landfill	0.227	Zero Waste SA
Hazard	Landfill	Commercial waste to landfill	0.227	Zero Waste SA
White paper	Recycling	Recycled waste	0.060	ToxFree reports
Document destruction	Recycling	Recycled waste	0.060	ToxFree reports
Cardboard	Recycling	Recycled waste	0.060	ToxFree reports
Comingled	Recycling	Recycled waste	0.023	ToxFree reports
Glass	Recycling	Recycled waste	0.080	ToxFree reports
Tubes	Recycling	Recycled waste	N/A	
Liquid	Recycling	Recycled waste	N/A	
Liquid grease trap	Recycling	Recycled waste	N/A	
Metal	Recycling	Recycled waste	0.240	ToxFree reports
Organic	Recycling	Recycled waste	0.500	NGA Factors
Sawdust	Recycling	Recycled waste	0.038	ToxFree reports
Timber	Recycling	Recycled waste	0.016	ToxFree reports

Source: WA Waste Authority 2012; Zero Waste SA n.d.

Calculation methodology

As information on specific composition of waste to landfill is not available from the waste services provider or internal waste audits, emissions factors for total waste disposed to landfill by broad waste stream category were used. A waste audit was conducted by students under the Sustainability Integration Program for Students (SIPS) in the reporting period. However, the audit was limited in terms of location and time, and therefore it was not considered to be representative of the whole of the University and have not been used in the calculation of emissions from waste.

Following the recommendations of the National Carbon Offset Standard for Organisations (Department of the Environment and Energy 2017a), default emission factors based on UK data (Department for Business, Energy and Industrial Strategy 2017) were used for waste sent to recycling.

Scope	Reporting Period	Emission source	Data source	Methodology reference	Emission factor (t CO_2-e/t)
3	01/01/17-31/12/17	Domestic waste to landfill	Supplier summary	NGA Factors	1.4
3	01/01/17-31/12/17	Commercial waste to landfill	Supplier summary	NGA Factors	1.2
3	01/01/17-31/12/17	Recycled waste	Supplier summary	DBEIS 2017	0.02

$$E = \sum_{wt} W_{wt} * EF_{wt}$$

Where:

E = GHG emissions (t CO_2-e)
W_{wt} = Total weight of waste category wt (t)
EF_w = Emission factor for waste of category wt (t CO_2-e/t waste)

Calculated emissions

Scope	Reporting period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-31/12/17	Domestic waste to landfill	1,454	t	2,036	t CO_2-e
3	01/01/17-31/12/17	Commercial waste to landfill	0	t	0	t CO_2-e
3	01/01/17-31/12/17	Recycled waste	212	t	5	t CO_2-e
Total for source			1,666	t	2,041	t CO_2-e

4.3.9 Sanitary waste

Activity Data

The sanitary services providers (Initial Pink Hygiene, Hygiene Services and Fresh and Clean) generally provide invoices detailing the number of bins serviced per invoice period, bin volume and visits per year. Where not detailed in invoices, providers were asked to provide number of bins and service frequency. The sanitary service providers were not able to provide any data on the total weight of waste collected, thus the number of bins and collection frequency have been used as the source data.

Assumptions

As the sanitary waste is not general waste, an assumption about its relative density is required. Considering the categories published in the NGA Factors, sanitary waste was considered most similar to “Nappies” (0.39 t m^{-3}). In the absence of any information on the bin levels, it will be assumed that each bin is 50% full.

Given that there is no specific category of waste for sanitary waste in the NGA Factors, the “Nappies" factor was used. The municipal waste to landfill factor was deliberately not used although a fair argument could be made for applying this. Using the municipal waste to landfill factor would result in lower overall emissions so the approach taken is conservative.

Calculation methodology

The number of total collections per invoiced period was calculated by multiplying the number of bins serviced by the number of visits in that period. The total number of collections for the reporting year was then multiplied by the bin volume (28 L in Rozelle; 26 L in all other campuses), and by the density conversion factor to calculate weight. The nappies emission factor was then used to calculate emissions from sanitary waste.

Scope	Reporting period	Emission source	Data source	Methodology reference	Emission factor (t CO_2-e/t waste)
3	01/01/17-31/12/17	Sanitary waste	Invoices and estimation	As above	1.8

$$E = \sum_n C_n * \frac{V_n}{2} / 1000 * CF_N * EF_N$$

Where:

E = GHG emissions (t CO_2-e)
C_n = Number of collections for bin n
V_n = Volume of bin n (L)
CF_N = Volume to weight conversion factor for nappies (t/m^3)
EF_N = Emission factor for nappies (t CO_2-e/t waste)

Calculated emissions

Scope	Reporting period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-31/12/17	Sanitary Waste	81	t	145	t CO_2-e

4.3.10 Water and waste water

The delivery of water requires energy to be expended by the water authority, which has emissions associated with both the supply of potable water and treatment of sewerage removed from the site.

Activity data

All water supplied to and removed from the University facilities is by TasWater. TasWater provides invoices detailing the quantity of water consumed and sewerage household equivalent (or equivalent tenements – ETs), which were used as the activity data. Water and waste water emissions are not estimated for the NSW campuses given there is no available data or estimates for this.

The consumption associated with facilities within main campus that are not under the University's operational control was deducted from the total reported consumption where available. Where this was not available it has been included in the reported total emissions, which is an overestimate of scope 3 emissions for the University. The water consumption at these facilities during the reporting period was 4,776 kL, representing 2% of the total water consumption across all facilities determined to be within the University organisational boundary.

Assumptions

For urban water, it is assumed that all water treatment emissions as reported relate to the treatment of urban water. There is not sufficient clarifying data in the report to determine if this is correct, therefore it is a conservative assumption of the two methods available (the potable water emissions are for urban plus regional water supplied, which results in a lower emissions factor).

Calculation methodology

The Office of the Tasmanian Economic Regulator (2017) publishes an annual summary of the TasWater activities per financial year. The latest available report at the time of developing this GHG Inventory was for the FY2015-16. This included the following emissions estimates for the organisation.

Metric	Total volume (ML)	Average volume (kL/household)	Total emissions (t CO_2-e)
Urban Water	52,383	259	9,873
Sewerage	50,433	283	22,646

From this data, it is possible to calculate an emission factor per volume (for water consumed) and an emission factor per installation (for treated sewerage).

Scope	Reporting period	Emission source	Data source	Methodology reference	Emission factor (t CO_2-e/ML or ET)
3	01/01/17-31/12/17	Water	Invoices	As above	0.1885
3	01/01/17-31/12/17	Waste water	Invoices	As above	0.1271

$$E = W_a/1000 * EF_a$$

Where:

E = GHG emissions (t CO_2-e)
W_a= Quantity of potable water (kL) for water consumption, or equivalent tenements (ETs) for sewerage
EF_a = Emission factor of water type a (t CO_2-e/ML or ET)

Calculated emissions

Scope	Reporting period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-31/12/17	Water	242,385	kL	46	t CO_2-e
3	01/01/17-31/12/17	Waste water	1,927	ETs	245	t CO_2-e
Total for source					291	t CO_2-e

4.3.11 Construction

The University of Tasmania undertook several construction activities in the reporting year, including two major facilities:

- NRAS Apartments, Melville St (completed)
- The Hedberg, Campbell St (ongoing)

Activity data

Total expenditure on construction was provided by Financial Services. Relevant natural account codes for construction are:

- 39202 Geotechnical services
- 39204 Quantity surveying
- 39206 Other building related professional fees
- 39208 Statutory fees
- 39210 Building contracts

Assumptions

The Australian Greenhouse Emissions Information System (AGEIS) reports the total emissions from the construction sector per year. Additionally, the Australia Bureau of Statistics measures the value of the construction industry quarterly. From these values, an emission factor for GHG emissions per expenditure was calculated for the latest year available.

Scope	2015 Construction emissions (t CO_2-e)	2015 Construction expenditure ($)	Emission factor (kg CO_2-e/$)
3	9,446,710	196,692,900,000	0.04803

Source: Australian Greenhouse Emissions Information System, n.d.; Australian Bureau of Statistics, 2017a

Calculation methodology

Scope	Reporting period	Emission source	Data source	Methodology reference	Emission factor (kg CO_2-e/$)
3	01/01/17-31/12/17	Construction	Consultant review report	Estimation	0.04803

$$E = \sum_{wt} CE * EF_{ce} /1000$$

Where:

E = GHG emissions (t CO_2-e)

CE = Total construction expenditure ($)

EF_{ce} = Calculated emission factor for construction expenditure (kg CO_2-e/$)

Calculated emissions

Scope	Reporting period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-31/12/17	Construction	35,610,285	$	1,710	t CO_2-e
Total for source			35,610,285	$	1,710	t CO_2-e

4.3.12 Office paper

Activity data

The total of reams of paper used is obtained from reports provided by the University's major supplier during the reporting period, Staples. Data from Staples reports is collected for white and coloured photocopy and printing paper of different sizes, grammages and percentage content of recycled paper.

Financial reports provide the expenditure on office paper per provider.

Assumptions

When unknown, paper is assumed to be virgin, A4 size and 80 g/m^2. If not specified, it is assumed that there are 500 sheets per ream. As less than 1% is imported paper, all paper is assumed to be domestic.

The percentage of office paper provided by Staples in relation to the total office paper purchased by the University (by total expenditure) can be calculated from Financial Services reports. Accordingly, the emissions calculated as a result of the Staples data were pro-rated to report the emissions associated with the total paper purchased, with the key assumption that the paper provided by Staples is consistent to that sourced from other suppliers.

Calculation methodology

Ream weight is calculated based on size, grammage and number of sheets per ream.

Emissions factors are sourced from the Victorian EPA (2013) and applied consistently through the reporting year. Certified carbon neutral paper is also purchased by the University and where this has been explicitly identified in the product description, an emissions factor of 0 has been applied.

Scope	Reporting Period	Emission source	Data source	Methodology reference	Emission factor (kg CO_2-e/kg)
3	01/01/17-31/12/17	Virgin paper	Supplier summary and estimation	Victorian EPA	1.30
3	01/01/17-31/12/17	Recycled paper	Supplier summary and estimation	Victorian EPA	1.52
3	01/01/17-31/12/17	Carbon neutral paper	Supplier summary and estimation	Victorian EPA	0

The percentage of office paper provided by Staples and other suppliers is as follows:

Scope	Reporting Period	Emission source	Data Source	Office paper from Staples (%)	Office paper from other suppliers (%)
3	01/01/17-31/12/17	Office paper	Financial Services	60.01	39.99

When the office paper purchased has more than 0%, but less than 100% recycled content, then the proportion of recycled content is added to the 100% recycled weight and the proportion of virgin content is added to the virgin weight (following EPA Victoria 2013 methodology).

$$E = \left(\sum_n PW_n * RC_n * EF_{100,n}/1000 + \sum_n PW_n * VC_n * EF_{0,n}/1000\right)/CF$$

Where:

E = Total GHG emissions (t CO_2-e)
PW_n = Weight of paper type n (kg)
RC_n = Content of recycling paper (%)
$EF_{100,n}$ = Emission factor of 100% recycled paper type n (kg CO_2-e/kg)
VC_n = Content of virgin paper (%)
$EF_{0,n}$ = Emission factor of virgin paper type n (kg CO_2-e/kg)
CF = Correction factor to extrapolate to all providers (% office paper from Staples)

Calculated emissions

Scope	Reporting Period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-31/12/17	Virgin paper	1,993	kg	3	t CO_2-e
3	01/01/17-31/12/17	Recycled paper	13,490	kg	20	t CO_2-e
3	01/01/17-31/12/17	Carbon neutral paper	74,718	kg	0	t CO_2-e
Total for source			90,201	kg	23	t CO_2-e

4.3.13 Paper towel and toilet tissue

Paper towels and toilet tissue are used throughout all campuses as washroom consumables. The emissions associated with the manufacture of these products are calculated and included in this inventory. It is noted that the emissions associated with the disposal of these products are captured either in Section 4.3.8 Waste or Section 4.3.10 Waste water.

Activity data

The University cleaner contractors (ISS Facility Services, Collings Property Services, Cleaning Star World and Challenger Commercial) provide invoices detailing the number of cartons provided per paper towel or toilet tissue type for each facility.

Assumptions

As part of the Government's assistance package to Emissions-Intensive Trade Exposed (EITE) Industries, the average emissions intensity of paper towel across Australia was calculated for the financial years FY07 and FY08. Using the results of these as published in the repealed Clean Energy Regulations 2011 (Commonwealth Government n.d.), the emissions factor for paper towels was calculated.

Tissue paper is defined as uncoated tissue paper that:

(a) has a grammage range of 13 g/m^2 to 75g/m^2;
(b) has a moisture content in the range of 4% to 11%; and
(c) is generally useable in sanitary products such as facial tissue, paper towel, bathroom tissue and napkins.

Accordingly, all toilet tissue and paper towels have been treated as tissue paper in these calculations.

Item	Activity	Basis for issue of free carbon units (t or kL[1])	Baselines		
			EI[a](t CO_2-e/basis)	EP[a](MWh/basis)	NGP[a](TJ/basis)
2.5	Tissue paper manufacturing	Uncoated tissue paper of saleable quality	0.646	1.67	n/a

Note that this program assumed a national average emissions intensity of electricity at 1 t CO_2-e/MWh. This assumption has been applied in this emissions factor for consistency. It is noted that the use of the EITE factor is likely to result in an overestimate of emissions associated with tissue paper, particularly in comparison to the emissions factors reported for paper. For comparison sake, the EITE factor for paper was compared with the virgin paper factor (1.497 kg CO_2-e/kg paper in EITE legislation versus 1.3 kg CO_2-e/kg paper from EPA Victoria). This is however the best data available at the time of the report for this specific source of paper.

Where paper towel or toilet tissue specific product was not detailed in the invoices provided by the cleaning contractors, an assumption was made based on description, price, other products purchased for the same facility, and the preferred products as specified in the University cleaning contract.

Calculation methodology

The average weight of a carton per product and the average number of products/rolls are used to calculate the total weight per carton. Weights were obtained from information available online for each product (weight of one pack/roll by number of packs/rolls per carton, or dimensions and grammage).

Scope	Reporting period	Emission source	Data source	Methodology reference	Emission factor (t CO_2-e / t)
3	01/01/17-31/12/17	Paper towel and toilet tissue	Invoices	As above	2.316

$$E = \sum_n CW_n * C_n * EF_{PT}$$

Where:

E = Total GHG emissions (t CO_2-e)
CW_n = Weight of individual cartons of type n (t)
C_n = Number of cartons of type n
EF_{PT}= Emission factor of paper towel and toilet tissue (t CO_2-e/t)

Calculated emissions

Scope	Reporting period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-31/12/17	Paper Towel and Toilet Tissue	57	t	132	t CO_2-e
Total for source			57	t	132	t CO_2-e

4.3.14 Business travel: Air travel

Staff, postgraduate students and visitors use air travel to undertake research, teaching and administrative commitments within Australia and internationally.

Activity data

The University had only one preferred air travel provider in 2017. The provider made available biannual spreadsheets of the details of flights booked for University travel, including the city pairs of the flights taken, distance and seating class.

Assumptions

The University Travel Policy states that "all specified University travel paid directly by the University must be booked through the University's contracted Travel Agent", so leakage of air travel due to staff booking flights outside the preferred travel providers is unlikely and it is assumed that all trips are booked through the preferred agent. The Travel Policy also indicates that "in accordance with the General Purchasing Policy all University travel expenditure must be for University business", therefore it is assumed that all trips are for business travel.

Emissions factors are sourced from the UK Department for Business, Energy and Industrial Strategy (DBEIS 2017). DBEIS emissions factors are applied on a calendar year basis, therefore no manipulation was required for the emissions calculation. When seating class is unknown, the average emission factor is used.

The Radiative Forcing Factor, a measure of the additional environmental impact of aviation, has not been applied in the calculation of greenhouse gas emissions from flights because of the very significant scientific uncertainty surrounding the quantification of its impacts.

Flight categories (by distance travelled) and flight classes (by seating class) have been defined in the table below.

GHG Inventory haul	DBEIS haul	Distance (km)	GHG Inventory class	DBEIS class
Short	Domestic to/from UK	≤ 463	Economy	Average
			Premium Economy	
			Business	
			First	
Medium	Short-haul to/from UK	463 – 3,700	Economy	Economy
			Premium Economy	Business
			Business	
			First	
Long	Long-haul to/from UK International to/from non-UK	> 3,700	Economy	Economy
			Premium Economy	Premium Economy
			Business	Business
			First	First

Calculation methodology

Scope	Reporting period	Emission source	Data source	Methodology reference	Emission factor (kg CO_2-e/km person)
3	01/01/17-31/12/17	Short Haul - All classes	Supplier summary	DBEIS 2017	0.14141
3	01/01/17-31/12/17	Medium Haul - Average	Supplier summary	DBEIS 2017	0.08513
3	01/01/17-31/12/17	Medium Haul - Economy	Supplier summary	DBEIS 2017	0.08378
3	01/01/17-31/12/17	Medium Haul - Premium, business, first	Supplier summary	DBEIS 2017	0.12565
3	01/01/17-31/12/17	Long Haul to/from non-UK - Average	Supplier summary	DBEIS 2017	0.09530
3	01/01/17-31/12/17	Long Haul to/from non-UK - Economy	Supplier summary	DBEIS 2017	0.07296
3	01/01/17-31/12/17	Long Haul to/from non-UK - Premium Economy	Supplier summary	DBEIS 2017	0.11675
3	01/01/17-31/12/17	Long Haul to/from non-UK - Business	Supplier summary	DBEIS 2017	0.21160
3	01/01/17-31/12/17	Long Haul to/from non-UK - First	Supplier summary	DBEIS 2017	0.29188
3	01/01/17-31/12/17	Long Haul to/from UK - Average	Supplier summary	DBEIS 2017	0.10439
3	01/01/17-31/12/17	Long Haul to/from UK - Economy	Supplier summary	DBEIS 2017	0.07993
3	01/01/17-31/12/17	Long Haul to/from UK - Premium Economy	Supplier summary	DBEIS 2017	0.12789
3	01/01/17-31/12/17	Long Haul to/from UK - Business	Supplier summary	DBEIS 2017	0.23179
3	01/01/17-31/12/17	Long Haul to/from UK - First	Supplier summary	DBEIS 2017	0.31971

$$E = \sum_{HC} D_{HC} * EF_{HC}/1000$$

Where:

E = Total GHG emissions (t CO_2-e)
D_{HC} = Distance travelled on flights with a haul H and seating class C (km person)
EF_{HC} = Emission factor for direct emissions for flights with a haul H and seating class C (kg CO_2-e/km person)

Calculated emissions

Scope	Reporting period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-31/12/17	Short Haul	920,979	km person	130	t CO_2-e
3	01/01/17-31/12/17	Medium Haul	14,054,241	km person	1,195	t CO_2-e
3	01/01/17-31/12/17	Long Haul	27,705,289	km person	2,385	t CO_2-e
Total for source			42,680,509	km person	3,710	t CO_2-e

4.3.15 Business travel: Accommodation

Staff, postgraduate students and visitors often stay at hotels while travelling to undertake research, teaching and administrative commitments within Australia and internationally.

Activity data

Financial Services provided a report of all expenses related to Tasmanian, mainland and international travel accommodation.

- 31000 Accommodation – Tasmania
- 31001 Accommodation – Australia (excl Tasmania)
- 31002 Accommodation – International

The University travel provider made available a report with details of accommodation booked using their services (approx. 36% of total University expense).

Assumptions

The total number of nights stayed in hotels was only available for stays booked through the University's travel provider, therefore total expense and total number of nights for domestic and international stays from the travel agent report were used to calculate average domestic and international hotel rates. Average rates were then used to calculate emission factors per expense from the emission factors calculated per room and night. It was assumed that average hotel rates were similar for Tasmania and mainland hotels as the travel agent report did not provided specific locations for all the stays.

The Department of Climate Change and Energy Efficiency provided a report with energy intensity data for Australian hotels (DCCEE 2012) by state/territory, but no data is available for Tasmania. Therefore the average energy intensity was used to calculate the emission factors for both Tasmania and the mainland. The latest available data from the Australian Bureau of Statistics in hotel occupancy rates was used to calculate the energy intensity per night stay.

The average room area for all hotel star ratings was used in the calculation of emission factors, since no information about star rating is available from the existing reports.

Region	Energy intensity (MJ/m^2)	Occupancy rate (%)	Avg. room area (m^2/room)	Energy per stay (MJ/room night)
AUST	1,350	66.7	53	130.39

Source: Department of Climate Change and Energy Efficiency 2012; Australian Bureau of Statistics 2016

The DCCEE 2012 report also indicates the proportion of energy used corresponding to electricity and natural gas for Australia.

Emission source	Energy use (%)	Energy per stay (MJ/room night)
Electricity	65	84.76
Natural gas	35	45.64

The average electricity emission factor for mainland states/territories was used in the calculation of the emission factor for mainland hotels, since specific location data is not available. The National Greenhouse Account Factors Workbooks were used to source natural gas (scope 1) and electricity (scope 2) emission factors (see section 4.1.1 for natural gas emission factors)

State or territory	Electricity EF for scope 2 (kg CO_2-e/kWh)	
	01/01/17-30/06/17	01/07/17-31/12/17
New South Wales and ACT	0.84	0.83
Victoria	1.09	1.08
Queensland	0.78	0.79
South Australia	0.53	0.49
S Western Australia	0.72	0.7
N Western Australia	0.64	0.62
DKIS	1.56	0.59
Northern Territory	0.67	0.64
Mainland Average	0.73	0.72
Tasmania	0.12	0.14

The UK Department of Business, Energy and Industrial Strategy (DBEIS) now provides an emission factor for international overnight hotel stays. Different emission factors are provided for a range of countries on a 'room per night' basis. These emission factors are based on estimates for an overnight stay in an average hotel.

The emission factor for international hotel stays was calculated as the average of emission factors for all countries except Australia.

Reporting Period	Emission source	Average rate ($/room night)	Emission factor (kg CO_2-e/room night)
01/01/17-30/06/17	Accommodation - TAS	192	5.18
01/07/17-31/12/17	Accommodation - TAS	192	5.65
01/01/17-30/06/17	Accommodation - mainland	192	19.51
01/07/17-31/12/17	Accommodation - mainland	192	19.24
01/01/17-30/06/17	Accommodation - international	223	58.08
01/07/17-31/12/17	Accommodation - international	223	58.08

Calculation methodology

The GHG emissions resulting from travel accommodation are calculated using the total annual expend and the calculated emission factors per expense unit and per region.

Scope	Reporting Period	Emission source	Data Source	Methodology reference	Emission factor (kg CO_2-e/$)
3	01/01/17-30/06/17	Accommodation - TAS	Financial and provider reports	As above	0.027
3	01/07/17-31/12/17	Accommodation - TAS	Financial and provider reports	As above	0.029
3	01/01/17-30/06/17	Accommodation - mainland	Financial and provider reports	As above	0.101
3	01/07/17-31/12/17	Accommodation - mainland	Financial and provider reports	As above	0.100
3	01/01/17-30/06/17	Accommodation - international	Financial and provider reports	As above	0.260
3	01/07/17-31/12/17	Accommodation - international	Financial and provider reports	As above	0.260

$$E = \sum_R TE_R / AR_R * EF_R / 1000$$

Where:

E = Total GHG emissions (t CO_2-e)
TE_R = Total expenditure for travel accommodation in region R ($)
AR_R = Average hotel night rate in region R ($/room night)
EF_R = Calculated emission factor for travel accommodation in region R (kg CO_2-e/room night)

Calculated emissions

Scope	Reporting period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-30/06/17	Accommodation - Tasmania	573,591	$	16	t CO_2-e
3	01/07/17-31/12/17	Accommodation - Tasmania	783,007		24	t CO_2-e
3	01/01/17-30/06/17	Accommodation - Mainland	508,930	$	46	t CO_2-e
3	01/07/17-31/12/17	Accommodation - Mainland	860,328		78	t CO_2-e

Scope	Reporting period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-30/06/17	Accommodation - International	526,514	$	136	t CO_2-e
3	01/07/17-31/12/17	Accommodation - International	763,625		197	t CO_2-e
Total for source			4,015,995	$	498	t CO_2-e

4.3.16 Business travel: Taxis (domestic)

University staff use taxis and public transport for travelling to research, teaching and administrative commitments within Australia.

Activity data

Financial Services provided a report of all expense items (private and University issued credit cards inclusive) recorded against the natural account codes below, which include taxi fares, but also other fares such as vehicle hire or parking fees.

- 31020 Other fares/Car hire/Mileage – Tasmania
- 31021 Other fares/Car hire/Mileage – Australia (excl Tasmania)

Assumptions

The reports from Financial Services were analysed to determine which of the expense items related to taxi fares. This was determined using the 'Narrative Data' of relevant transactions to locate items that contained the words "taxi", "cab" or "yellow". Items that did not contain any of these words were assumed not to be a taxi fare.

The Office of the Tasmania Economic Regulator (2013) published data on Tasmanian taxi fares, as well as average distance and waiting time per trip. This data was used, together with current taxi fare data obtained from the Tasmanian Department of State Growth (n.d.), to calculate the average taxi fare per trip for the reporting period. It is assumed that the average distance and waiting time per trip has not changed since 2014.

The Australian Taxi Industry Association (ATIA) publishes calendar year statistics on the average metropolitan fares and distance travelled per trip by state/territory. The last publication released was for 2014 data (Australian Taxi Industry Association, 2015) and as such this data has been used for the reporting period.

ATIA also estimated the percentage of taxis using either a hybrid or LPG vehicle, but this information is not available for Tasmania and the remaining percentage of fuels are unknown. Although the Office of the Tasmania Economic Regulator estimated the percentage of Tasmanian taxis for all fuel types, a decision was made to search the Green Vehicle Guide and select the vehicle with the highest tailpipe emission for a consistent and conservative approach. The Green Vehicle Guide was searched for all passenger vehicles manufactured from 2004 to present for each fuel type, and the highest tailpipe emissions were for the 2009 Ford BF Mk III Falcon XT, a vehicle that uses LPG.

The emissions factors for taxis was derived from the Tasmanian and Australian average distance per trip, the average fare per trip, and the maximum tailpipe emissions per vehicle, as obtained from the aforementioned sources.

Region	Avg. trip (km/trip)	Avg. fare ($/trip)	LPG vehicle max. tailpipe emissions (kg CO_2-e/km)	Emission factor (kg CO_2-e/trip)	Emission factor (kg CO_2-e/$)
TAS	8.0	20.40	0.329	2.632	0.129
AUST	8.9	23.97	0.329	2.928	0.122

Source: Office of the Tasmanian Economic Regulator 2013; Department of State Growth n.d.; Australian Taxi Industry Association 2015; Green Vehicle Guide 2017

Calculation methodology

The GHG emissions resulting from staff use of taxis are calculated using the emission and conversion factors above, applied to the total annual expend.

Scope	Reporting period	Emission source	Data source	Methodology reference	Emission factor (kg CO_2-e/$)
3	01/01/17-31/12/17	Taxi - Tasmania	Financial Services	As above	0.129
3	01/01/17-31/12/17	Taxi - Mainland	Financial Services	As above	0.122

$$\mathrm{E} = \sum_{\mathrm{r}} TE_r * \mathrm{EF}_{\mathrm{r}}/1000$$

Where:

E = GHG emissions (t CO_2-e)
TE_r = Total taxi expenditure in region r ($)
EF_r = Calculated emission factor for taxi expenditure in region r (kg CO_2-e/$)

Calculated emissions

Scope	Reporting period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-31/12/17	Taxi - Tasmania	178,750	$	23	t CO_2-e
3	01/01/17-31/12/17	Taxi - Mainland	256,355	$	31	t CO_2-e
Total for source			435,105	$	54	t CO_2-e

4.3.17 Business travel: Hire cars (domestic)

All fuel used in domestic hire cars has been included in the total fuel reported in Section 4.1.3 Transport fuels. Although these emissions are identified as scope 3 emissions, the scope 1 emissions have been calculated and reported accordingly. Refer to Section 4.1.3 for a detailed explanation.

4.3.18 Staff commuting

Staff at the University of Tasmania use different transport means to travel to and from the different University campuses, including cars, taxis, motorbikes, bicycles, buses, and on foot, as well as train in mainland campuses.

Activity data

The University conducts a biannual Travel Behaviour Survey (last conducted in 2017) where staff members provide information on their transport habits when travelling to and from the University during a typical

week in semester 1. Respondents detail the transport method/s and duration of each trip, together with the suburb in which they reside and the campus they attended, among other information.

Assumptions

Respondent rate was relatively high (~ 14% of staff), so this is considered to be a representative sample. It is assumed that survey staff were representative of all staff.

Only staff driving (either sole or multiple occupant cars) were included. Multi-occupant car passengers are assumed to be already included in those driving multi-occupant cars.

It is assumed that all staff uses the most direct route between their residence and their main campus. This might not be always the case as some staff realises other activities on their way to/from work, however as these would not be part of commuting and because of the impossibility of obtaining precise data, this is a reasonable assumption.

It is assumed that all staff take four weeks of paid leave per year. Public holidays were also accounted for (estimated as 10 days, which is less than the current gazetted number of public holidays and thus a conservative estimate). Therefore, it is assumed that transport to work was required for 46 weeks a year for all staff.

Calculation methodology

The Australian Bureau of Statistics (2017b) provides information by state/territory on the quantity of different fuels used in several types of vehicles (from where we can calculate the percentage use), and the average consumption per vehicle type. Using these values together with scope 1 emission factors for transport fuels (see Section 4.1.3), the average emissions per distance unit have been calculated for passenger vehicles, motorcycles and buses both for Tasmania and New South Wales (as the University has a campus in Sydney) where relevant.

The emission factor for Tasmanian buses was adjusted by dividing this emission factor by the average patronage per trip for buses servicing the University campuses, calculated from data provided by MetroTAS upon request.

The Office of the Tasmania Economic Regulator (2013) published data on taxi fuel percentages for Tasmania. These percentages, together with the average consumption for passenger vehicle provided by ABS (in the absence of better data), have been used to calculate an emission factor for taxis. Bi-fuel taxis were assumed to use only petrol, which has a higher emission factor than LPG.

State	Transport	Petrol			Diesel			LPG and other			Average patronage
		ML	%	L/100km	ML	%	L/100km	ML	%	L/100km	
TAS	Car	326	84.9	10.5	53	13.8	9.4	5	1.3	9.7	
	Motorcycle	2	100.0	6.2	0	0.0	0.0	0	0.0	0.0	
	Bus	1	6.7	15.0	14	93.3	25.6	0	0.0	10.0	10.23
	Taxi	-	74.6	10.5	-	0.0	0.0	-	25.4	9.7	
NSW	Car	4,802	86.8	11.0	670	12.1	10.2	60	1.1	12.6	

Source: ABS 2016; Office of the Tasmania Economic Regulator 2013; MetroTas report

Scope	Reporting period	Emission source	Data source	Methodology reference	Emission factor (kg CO_2-e/km)
3	01/01/17-31/12/17	Staff commuting – Car TAS	Staff survey	As above	0.243
3	01/01/17-31/12/17	Staff commuting – Motorcycle TAS	Staff survey	As above	0.143
3	01/01/17-31/12/17	Staff commuting – Bus TAS	Staff survey	As above	0.066
3	01/01/17-31/12/17	Staff commuting – Taxi TAS	Staff survey	As above	0.220
3	01/01/17-31/12/17	Staff commuting – Car NSW	Staff survey	As above	0.257

Source: ABS 2016; Office of the Tasmania Economic Regulator 2013; MetroTas report

Based on the 2017 Travel Behaviour Survey (TBS) results, the number of trips per transport mode was calculated, and the distance between residence and main campus estimated using Google Maps. This data was used to calculate the total distance travelled per transport mode and per state in one typical working week. Distance was then multiplied by the number of working weeks, total number of staff (including permanent, fixed-term and casuals) and the specific emission factors to estimate the emissions from each transport mode.

Staff data is obtained from the University Human Resources department, HR Systems and Reporting. The following data was provided for the reporting year:

Reporting year	Ongoing staff (headcount)	Fixed term staff (headcount)	Casual staff (headcount)	Total (headcount)
2017	1,512	1,195	1,359	4,066

$$E = \sum_{ms} D_{ms} * W * EF_{ms}/1000 * S/SR$$

Where:

E = Total GHG emissions (t CO_2-e)
D_{ms} = Distance travelled for work by survey respondents in a week on transport mode 'm' and state 's' (km)
W = Number of working weeks
EF_{ms} = Emission factor for transport mode m and state s (kg CO_2-e/km)
S = Total number of staff (headcount)
SR = Number of survey respondents (headcount)

Data for type of car used for commuting purposed by University staff (efficient/ small/ medium/ large and 2WD/4WD) was collected in the 2017 TBS. However, to our knowledge, there are not current emission factors for Tasmania for specific vehicle types. The Green Vehicle Guide provides emission factors for different car types, but only the greener vehicles are listed and therefore we do not consider these appropriate.

For comparison purposes, the same methodology described above was used, but replacing the calculated emission factors with EPA Victoria (2014) emission factors. The emissions calculated with EPA Victoria factors were 10 % lower, which is not a material difference for the overall reported emissions from the University. Therefore, the calculation methodology outlined above will continue to be applied in future years.

Calculated emissions

Scope	Reporting period	Emission source	Activity data	Unit	GHG emissions	Unit
3	01/01/17-31/12/17	Staff commuting - Car	16,695,437	km	4,065	t CO_2-e
3	01/01/17-31/12/17	Staff commuting - Motorcycle	132,180	km	19	t CO_2-e
3	01/01/17-31/12/17	Staff commuting - Bus	1,068,546	km	70	t CO_2-e
3	01/01/17-31/12/17	Staff commuting – Taxi	38,388	km	8	t CO_2-e
Total for source			17,934,550	km	4,163	t CO_2-e

5 ASSESSMENT OF UNCERTAINTY

There is statistical uncertainty associated with GHG source data, resulting from natural variations (e.g., random human errors in the measurement process) and fluctuations in measurement equipment. Uncertainty associated with quantifying the parameters used as inputs (e.g., activity data and emission factors) arises any time GHG emissions are quantified (The Green House Gas Protocol: Guidance on uncertainty assessment in GHG inventories and calculating statistical parameter uncertainty 2003).

An estimate of the data uncertainty has been carried out for each measurement parameter. The total uncertainty is calculated from the square root of the sum of the squares of each uncertainty value. This assessment has been carried out in accordance with the National Greenhouse and Energy Reporting (Measurement) Determination 2008 and the GHG Protocol.

Total uncertainty for the 2017 GHG Inventory was 4.09%

6 FUTURE IMPROVEMENTS

6.1 Assurance

The University of Tasmania is committed to periodic (triennial) external assurance of its carbon footprint. As an assurance statement was completed for the 2015 baseline, no external assurance is currently planned for the 2017 inventory. Assurance statements when completed are uploaded to the University Sustainability website.

6.2 Data collection

For a small number of facilities, estimates of the electricity consumption were required to be made as set out above. For these facilities, the University will attempt to source the actual consumption data in future years.

It is anticipated that upcoming waste management and cleaning contracts will enable collection of relevant data for waste streams. Additionally, internal audits will be conducted through the Sustainability Integration Program for Students.

It is anticipated that transport data for commuting calculations will continue to be collected biennially through the University's Travel Behaviour Survey and associated targeted counting regime.

6.3 Data storage

The University is currently working towards the modification of the existing Asset Management Information Systems (AMIS) Portal so it can be used in the future for the University GHG Inventories record keeping.

From 2018, provider reports and other documents used in the emissions calculation of some sources (e.g., air travel, office paper) will be stored in HPE RM (Hewlett Packard Enterprise Records Manager), an Electronic Document and Records Management System (EDRMS) used by the University of Tasmania to capture, manage and provide access to records and information.

7 REFERENCES

Australian Bureau of Statistics (2016). 8635.0 – Toursit Accommodation, Australia, 2015-16. Available at: http://www.abs.gov.au/ausstats/abs@.nsf/mf/8635.0/. Last accessed 15/02/2018

Australian Bureau of Statistics (2017a). 8755.0 - Construction Work Done, Australia. Available at: http://www.abs.gov.au/AUSSTATS/abs@.nsf/second+level+view?ReadForm&prodno=8755.0&viewtitle=Construction%20Work%20Done,%20Australia,%20Preliminary~Jun%202017~Previous~30/08/2017&&tabname=Past%20Future%20Issues&prodno=8755.0&issue=Jun%202017&num=&view=&. . Last accessed 15/02/2018

Australian Bureau of Statistics (2017b). 9208.0 – Survey of motor vehicle use, Australia, 12 months ended 30 June 2016. Available at: http://www.abs.gov.au/ausstats/abs@.nsf/mf/9208.0. Last accessed 15/02/2018

Australian Greenhouse Emissions Information System (n.d.). National Greenhouse Gas Inventory - Kyoto Protocol classifications. Available at: http://ageis.climatechange.gov.au/NGGI.aspx#. Last accessed 15/02/2018

Australian Energy Regulator (n.d.) Energy made easy. Available at: https://www.energymadeeasy.gov.au/benchmark. Last accessed 15/02/2018

Australian Institute of Petroleum (2018). Retail Prices: Calendar Year & Financial Year Averages for Petrol and Diesel. Canberra: AIP. Available at: http://www.aip.com.au/aip-annual-retail-price-data. Last accessed 15/02/2018

Australian Taxi Industry Association (2015). Taxi statistics. Available at: http://www.atia.com.au/taxi-statistics/. Last accessed 15/02/2018

Commonwealth Government (n.d.). Clean Energy Regulations 2011. Available at: https://www.legislation.gov.au/Details/F2014C01341. Last accessed 15/02/2018

Department for Business, Energy and Industrial Strategy (2017). Greenhouse gas reporting – Conversion factors 2017. Available at: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2017. Last accessed 15/02/2018

Department of Climate Change and Energy Efficiency (2012). Baseline energy consumption and greenhouse gas emissions in commercial buildings in Australia. Department of Climate Change and Energy Efficiency, Commonwealth of Australia. Available at: https://industry.gov.au/Energy/EnergyEfficiency/Non-residentialBuildings/Documents/CBBS-Part-1.pdf. Last accessed 15/02/2018

Department of the Environment and Energy (2016). Australian National Greenhouse Accounts (August 2016). National Greenhouse Accounts Factors. Department of Environment, Australia

Department of the Environment and Energy (2017a). National Carbon Offset Standard for Organisations. Department of Environment, Commonwealth of Australia

Department of the Environment and Energy (2017b). Australian National Greenhouse Accounts (July 2017). National Greenhouse Accounts Factors. Department of Environment, Australia

Department of State Growth (n.d.). Taxi fares. Available at: http://www.transport.tas.gov.au/passenger/taxi/fares. Last accessed 15/02/2018

EPA Victoria (2014). EPA Victoria's Greenhouse Gas Inventory Management Plan: 2012-13 Update. Publication 1562. Environment Protection Authority (EPA) Victoria, Carlton (Australia). Available at: http://www.epa.vic.gov.au/~/media/Publications/1562.pdf. Last accessed 15/02/2018

EPA Victoria (2013). Greenhouse Gas Emissions Factors for Office Paper. Publication 1374.1. Environment Protection Authority (EPA) Victoria, Carlton (Australia). Available at: http://www.epa.vic.gov.au/~/media/Publications/1374%201.pdf. Last accessed 15/02/2018

Green Vehicle Guide (2017). Available at: https://www.greenvehicleguide.gov.au/. Last accessed 15/02/2018

IPCC (2006). IPCC Guidelines for National Greenhouse Gas Inventories. Volume 4. Agriculture, Forestry and Other Land Use. IGES, Hayama (japan). Available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html. Last accessed 15/02/2018

Office of the Tasmanian Economic Regulator (2013). Setting taxi fares in Tasmania. Available at: http://www.economicregulator.tas.gov.au/Documents/Taxi%20Fare%20Inquiry%20CIE%20Report%20April%202013%20(13%201756).PDF. Last accessed 15/02/2018

Office of the Tasmanian Economic Regulator (2017). Tasmanian water and sewerage state of the industry report 2015-16. Available at: http://www.economicregulator.tas.gov.au/water/reports/performance-monitoring/state-of-the-industry-reports. Last accessed 15/02/2018

Waste Authority WA (2012). Resource C. Converting volumes to tonnes. Available at: http://www.wasteauthority.wa.gov.au/publications/converting-volumes-to-tonnes. Last accessed 15/02/2018

WRI/WBCSD (2004). The Greenhouse Gas Protocol. A Corporate Accounting and Reporting Standard (revised edition). Available at: http://www.wbcsd.org/Clusters/Climate-Energy/Resources/A-corporate-reporting-and-accounting-standard-revised-edition. Last accessed 15/02/2018

Zero Waste SA (n.d.). Solid waste and recycling reporting template. Available at: http://www.zerowaste.sa.gov.au/upload/industry/toolkits-templates-and-guides/waste-management-toolkit/150811_Waste%20and%20Recycling%20Reporting%20Template%20-%20EXAMPLE.xlsx. Last accessed 15/02/2018

APPENDIX A. SUMMARY OF THE UNIVERSITY GHG INVENTORY 2017

Emissions source		Activity data		Unit	Emissions by scope (t CO_2-e)			Total emissions (t CO_2-e)
					1	2	3	
Natural gas	Natural gas	47,572	47,572	GJ	2,451		379	2,830
Stationary fuels and petroleum based products	Stationary diesel	12,652	36,565 / 5	L	11		2	59
	Stationary gasoline	3,289		L	9		0	
	Stationary liquefied petroleum gas	15,354		L	24		1	
	Stationary kerosene	4,095		L	11		1	
	Stationary petroleum based oils	1,156		L	1		0	
	Solvents	20		L	0		0	
	Dry wood	5		t	0		0	
Transport fuels	Transport (pre 2004) diesel	82,247	418,474	kL	224		11	1,102
	Transport (post 2004) diesel	111,549		kL	304		16	
	Transport (post 2004) gasoline	224,678		kL	520		28	
Electricity	Electricity - TAS	49,940,928	52,699,599	kWh		6,247	1,716	10,489
	Electricity - NSW	2,637,100		kWh		1,687	757	
	Electricity - SA	61,714		kWh		31	6	
	Electricity - NT	40,289		kWh		26	4	
	Electricity - WA	47,572		kWh		14	1	
Refrigerant gas	Refrigerant gas 134a	17	109	kg			24	314
	Refrigerant gas 404a	56		kg			220	
	Refrigerant gas 407	14		kg			25	
	Refrigerant gas 410	22		kg			45	
Livestock	Dairy cows	359	613	head/yr			808	1,188
	Other livestock	254		head/yr			381	
Waste to landfill and recycling	Domestic waste to landfill	1,454	1,666	t			2,036	2,041
	Commercial waste to landfill	0		t			0	
	Recycled waste	212		t			5	

Emissions source		Activity data		Unit	Emissions by scope (t CO_2-e)			Total emissions (t CO_2-e)
					1	2	3	
Sanitary waste	Sanitary waste	81	81	t			145	145
Water	Water	242,385	242,385	kL			46	46
Waste water	Waste water	1,927	1,927	ETs/yr			245	245
Construction	Construction	35,610,285	35,610,285	$			1,710	1,710
Office paper	Virgin paper	1,993	90,201	kg			3	23
	Recycled paper	13,490		kg			20	
	Carbon neutral paper	74,718		kg			0	
Paper tissue	Paper towels and toilet tissue	57	57	t			132	132
Business travel: Flights	Short haul	920,979	42,680,509	km			130	3,710
	Medium haul	14,054,241		km			1,195	
	Long haul	27,705,289		km			2,385	
Business travel: Accommodation	Accommodation - Tasmania	1,356,598	4,015,995	$			40	498
	Accommodation - Mainland	1,369,258		$			124	
	Accommodation - International	1,290,139		$			334	
Business travel: Taxis	Taxis - Tasmania	178,750	435,105	$			23	54
	Taxis - Mainland	256,355		$			31	
Staff Commuting	Car	16,695,437	17,934,550	km			4,065	4,163
	Motorcycle	132,180		km			19	
	Bus	1,068,546		km			70	
	Taxi	38,388		km			8	
					3,554	8,006	17,189	28,749
Electricity generation	Solar photovoltaic	132,824	132,824	kWh				17
TOTAL GHG EMISSIONS								28,731

APPENDIX B. CHANGE IN EMISSIONS FROM 2016

The following table shows the change in GHG emissions from 2016 to 2017. Those emission sources that had a significant change in methodology have been recalculated, as stated in Section 2.3, so they can be accurately compared between years. Emissions from refrigerant gases and tissue paper have also been recalculated because of an error in the GHG Inventory 2016. Recalculated sources are marked with *.

Emissions source		2016 emissions (t CO_2-e)	2017 emissions (t CO_2-e)	Change in emissions (%)
Natural gas	Natural gas	2,437	2,830	16.12
Stationary fuels and petroleum based products	Stationary diesel	80	13	-84.42
	Stationary gasoline	15	9	-40.40
	Stationary liquefied petroleum gas	28	25	-8.37
	Stationary kerosene	20	11	-43.90
	Stationary petroleum based oils	1	1	18.93
	Solvents	0	0	NA
	Dry wood	0	0	NA
Transport fuels & Hire cars	Transport (pre 2004) diesel	257	235	-8.64
	Transport (post 2004) diesel	261	319	14.62
	Hire cars (post 2004) diesel	18		
	Transport (post 2004) gasoline	463	548	-9.48
	Hire cars (post 2004) gasoline	142		
Electricity	Electricity - TAS	6,143	7,963	29.61
	Electricity - NSW	2,074	2,444	17.84
	Electricity - SA	49	37	-25.30
	Electricity - NT	29	30	1.93
	Electricity - WA	17	15	-10.97
Refrigerant gas *	Refrigerant gas 134a	88	24	-72.73
	Refrigerant gas 404a	401	220	-45.21
	Refrigerant gas 407	41	25	-37.83
	Refrigerant gas 410	72	45	-38.04
Livestock	Dairy cows	919	808	-12.17
	Other livestock	319	381	19.51
Waste to landfill and recycling	Domestic waste to landfill	1,626	2,036	25.23
	Commercial waste to landfill	1	0	-72.59
	Recycled waste *	4	5	12.87
Sanitary waste	Sanitary waste	117	145	24.25
Water	Water	39	46	18.59
Waste water	Waste water	185	245	32.68
Construction	Construction	2,423	1,710	-29.42
Office paper	Virgin paper	20	3	-86.67
	Recycled paper	31	20	-33.33
	Carbon neutral paper	0	0	NA

Emissions source		2016 emissions (t CO_2-e)	2017 emissions (t CO_2-e)	Change in emissions (%)
Tissue paper *	Paper towels and toilet tissue	127	132	3.64
Business travel: Flights	Short haul	52	130	150.05
	Medium haul	1,254	1,195	-4.72
	Long haul	2,518	2,385	-5.28
Business travel: Accommodation *	Accommodation - Tasmania	34	40	16.00
	Accommodation - Mainland	112	124	10.74
	Accommodation – International	457	334	-26.98
Business travel: Taxis	Taxis - Tasmania	31	23	-25.60
	Taxis - Mainland	29	31	6.22
Staff Commuting *	Car	4,401	4,065	-7.63
	Motorcycle	22	19	-15.16
	Bus	61	70	15.38
	Taxi	14	8	-40.67
	Train	11	0	NA
TOTAL CHANGE		27,445	28,749	4.75
Electricity generation	Solar photovoltaic	10	17	73.84
TOTAL CHANGE		27,435	28,695	4.73

APPENDIX C. UNIVERSITY OF TASMANIA AUSTRALIAN FACILITIES