Greenhouse gas (GHG) inventory and management plan 2018–2019

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EPA VICTORIA
Environment Protection Authority Victoria

VICTORIA State Government

Greenhouse gas (GHG) inventory and management plan 2018–2019

Introduction

EPA has a step-by-step continuous improvement framework to manage its own greenhouse gas (GHG) emissions and achieve carbon neutrality. It is known as EPA's *Carbon management principles*.

EPA takes the following steps to manage its own carbon footprint and demonstrate best-practice carbon neutrality:

- We measure and record our GHG emissions in our GHG Inventory using
    - the World Resources Institute and
    - World Business Council for Sustainable Development's GHG Protocol - Corporate Accounting and Reporting Standard ('Corporate Standard').
- We obtain independent verification of our GHG emissions and our GHG Inventory Management Plan.
- We externally publish both our GHG emissions (in our Annual Report) and our GHG Inventory Management Plan (to our website).
- We identify and assess our emission reduction options using the Carbon management principles.
- We assess the reduction and offset options from a financial and environmental perspective.

This document outlines the EPA's annual process to develop its GHG Inventory. The process involves:

- defining organisational and operational boundaries
- identifying GHG emissions sources
- collecting activity data
- calculating GHG emissions
- identifying reduction measures
- offsetting.

Reporting boundary

Organisational boundary

EPA uses the Corporate Standard's definition of *operational control* to define its organisational boundary. The Corporate Standard states:

'A company has operational control over an operation if the former or one of its subsidiaries has the full authority to introduce and implement its operating policies at the operation. This criterion is consistent with the current accounting and reporting practice of many companies that report on emissions from facilities, which they operate'.

The *operational control* definition with explanatory notes can be found in section 3 of the Corporate Standard. It has also been used by the Australian Federal Government to define organisational boundaries for its mandatory and voluntary GHG emissions reporting schemes.

A review of the organisational boundary is undertaken annually prior to preparation of the GHG Inventory.

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Emissions scopes and sources

EPA performs a comprehensive review of its operations to identify activities that generate GHG emissions. This includes EPA's direct activities as well as those that occur upstream and downstream of these direct activities. Once all sources of GHG emissions are identified they are categorised based on the Corporate Standard approach to accounting and reporting of GHG emissions sources using scopes (Figure 1). Scopes help delineate direct and indirect emissions sources and improve transparency. The Corporate Standard defines three scopes:

Scope 1: direct GHG emissions that occur from sources that are controlled by the organisation. The following scope 1 emissions sources were identified as part of our review:

- natural gas – tenant
- transport fuels – vehicle and boat fuel
- refrigerants – building, kitchen, laboratory and vehicle refrigeration.

Scope 2: indirect GHG emissions associated with purchased energy commodities including electricity and steam. Scope 2 emissions physically occur at the facility where the energy commodity is produced. The following scope 2 emissions sources were identified as part of our review:

- purchased electricity
- high temperature hot water.

Scope 3: all other indirect GHG emissions resulting from the activities of the organisation, but from sources not owned or controlled by the organisation. The following scope 3 emissions sources were identified as part of our review:

- natural gas – trigeneration plant
- base building natural gas – communal areas where EPA is a tenant
- base building electricity – communal areas where EPA is a tenant
- natural gas transmission and distribution losses – tenant and base building
- electricity transmission and distribution losses – tenant and base building
- fuel extraction, production and transportation
- stationary fuels – backup generators
- reticulated water
- air travel
- taxi travel
- public transport
- staff commuting
- waste
- office paper
- catering services
- courier services
- printing and publication services.

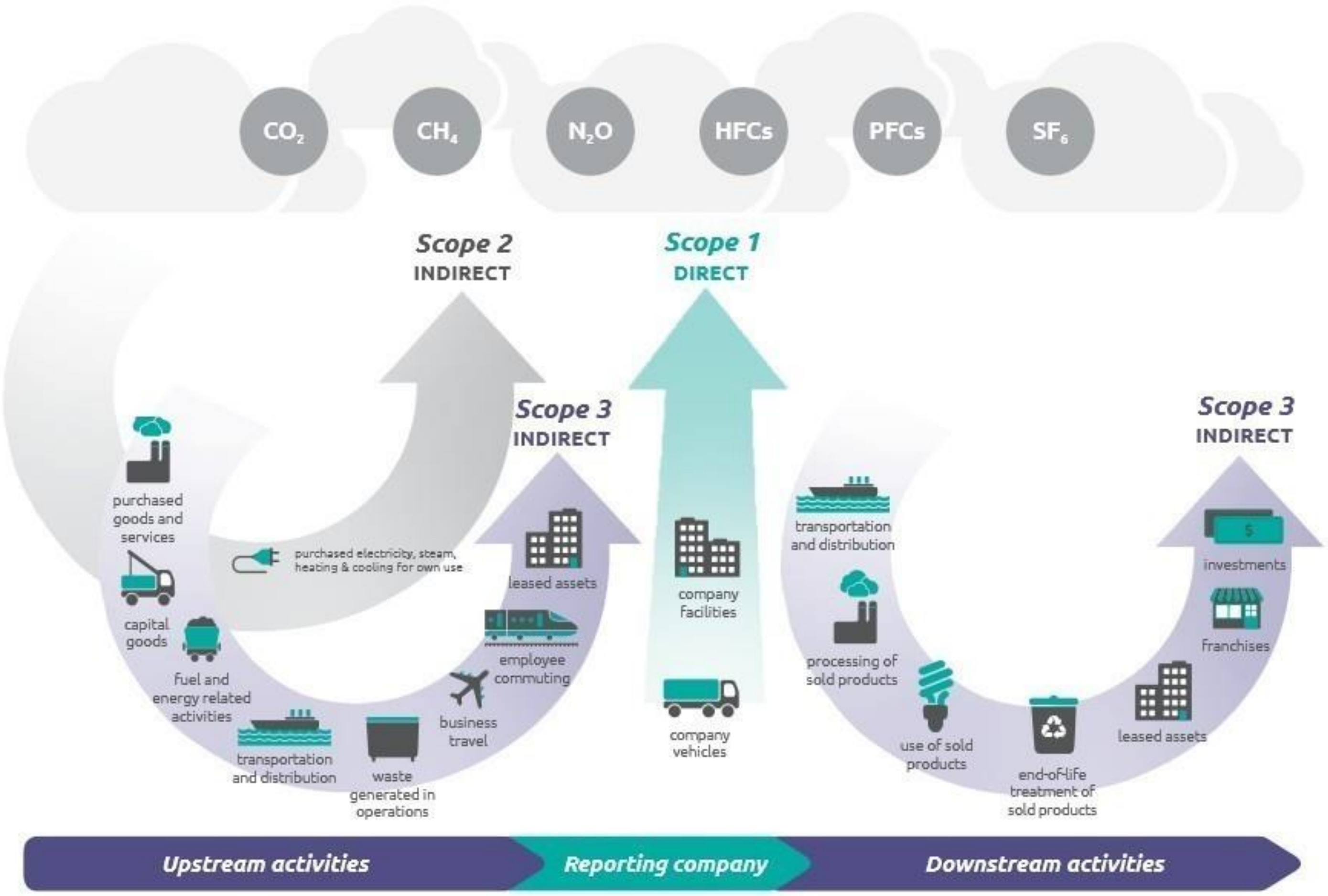

Figure 1. Overview of scopes and emissions across a value chain (GHG Protocol - [Corporate Value Chain (Scope 3) Accounting and Reporting Standard](), World Resources Institute and World Business Council for Sustainable Development)

Data and methods

Scope 1, scope 2 and scope 3 GHG emissions are calculated using activity data and GHG emissions quantification methodologies.

Activity data

Activity data is a key input into the calculation of GHG emissions. It refers to quantitative data associated with the activity that generated the GHG emissions. For example, activity data for emissions from purchased electricity may refer to electricity consumption amounts stated on supplier invoices (typically in kWh). Activity data provides a measure for the level of emissions intensity of the activity.

EPA reports its GHG emissions for each financial year period from 1 July to 30 June. Each year EPA collects activity data from around the organisation for all emission sources.

Quantification methods

Prescriptive quantification methods have been established in order for an organisation to calculate its GHG emissions and express the quantity of emissions in a way that is consistent year-on-year and comparable with other organisations. EPA uses tonnes of carbon dioxide equivalent (t.CO_2-e) as the unit of measurement to quantify its emissions. Its GHG inventory includes all six greenhouse gases covered by the Kyoto Protocol — carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6).

EPA relies on the quantification methods, including conversion factors, published by the Australian Federal Government and other reputable authorities. In circumstances where appropriate quantification methods are not available, EPA applies assumptions to develop its own quantification methods. These assumptions are based on the best available information at the time the GHG inventory is prepared.

The following pages provide details of the activity data origins, quantification methods and assumptions used to prepare EPA's GHG inventory.

Scope 1 GHG emissions

1.1 Natural gas – tenant	
Activity data	**Background:** EPA sites which consume natural gas include Head Office, Centre for Environmental Studies (CES) Macleod and South West Geelong. However, Head Office does not use gas directly. As such, only activity data for base building natural gas is collected for Head Office (see 3.2). Activity data for tenant natural gas is collected for CES Macleod and South West Geelong only. **Activity data:** Gas consumption amounts as stated on supplier invoices or provided directly from the property managers – expressed in gigajoules (GJ). As EPA is not the sole tenant for each of these sites, tenant natural gas data was collected separately from base building data.
Calculation method	$$\mathrm{X} = Q \times \frac{EF}{1000}$$ Where: **X** = scope 1 emissions ($t.CO_2$-e) **Q** = quantity of natural gas purchased (GJ) **EF** = scope 1 emission factor for natural gas distributed in a pipeline which includes the effect of an oxidation factor ($kg.CO_2$-e/GJ)
Assumptions	Where data was not available for the final months of 2018-19, estimations were made using average daily consumption, calculated using data provided for previous months. As EPA is not the sole tenant of these buildings, in the instance data was provided for the entire building or one floor of a building, GHG emissions were apportioned using EPA's Net Lettable Area (NLA) as a portion of the total NLA for the building or floor.
Factors	**EF**: 51.53 ($kg.CO_2$-e/GJ)
Reference	National Greenhouse Accounts (NGA) Factors (July 2018), Department of Environment and Energy • Table 2: emission factors for the consumption of natural gas (Victoria).
1.2 Transport fuels – vehicle and boat fuel	
Activity data	Fuel consumption amounts by fuel type, as stated on vehicle fuel card reports and boat fuel invoices – expressed in litres (L). Commonly used fuel types include gasoline, diesel and LPG.
Calculation method	$$\mathrm{X} = \sum \frac{Q_i \times EC_i \times EF_i}{1000000}$$ Where: **X** = scope 1 emissions ($t.CO_2$-e) $\mathbf{Q_i}$ = quantity of fuel type (i) (L)

	EC_i = energy content factor for fuel type (i) (GJ/kL) **EF_i** = emission factor for each fuel type (i), which includes the effect of an oxidation factor, for fuel type (i) (kg.CO_2-e/GJ)
Assumptions	EC_i and EF_i for blended fuels is calculated by combining the emission factors available for each of the fuel types included in the blended fuel. The ratio used to calculate EC_i and EF_{ij} for blended fuels is the maximum standard specified for the fuel. For example, it is assumed E10 contains 10% ethanol and 90% gasoline while B20 contains 20% diesel and 80% biodiesel. As all EPA vehicles are post 2015, the NGA factors for 'post-2004 vehicles' were used.
Factors	**EC_i**: ULP = 34.20, DSL = 38.60, LPG = 26.20, E10 = 33.12, B20 = 37.80, Jet = 36.80 and Oil = 39.70 (GJ/kL) **EF_i**: ULP = 69.70, DSL = 70.50, LPG = 61.50, E10 = 62.99, B20 = 56.92, Jet = 70.21 and Oil = 74.27 (kg.CO2-e/GJ)
Reference	NGA Factors (July 2018), Department of Environment and Energy Table 4: Fuel combustion emission factors – fuels used for transport energy purposes • boat fuel (general transport) • vehicle fuel (post-2004 vehicles).
1.3 Refrigerants – building, kitchen, laboratory and vehicle refrigeration	
Activity data	Number and type of refrigerant containing assets sourced from internal audit. Refrigerant types and charge capacity – expressed in kilograms per year (kg/yr) sourced from manufacture specifications as stated on nameplate data on equipment.
Calculation method	$$X = \sum \frac{Q_i \times LR_i \times G_{ij}}{1000}$$ Where: **X** = scope 1 emissions (t.CO_2-e) **Q_i** = charge capacity for equipment (i) (kg/yr) **LR_i** = leakage rate for equipment (i) (% of capacity) **G_{ij}** = 100-year global warming potential of the refrigerant gas (j) for equipment (i) (kg.CO_2-e/kg).
Assumptions	In instances where EPA is not the sole tenant of a building, GHG emissions from relevant equipment (e.g. air-conditioning units) were apportioned using EPA's Net Lettable Area (NLA) as a portion of the total NLA for the building. Applied light vehicle leakage rate for vehicles, stand-alone commercial application for small stand-alone freezers, medium and large commercial applications for large commercial stand-alone freezers and chillers and domestic refrigeration for kitchen fridges and coolers.
Factors	**LR_i**: vehicles = 18.9, commercial air-conditions = 7.6, commercial stand-alone freezers – small (<300L) = 8.8, commercial stand-alone freezers and chillers – large (>500L) = 15.1, kitchen fridges and water coolers = 0.4 (%) **G_{ij}**: R123 = 77.00, R141b = 713.00, R143a = 1,430.00, R22 = 1,810.00, R407c = 1,773.85, R410A = 2,087.50, R407b = 2,803.50, R404a = 3,921.60, R507A =

	3,985.00, R502 = 4,657.00, R12 = 10,900.00, R600A = 3.00
Reference	Annual leakage rates for commercial air-conditioning: NGA Factors (July 2018), Department of Environment and Energy • Table 25: leakage rates for synthetic gases Annual leakage rates for other: National Inventory Report 2017 (V1), Australian Government Department of Environment and Energy • Table 4.27: halocarbons: key assumptions concerning average equipment life, initial and annual losses and replenishment rates, by equipment type 100-year Global Warming Potential: Industrial Gases (2018), The Linde Group

Scope 2 GHG emissions

2.1 Purchased electricity	
Activity data	Electricity consumption amounts and Green Power percentages as stated on supplier invoices or provided directly from property managers – expressed in kilowatt hours (kWh). Capacity of solar panels from operations officer – expressed in kilowatts (kW). In the instance that EPA is the sole tenant for a site, electricity data covering both tenant and base building was collected. In the instance that EPA is not the sole tenant for a site, base building electricity data was collected separately from tenant data. This is relevant for Head Office, Exhibition Street, CES Macleod and South West Geelong sites.
Calculation method	$Y = Q \times \frac{EF}{1000}$ Where: **Y** = scope 2 emissions (t.CO_2-e) **Q** = quantity of purchased electricity (kWh) **EF** = scope 2 emission factor for purchased electricity (kg.CO_2-e/kWh)
Assumptions	Where data was not available for the final months of 2018-19, estimations were made using average daily consumption, calculated using data provided for previous months. Data was not available for a number of air monitoring stations. Estimations were made based on known consumption of similar air monitoring stations or electricity use in prior year. Data was not available for all thirteen small footprint sites (including sites with sensors and cameras only) which are powered by 100% solar energy. As these sites are powered by 100% solar energy, there are no emissions associated with the electricity used by these sites. However, estimations for electricity use for these sites were made using the average power consumption and run-time for the year. In the instance that EPA is not the sole tenant of the building and data was provided for the entire building or one floor of a building, GHG emissions were apportioned using EPA's Net Lettable Area (NLA) as a portion of the total NLA for the building or floor. Emissions associated with electricity powered by renewable energy are zero.
Factors	**EF**: 1.17 (kg.CO_2-e/kWh)
Reference	Scope 2 emission factor for Victoria: NGA Factors (July 2018), Department of Environment and Energy • Table 5: indirect (scope 2) emission factors for consumption of purchased electricity or loss of electricity from the grid (Victoria).
2.2 High temperature hot water (HTHW)	
Activity data	**Background:** Activity data relevant for EPA's CES Macleod site only. In prior years, EPA's high temperature hot water was produced using cogeneration and hot water boiler technology. In current year, EPA's high temperature hot water was produced using

	hot water boiler technology only. **Activity data:** HTHW consumed at EPA facility as provided by the plant operator – expressed in gigajoules (GJ). Natural gas consumption quantities supplied to the hot water boiler as provided by the plant operator – expressed in gigajoules (GJ). Proportion of energy content of natural gas converted to HTHW and losses and auxiliary services attributable to HTHW generation for hot water boiler as estimated by plant operator.
Calculation method	The following method was developed to estimate emissions in collaboration with the plant operator: $$Y = \frac{Q \times EF}{1000}$$ Where: **Y** = scope 2 emissions (t.CO_2-e) **Q** = quantity of natural gas attributed to HTHW consumed by EPA's CES facility (GJ) **EF** = full cycle emission factor (Scope 1 + Scope 3) for natural gas distributed in a pipeline which includes the effect of an oxidation factor (kg.CO_2-e/GJ) Where: $$Q = P \times [(N_{lt} \times P_{hthw}) + (N_{lt} \times P_{loss})]$$ Where: **P** = proportion of HTHW consumed by EPA's CES facility (%) **N_{lt}** = quantity of natural gas consumed by the hot water boiler at La Trobe University **P_{hthw}** = proportion of natural gas attributed to HTHW generation **P_{loss}** = proportion of natural gas attributed to system loses and auxiliary services $$P = \frac{(P_{CES})}{\frac{(N_{lt} \times P_{hthw})}{1000}}$$ Where: **P_{CES}** = quantity of embodied energy in the HTHW consumed by EPA's CES facility
Assumptions	Where data was not available for the final months of 2018-19, estimations were made using average daily consumption, calculated using data provided for previous months. As EPA is not the sole tenant of the CES Macleod building, GHG emissions are apportioned using EPA's Net Lettable Area (NLA) as a portion of the total NLA for the building. The following are relevant for the hot water boilers and were based on estimates by the plant operator:

	• proportion of energy content of natural gas converted to HTHW: 85% • proportion of energy content of natural gas that is lost in the system: 15%.
Factors	**EF**: 55.43 (kg.CO_2-e/GJ)
Reference	NGA Factors (July 2018), Department of Environment and Energy. • Table 2: emission factors for the consumption of natural gas (Victoria) • Table 38: scope 3 emission factors – natural gas for a product that is not ethane (inclusive of coal seam gas) (Victoria) Sinclair Knight Merz, (2003). La Trobe University Cogeneration Plant Energy Audit, LTU Level 2, Final, October 2003

Scope 3 GHG emissions

3.1 Natural gas – trigeneration plant	
Activity data	**Background:** activity data relevant for EPA's Head Office only. **Activity data:** all electricity data – expressed in kilowatt hours (kWh) and natural gas data – expressed in gigajoules (GJ) provided by plant manager. As EPA is not the sole tenant of its Head Office site, tenant and base building data was gathered separately.
Calculation method	$$Z = Q \times \frac{EF}{1000}$$ Where: **Z** = scope 3 emissions ($t.CO_2$-e) **Q** = quantity of trigeneration natural gas consumed by EPA (GJ) **EF** = full cycle emission factor (Scope 1 + Scope 3) for natural gas distributed in a pipeline which includes the effect of an oxidation factor ($kg.CO_2$-e/GJ) Quantity of trigeneration natural gas consumed by EPA was not directly available. As such natural gas was estimated via the following methodology: $$Q = Q_{GasT} \times \frac{Q_{ElecT}}{Q_{ElecEPA}}$$ Where: $\mathbf{Q_{GasT}}$ = quantity of trigeneration natural gas consumed by whole building (GJ) $\mathbf{Q_{ElectT}}$ = quantity of trigeneration electricity consumed by whole building (kWh) $\mathbf{Q_{ElecEPA}}$ = quantity of trigeneration electricity consumed by EPA (kWh)
Assumptions	Proportion of EPA trigeneration gas consumption to total building trigeneration gas consumption is assumed to be adequately estimated by EPA trigeneration electricity consumption to total building trigeneration electricity consumption. To calculate EPA's base building trigeneration electricity consumption, base building trigeneration electricity consumption for the entire building was apportioned using EPA's Net Lettable Area (NLA) as a portion of the total NLA for the building. Tenant data for EPA only was provided. As such, apportionment was not required.
Factors	**EF**: 55.43 ($kg.CO_2$-e/GJ)
Reference	NGA Factors (July 2018), Department of Environment and Energy. • Table 2: emission factors for the consumption of natural gas (Victoria) • Table 38: scope 3 emission factors – natural gas for a product that is not ethane (inclusive of coal seam gas) (Victoria).
3.2 Base building natural gas – communal areas of buildings where EPA is a tenant	
Activity data	**Background:** EPA sites which consume natural gas include Head Office, CES Macleod and South

	West Geelong. Activity data for base building natural gas is collected for these sites only. **Activity data:** natural gas consumption amounts as stated on supplier invoices or provided directly from property manager– expressed in kilowatt hours (kWh). As EPA is not the sole tenant for each of these sites, base building natural gas data was collected separately from tenant data.
Calculation method	$$Z = Q \times \frac{EF}{1000}$$ Where: **Z** = full cycle (Scope 1 + 3) emissions (t.CO_2-e) **Q** = quantity of natural gas (GJ) **EF** = full cycle emission factor (Scope 1 + Scope 3) for natural gas distributed in a pipeline which includes the effect of an oxidation factor (kg.CO_2-e/GJ)
Assumptions	Where data was not available for final months of 2018-19, estimations were made using average daily consumption, calculated using data provided for previous months. As EPA is not the sole tenant of these buildings, in the instance data was provided for the entire building or one floor of a building, GHG emissions were apportioned using EPA's Net Lettable Area (NLA) as a portion of the total NLA for the building or floor.
Factors	**EF**: 55.43 (kg.CO_2-e/GJ)
Reference	NGA Factors (July 2018), Department of Environment and Energy. • Table 2: scope 1 emission factors for the consumption of natural gas (Victoria). • Table 38: scope 3 emission factors – natural gas for a product that is not ethane (inclusive of coal seam gas) (Victoria).
3.3 Base building electricity – communal areas of buildings where EPA is a tenant	
Activity data	Electricity consumption amounts and Green Power percentages as stated on supplier invoices or provided directly from property manager – expressed in kilowatt hours (kWh). In the instance that EPA is the sole tenant for a site, electricity data covering both tenant and base building was collected. In the instance that EPA is not the sole tenant for a site, base building electricity data was collected separately from tenant data. This is relevant for Head Office, Exhibition Street, CES Macleod and South West Geelong sites.
Calculation method	$$Z = Q \times \frac{EF}{1000}$$ Where: **Z** = full cycle (Scope 2 + 3) emissions (t.CO_2-e) **Q** = quantity of electricity (kWh) **EF** = full cycle (Scope 2 + 3) emission factor for purchased electricity (kg.CO_2-

	e/kWh)
Assumptions	Where data was not available for the final months of 2018-19, estimations were made using average daily consumption, calculated using data provided for previous months. In the instance that EPA is not the sole tenant of the building and data was provided for the entire building or one floor of a building, GHG emissions were apportioned using EPA's Net Lettable Area (NLA) as a portion of the total NLA for the building or floor. Emissions associated with purchases of Green Power are zero.
Factors	**EF**: 1.17 (kg.CO_2-e/kWh)
Reference	NGA Factors (July 2018), Department of Environment and Energy. • Table 41: Scope 2 and 3 emission factors – consumption of purchased electricity by end users (Victoria).
3.4 Natural gas transmission and distribution losses – tenant and base building	
Activity data	**Background:** Head Office, CES Macleod and South West Geelong consume natural gas. Activity data is relevant for these sites only. **Activity data:** natural gas consumption amounts stated on supplier invoices or provided directly from property manager in excel as per 1.1 – expressed in gigajoules (GJ). As EPA is not the sole tenant for each of these sites, tenant natural gas data was collected separately from base building data.
Calculation method	$$Z = Q \times \frac{EF}{1000}$$ Where: **Z** = scope 3 emissions (t.CO_2-e) **Q** = quantity of natural gas purchased (GJ) **EF** = scope 3 emission factor for natural gas for a product that is not ethane (kg.CO_2-e/GJ)
Assumptions	Where data was not available for final months of 2018-19, estimations were made using average daily consumption, calculated using data provided for previous months. As EPA is not the sole tenant of these buildings, in the instance data was provided for the entire building or one floor of a building, GHG emissions were apportioned using EPA's Net Lettable Area (NLA) as a portion of the total NLA for the building or floor.
Factors	**EF**: 3.9 (kg.CO_2-e/GJ)
Reference	NGA Factors (July 2018), Department of Environment and Energy. • Table 38: scope 3 emission factors – natural gas for a product that is not ethane (inclusive of coal seam gas).
3.5 Electricity transmission and distribution losses – tenant and base building	

Activity data	Electricity consumption amounts and Green Power percentages as stated on supplier invoices or provided directly from property manager as per 2.1 – expressed in kilowatt hours (kWh). Capacity of solar panels from operations officer – expressed in kilowatts (kW). In the instance that EPA is the sole tenant for a site, electricity data covering both tenant and base building was collected. In the instance that EPA is not the sole tenant for a site, base building electricity data was collected separately from tenant data. This is relevant for Head Office, Exhibition Street, CES Macleod and South West Geelong sites.
Calculation method	$$Z = Q \times \frac{EF}{1000}$$ Where: **Z** = scope 3 emissions (t.CO_2-e) **Q** = quantity of electricity purchased (kWh) **EF** = scope 3 emission factor for Victoria (kg.CO_2-e/kWh)
Assumptions	Where data was not available for the final months of 2018-19, estimations were made using average daily consumption, calculated using data provided for previous months. Data was not available for a number of air monitoring stations. Estimations were made based on known consumption of similar air monitoring stations or electricity use in prior year. Data was not available for all thirteen small footprint sites (including sites with sensors and cameras only) which are powered by 100% solar energy. As these sites are powered by 100% solar energy, there are no emissions associated with the electricity used by these sites. However, estimations for electricity use for these sites were made using the average power consumption and run-time for the year. In the instance that EPA is not the sole tenant of the building and data was provided for the entire building or one floor of a building, GHG emissions were apportioned using EPA's Net Lettable Area (NLA) as a portion of the total NLA for the building or floor. Emissions associated with electricity powered by renewable energy are zero.
Factors	**EF**: 0.10 (kg.CO2-e/kWh)
Reference	Scope 2 emission factor for Victoria: [NGA Factors (July 2018)], Department of Environment and Energy. • Table 41: scope 2 and 3 emission factors – consumption of purchased electricity by end users (scope 3, Victoria – latest estimate).
3.6 Fuel extraction, production and transportation – vehicle and boat fuel	
Activity data	Fuel consumption amounts by fuel type as stated on vehicle fuel card reports and boat fuel invoices as per 1.2 – expressed in litres (L). Commonly used fuel types include gasoline, diesel and LPG.
Calculation method	$$Z = \sum \frac{Q_i \times EC_i \times EF_i}{1000000}$$

	Where: **Z** = scope 3 emissions ($t.CO_2$-e) **Q_i** = quantity of fuel type (i) (L) **EC_i** = energy content factor for fuel type (i) (GJ/kL) **EF_i** = scope 3 emission factor for fuel type (i) ($kg.CO_2$-e/GJ).
Assumptions	EC_i and EF_i for blended fuels is calculated by combining the emission factors available for each fuel types included in the blended fuel. The ratio used to calculate EC_i and EF_{ij} for blended fuels is the maximum standard specified for the fuel. For example, it is assumed E10 contains 10% ethanol and 90% gasoline while B20 contains 20% diesel and 80% biodiesel.
Factors	**EC_i**: ULP = 34.2, DSL = 38.6, LPG = 26.2, E10 = 33.12, B20 = 37.80, Jet = 36.8 and Oil = 39.70 (GJ/kL) **EF_i**: All = 3.6 (kg.CO2-e/GJ)
Reference	NGA Factors (July 2018), Department of Environment and Energy. • Table 4: fuel combustion emission factors – fuels used for transport energy purposes (post-2004 vehicles). • Table 40: scope 3 emission factors – liquid fuels and certain petroleum based products Fuel combustion emission factors – fuels used for transport energy purposes.
3.7 Stationary fuels – backup generator	
Activity data	Diesel consumption amounts as provided by the building landlord based on estimations – expressed in litres (L).
Calculation method	$$Z = \frac{Q \times EC \times EF}{1000000}$$ Where: **Z** = scope 3 emissions ($t.CO_2$-e) **Q** = quantity of diesel (L). **EC** = energy content factor for diesel (GJ/kL) **EF** = full cycle (Scope 1 + 3) emission factor for diesel, which includes the effect of an oxidation factor, for diesel ($kg.CO_2$-e/GJ)
Assumptions	Estimated fuel use was based on a run time of 10.3hrs.
Factors	**EC**: DSL = 38.6 (GJ/kL) **EF**: DSL = 73.80 ($kg.CO_2$-e/GJ)
Reference	NGA Factors (July 2018), Department of Environment and Energy. • Table 3: fuel combustion emission factors – liquid fuels and certain petroleum based products for stationary energy purpose.
3.8 Reticulated water	
Activity data	Water consumption quantities as stated on supplier invoices or provided directly from property manager– expressed in kilolitres (kL).

Calculation method	$$Z = Q \times \frac{EF}{1000}$$ Where: **Z** = scope 3 emissions (t.CO_2-e) **Q** = total quantity of water consumed (kL) **EF** = emission factor for water consumption (kg.CO_2-e/kWh)
Assumptions	Where data was not available for the final months of 2018-19, estimations were made using average daily consumption, calculated using data provided for previous months. In the instance that EPA is not the sole tenant of the building and data was provided for the entire building or one floor of a building, GHG emissions were apportioned using EPA's Net Lettable Area (NLA) as a portion of the total NLA for the building or floor. The emissions factor for reticulated water was developed specifically for Victoria using GHG and total water supply data from Victoria's metropolitan water authorities. The methodology incorporates considerations of wholesale versus retail water providers and is as follows: $$EF = \sum \frac{EI_W}{Q_w} + \sum \frac{EI_R}{Q_R}$$ Where: **EI_W** = emissions intensity of whole sale retailer (W) (kg.CO_2-e/kL) **Q_W** = number of wholesale water suppliers **EI_R** = emissions intensity of retail water supplier (R) (kg.CO_2-e/kL) **Q_R** = number of retail water suppliers. Where: $$EI = \frac{GHG_i}{KL_i}$$ **EI** = emissions intensity of water supplier (kg.CO_2-e/kL) **GHG** = total GHG emissions for reporting period (i) (t.CO_2-e) **KL** = total water supplied for reporting period (i) (ML). The GHG data (t.CO_2-e) and total water supply (ML) was taken from each respective water authority's Annual Reports for 2017-18 and are as follows: • Melbourne Water Corporation: 453,477 t.CO_2-e, 449,000 ML • South East Water: 47,634 t.CO_2-e, 146,341 ML • City West Water: 13,013 t.CO_2-e, 104,762 ML • Yarra Valley Water: 34,171 t.CO_2-e, 144,607 ML.

Factors	**EF**: 1.239 (kg.CO_2-e/kL) Note: as the emission factor for reticulated water (kg.CO_2-e/kL) is developed using data from Victorian water authorities, it is recommended that organisations recalculate the state specific emission factor for reticulated water using state specific GHG and water supply data.
Reference	Annual Reports for Victoria's Metropolitan Water Authorities: • Melbourne Water Annual Report 2017-18 (Total water supply to retail customers p. 11, Total GHG p. 157) • South East Water Annual Report 2017-18 (Total water consumption by customers p. 23, Total GHG p. 31) • City West Water Annual Report 2017-18 (Total water consumption by customers p. 26, Total GHG p. 33) • Yarra Valley Annual Report Water 2017-18 (Total water consumption by customers p. 100, Total GHG p. 104)
3.9 Air travel	
Activity data	Flight transaction records as provided by EPA's travel agent. Relevant flight data includes class type and distance travelled – expressed in kilometres (km).
Calculation method	$$\mathrm{Z} = \sum Q_i \times \frac{EF_{ijk}}{1000}$$ Where: **Z** = scope 3 emissions (t.CO_2-e) **Q_i** = distance travelled (km) for flight (i) **EF_{ijk}** = emission factor for haul type (j), which includes the effect of radiative forcing, and class type (k) for flight (i) (kg.CO_2-e/km).
Assumptions	Haul types are based on the following distances as guided by the United Kingdom (UK) Department for Environment, Food & Rural Affairs (DEFRA): • domestic: 0-500km • short-haul = 501-3,700km • long-haul > 3,700km.
Factors	**EF_{ijk}** = domestic economy = 0.29832, domestic business class = 0.29832, short-haul economy class = 0.1597, short-haul business class = 0.23955, long-haul economy class = 0.16279 and long-haul business class = 0.47208 (kg.CO_2-e/km).
Reference	Greenhouse gas reporting - Conversion factors (2018) – UK DEFRA (Business – air tab).
3.10 Taxi travel	
Activity data	Taxi travel expenditure data provided by Cab Charge – expressed in Australian currency inclusive of GST ($). Data on time, origin and destination of trips were also provided.
Calculation method	$$\mathrm{Z} = \sum \frac{\left(Q_i - F_{jk}\right) \times R_{jk} \times EF}{1000000}$$

	Where: **Z** = scope 3 emissions (t.CO_2-e) $\mathbf{Q_i}$ = spend ($) on taxi trip (i) GST inclusive $\mathbf{F_{jk}}$ = flag fall fare for state (j) at time (k) ($) $\mathbf{R_{jk}}$ = taxi rate (km/$) for state (j) at time (k) **EF** = emission factor for taxis (kg.CO_2-e/km).
Assumptions	Taxi rates were taken for each state's CBD. Regional taxi rates were not incorporated as these trips represented only a small proportion of total trips. Expenditure has been multiplied by kilometres per dollar (km/$) only. As such, taxi travel emissions do not reflect the proportion of expenditure that is due to duration of trip.
Factors	**Flag fare ($)** $\mathbf{F_{VIC}}$: tariff 1 (9am-5pm) = 4.20, Tariff 2 (5pm-9am) = 5.20 $\mathbf{F_{NSW}}$: tariff 1 (6am-10pm) = 3.60, Tariff 2 (10pm-6am) = 3.60 $\mathbf{F_{WA}}$: tariff 1 (6am-6pm) = 4.20, Tariff 2 (6pm-6am) = 6.10 $\mathbf{F_{NT}}$: tariff 1 (6am-6pm) = 4.40, Tariff 2 (6pm-6am) = 5.50 $\mathbf{F_{QLD}}$: tariff 1 (5am-7pm) = 2.90, Tariff 2 (7pm-12am) = 4.30, Tariff 3 (12am-5am) = 6.30 $\mathbf{F_{SA}}$: tariff 1 (6am-7pm) = 3.70, Tariff 2 (7pm-6am) = 4.90 $\mathbf{F_{TAS}}$: tariff 1 (6am-8pm) = 3.60, Tariff 2 (8pm-6am) = 3.60 $\mathbf{F_{ACT}}$: tariff 1 (6am-9am) = 5.00, Tariff 2 (9pm-6am) = 5.00 **Taxi rates (km/$)** $\mathbf{F_{VIC}}$: tariff 1 = 0.62, Tariff 2 = 0.56 $\mathbf{F_{NSW}}$: tariff 1 = 0.46, Tariff 2 = 0.38 $\mathbf{F_{WA}}$: tariff 1 = 0.58, Tariff 2 = 0.58 $\mathbf{F_{NT}}$: tariff 1 = 0.65, Tariff 2 = 0.53 $\mathbf{F_{QLD}}$: tariff 1 = 0.46, Tariff 2 = 0.46, Tariff 3 = 0.46 $\mathbf{F_{SA}}$: tariff 1 = 0.53, Tariff 2 = 0.46 $\mathbf{F_{TAS}}$: tariff 1 = 0.52, Tariff 2 = 0.43 $\mathbf{F_{ACT}}$: tariff 1 = 0.49, Tariff 2 = 0.42 **Emission factor for taxis** **EF** = 0.144 (kg.CO_2-e/km) Note: as the emission factor for taxis (kg.CO_2-e/km) is developed using Victoria specific proportions of LPG and ULP, it is recommended that organisations recalculate the state specific emission factor for taxis using state specific fuel factors and proportions.
Reference	Flag fall and km/$: Taxi Rates, Taxi Fare Calculator (2019) Emission factor: Carbon Dioxide Emissions Intensity for New Australian Light Vehicles 2017 (2018), National Transport Commission:

	• Table 15: average emissions intensity and annual sales by detailed buyer type 2016 and 2017.
3.11 Public transport	
Activity data	Public transport expenditure data broken down by regional and metropolitan public transport as sourced from EPA's finance system – expressed in Australian currency ($). Responses from a survey of staff public transport usage for a sample of EPA staff. The survey provided insight into the nature of public transport use by EPA staff for work purposes including type and distance.
Calculation method	$$Z = D_R \times EF_R + Q_M \times EF_M$$ Where: **Z** = scope 3 emissions ($t.CO_2$-e) **D_R** = total passenger kilometres travelled by regional public transport (person.km) **EF_R** = emission factor for regional public transport ($t.CO_2$-e/person.km) **Q_M** = total expenditure on metropolitan public transport ($) **$EF_M$** = emission factor for metropolitan public transport ($t.CO_2$-e/$). **Regional public transport distance travelled** Distance travelled by regional public transport was calculated using EPA expenditure data via the following method: $$D_R = \frac{Q_R}{Q_F} * D$$ Where: **Q_R** = total expenditure on regional public transport ($) **$Q_F$** = average expenditure per fare ($) **D** = average distance per fare (km). **Metropolitan public transport emission factor** Kilometres travelled and emission factors per dollar for metropolitan public transport were not available. As such, the following method was used to develop metropolitan public transport emission factors: $$ER_M = \frac{ER_F}{Q_F}$$ Where: **ER_F** = emission factor for metropolitan public transport per fare ($t.CO_2$-e/fare) **Q_F** = average expenditure per fare ($/fare). Where: $$ER_F = \sum EF_i \times D_i \times P_i$$ Where:

	ER_i = emission factor for metropolitan public transport per person.km for mode of transport (i) (t.CO_2-e/person.km) **D_i** = EPA specific average distance travelled for mode of transport (i) (km) **P_i** = proportion of EPA trips travelled by mode of transport (i) (%) and $$Q_F = \sum F_j \times P_j$$ Where: **F_j** = price of fare type (j) ($) **$P_j$** = proportion of EPA fares of fare type (j) (%).
Assumptions	**Regional travel assumptions** Average expenditure per fare ($/fare) and average distance per fare (km/fare) for regional public transport was calculated by taking the average price and distance for single fare tickets across all EPA regional sites (Bendigo, Geelong, Traralgon and Wangaratta), in 2018-2019 as follows: • Bendigo: $33.40, 162km • Geelong: $13.40, 73km • Traralgon: $31.20, 158km • Wangaratta: $40.20, 234km. Emissions per person kilometre was sourced from SimaPro. SimaPro is a life cycle analysis (LCA) software package with access to a range of international life cycle databases. In the Australian context, emission factors and other life cycle data is maintained in the Australian National Life Cycle Inventory Database (AusLCI) The available AusLCI unit process for regional train travel uses electricity as the fuel for operation. As Vline trains were assumed to be the sole mode of regional transport, this process was edited in recognition that Vline trains are diesel operated. An assumption of 1.7 MJ of energy from diesel use per person.km was used, taken from another SimaPro Unit process "Rail - rural passenger/AU U", to provide the emission factor for regional public transport (t.CO_2-e/person.km). EPA distributed a public transport usage survey to the staff. This was used to inform the total emissions by identifying the average distance travelled and proportion of fares represented by each mode of public transport as well as the proportion of different types of fares purchased (e.g. Zone 1). **Metropolitan travel assumptions** The metropolitan per person kilometre emission factors for each mode of metropolitan public transport (bus, train and tram), which were used to develop per dollar expenditure metropolitan public transport emission factor, were also sourced from SimaPro and are as follows: • bus: 0.00012t.CO_2-e/person.km • rail: 0.00002t.CO_2-e/person.km • tram: 0.00012t.CO_2-e/person.km. Average distance travelled for each metropolitan mode of transport, informed by the

	public travel survey: • bus: 10.4km • rail: 31km • tram: 4km. Proportions of EPA fares represented by each mode of transport, informed by the public travel survey: • bus: 8% • rail: 27% • tram: 65%. Price of fare types were obtained from the Myki website as at July 2019. Full fare fees were assumed for all fares and proportions were informed by the public transport usage survey. These figures are as follows: • 2-hour, Zone 1: $4.40, 32% • 2-hour, Zone 2: $3.00, 0% • 2-hour, Zone 1+2: $4.40. 4% • All-day, Zone 1: $8.80, 32% • All-day, Zone 2: $6.00, 4% • All-day, Zone 1+2: $8.80, 28%.
Factors	**EF_R**: 0.000078 (t.CO_2-e/person.km) **EF_M**: 0.00004 (CO_2-e/$). Note: the factor for metropolitan public transport is specific to EPA and is not recommended for direct external use. See above for guidance of developing a bespoke emission factor.
Reference	Emission factor per person.km - train (metro) Vline, tram and bus: SimaPro 8.5.2.0 • calculation methodology: IPCC 2013 GWP 100a V1.03 • SimaPro Unit Process (train metro): Transport, metropolitan train, SBB Mix/CH U/AusSD U • SimaPro Unit Process (Vline): Transport, regional train, SBB Mix/CH U/AusSD U • SimaPro Unit Process (tram): Transport, tram/CH U/AusSD U • SimaPro Unit Process (bus): Transport, regular bus/CH U/AusSD U. Site specific expenditure per fare ($/fare) for regional public transport: Annual fare adjustment for 2019, PTV and Regional Fares, PTV. Cost of metropolitan fare type: Annual fare adjustment for 2019, PTV.
3.12 Staff commuting	
Activity data	Responses from survey of staff commuting patterns for a sample of EPA staff. The survey provided a snap shot of how staff commutes to and from EPA office locations over the period of 1 week. This includes modes of transport, distance travelled, vehicle fuel efficiencies and fuel types (including electricity).

Calculation method	$$Z = \sum \frac{Q_i \times EF_i}{1000}$$ Where: **Z** = scope 3 emissions (t.CO_2-e) Q_i = distance travelled (km OR person.km) for mode of transport (i) EF_i = scope 3 emission factors for each mode of transport (i) (kg.CO_2-e/km).
Assumptions	Survey results are extrapolated across all FTE figures across 52 weeks. Emissions for walking and biking are zero. **Motorbikes/scooters emission factor:** Emission factor for motorbikes/scooters (electric and non-electric) was developed by the following methodology: $$EF = P_E \times FE_E \times EF_E + \sum P_i \times FE_i \times EC_i \times EF_i$$ Where: **EF** = emission factor for motorbikes (electric and non-electric) (kg.CO_2-e/km) P_E = percentage of electric motorbikes/scooters (%) FE_E = fuel efficiency of electric motorbikes/scooters (kWh/100km) EF_E = full cycle emission factors (Scope 2 + 3) for electricity (kg.CO_2-e/kWh) P_i = percentage of non-electric motorbikes/scooters using fuel type (i) (%) FE_i = fuel efficiency of non-electric motorbikes/scooters using fuel type (i) (L/100km) EC_i = energy content factor for fuel type (i) (GJ/L) EF_i = full cycle emission factors (Scope 1 + 3) for fuel type (i) (kg.CO_2-e/GJ). Percentages of motorbikes/scooters using each fuel type (including electricity) were calculated using responses from the commuter survey and are as follows: • **P**: ULP = 63.64, LPG = 0.00, DSL = 0.00, B20 = 0.00, E10 = 0.00, electricity = 36.36 (%). Average fuel efficiency of all non-electric motorbikes/scooters was calculated using responses from the commuter survey while the fuel efficiency of electric motorbikes/scooters was obtained as per an electric vehicle analysis performed by Dinh T. & Slater B. These fuel efficiencies are as follows: • **FE**: non-electric = 5.15 (L/100km), 3lectric = 2.55kWh/100km. Energy content factors for fuels and full cycle emission factors for fuels and electricity were obtained from NGA Factors (Jul 2018) and are as follows: • EC_i: ULP = 34.2, DSL = 38.6, LPG = 26.2, E10 = 33.12, B20 = 37.80, Jet = 36.8 and Oil = 39.70 (GJ/kL) • **EF**: ULP = 71.22, LPG = 64.50, DSL = 74.11, B20 = 60.52, E10 = 64.50 (kg.CO_2-e/GJ), Electricity = 1.17 (kg.CO_2-e/kWh). Motorbikes/scooters were assumed to be post-2004 vehicles and the emission factor for electricity represents the average for the Victorian grid.

	Not all respondents who used a motorbike/scooter provided answers to fuel use and efficiency. However, the developed motorbike/scooter emission factor has been applied to all kilometres travelled by motorbike/scooter. **Car emission factors:** Emission factors for each car type (hybrid, small, medium and large) were developed according to the following methodology: $$EF_i = \frac{\sum FE_{ij} \times EC_{ij} \times EF_{ij}}{Q_i}$$ Where: **EF_i** = emission factor for car type (i) (hybrid, small, medium, large) (kg.CO_2-e/km) **FE_{ij}** = fuel efficiency of car (j) of car type (i) (L/100km) **EC_{ij}** = energy content of fuel used by car (j) of car type (i) (GJ/L) **EF_{ij}** = emissions factor of fuel used by of car (j) of car type (i) (kg.CO_2-e/GJ) **Q_i** = number of cars of car type (i). Fuel efficiencies and fuel type for each car were obtained from the commuter survey and are too numerous to state in this document. Energy content factors and full cycle emission factors for fuels were obtained from NGA Factors (July 2018) and are as follows: • **EC_i**: ULP = 34.2, DSL = 38.6, LPG = 26.2, E10 = 33.12, B20 = 37.80, Jet = 36.8 and Oil = 39.70 (GJ/kL) • **EF**: ULP = 71.22, LPG = 64.50, DSL = 74.11, B20 = 60.52, E10 = 64.50 (kg.CO2-e/GJ). Cars were assumed to be post-2004 vehicles. There were no electric cars used by staff to commute to work in 2018-19. As such, electricity as a fuel was not incorporated into calculations. Not all respondents who used a car provided answers to fuel use and efficiency data requests. However, the car (hybrid, small, medium and large) emission factors have been applied to all kilometres travelled by each car type. There were no taxis used by staff to regularly commute to work in 2018-19. As such, taxi usage was not incorporated into calculations. **Public transport emission factors:** Emissions per person kilometre was sourced from SimaPro. SimaPro is a LCA software package with access to a range of international life cycle databases. In the Australian context, emission factors and other life cycle data is maintained in the Australian National Life Cycle Inventory Database (AusLCI). Emission factors for train (metro), tram and bus were taken directly from SimaPro. However, the available AusLCI unit process for regional train travel uses electricity as the fuel for operation. As Vline trains were assumed to be the sole mode of regional transport, this process was edited in recognition that Vline trains are diesel operated. An assumption of 1.7 MJ of energy from diesel use per person.km was used, taken from another SimaPro Unit process "Rail - rural passenger/AU U", to provide the emission factor for regional public transport (t.CO_2-e/person.km). For public transport (tram, train - metro, train - regional and bus) emission factor

	units are kg.CO_2-e/person.km as one passenger does not take responsibility for the emissions of the entire unit. For all other modes of transport, kgCO_2-e/km has been used as one passenger takes responsibility for the entire vehicle. This is with the exception of car-pooling where the sharing of emissions has already been incorporated into the emission factor.
Factors	**EF$_i$**: walk = 0, bike = 0, motorbike/scooter = 0.09, tram = 0.12, train (metro) = 0.02, train (Vline) = 0.04, bus = 0.12, taxi = 0.14, car-pooling = 0.11, hybrid car = 0.12, small car = 0.17, medium car = 0.23 and large car = 0.25 (kg.CO_2-e/km). Note: the factors for motorbike/scooters and cars (hybrid, small, medium and large) are specific to EPA staff survey responses and incorporate Victorian specific electricity emission factors. As such, they are not recommended for direct external use. See above assumptions for guidance on developing bespoke emission factors for these modes of transport.
Reference	Fuel efficiency (electric bike): Electric Motorcycle Analysis (2014), Dinh T. & Slater B. Energy content factors for fuels and full cycle emission factors for fuels and electricity: NGA Factors (July 2018), Department of Environment and Energy. • Table 4: fuel combustion emission factors – fuels used for transport energy purposes (post-2004 vehicles) • Table 40: scope 3 emission factors – liquid fuels and certain petroleum based products Fuel combustion emission factors – fuels used for transport energy purposes • Table 41: scope 2 and 3 emission factors – consumption of purchased electricity by end users (Victoria). Emission factors train (metro) Vline, tram and bus: SimaPro 8.5.2.0. • Calculation methodology: IPCC 2013 GWP 100a V1.03 • SimaPro Unit Process (train metro): transport, metropolitan train, SBB Mix/CH U/AusSD U • SimaPro Unit Process (Vline): transport, regional train, SBB Mix/CH U/AusSD U • SimaPro Unit Process (tram): transport, tram/CH U/AusSD U • SimaPro Unit Process (bus): transport, regular bus/CH U/AusSD U. Emission factor for car-pooling was obtained through consultation with the Victorian Department of Transport (VOT) 2014.
3.13 Waste	
Activity data	Waste volume and waste data as obtained from EPA's annual waste audits. The annual waste audit covers a two-week duration.
Calculation method	$$Z = \sum \frac{Q_i \times EF_i}{1000}$$ Where: **Z** = scope 3 emissions (t.CO_2-e) **Q$_i$** = extrapolated total weight (kg) of each waste type (i) **EF$_i$** = emission factor for each waste type (i) (kg.CO_2-e/kg).

Assumptions	Waste audit results are extrapolated across all FTE figures across 52 weeks. Recycled materials (secured documents, co-mingled recycling, E-waste, organic recycling/compost, paper, cardboard and other recycled materials) have zero net emissions. Liquid, bottles, cans & containers, clean soft plastics, e-waste and other recycled materials which have gone to landfill have zero emissions as they are inert and do not break down.
Factors	**EF$_i$** (kg.CO_2-e/kg): • recycled materials = 0 • liquid, bottles, cans & containers, clean soft plastics, e-waste and other recycled materials which have gone to landfill = 0 • cardboard, paper, paper cups, paper towels which have gone to landfill = 2.9 • compostable material which has gone to landfill = 1.9 • non-recyclable material which has gone to landfill = 1.2 • contamination in recycling = 1.2.
Reference	NGA Factors (July 2018), Department of Environment and Energy. • Emission factors for cardboard, paper, paper cups and paper towels to landfill: Table 42: Waste mix methane conversion factors (paper and cardboard). • Emission factor for compostable material to landfill: Table 42: Waste mix methane conversion factors (food). • Emission factor for non-recyclable material and contamination in recycling: Table 44: Waste emission factors for total waste disposed to landfill by broad waste stream category (commercial and industrial solid waste).
3.14 Office paper	
Activity data	Weight of paper purchased from paper supplier – expressed in kilograms (kg). Supplier data also includes the origin of paper manufacturing, recycled content and carbon neutrality status.
Calculation method	$Z = \sum \frac{Q_i \times EF_i}{1000}$ Where: **Z** = scope 3 emissions (t.CO_2-e) **Q$_i$** = total weight (kg) of each paper type (i) **EF$_i$** = emission factor for each paper type (i) (kg.CO_2-e/kg).
Assumptions	EF$_i$ varies based on paper type. Paper type is determined by two factors: manufacturing location (domestic or international) and quantity of recycled content (%). Paper certified as carbon neutral has zero net emissions. Emission factors for imported recycled paper and domestic virgin paper were developed using the emission factor for domestic recycled paper, obtained from Australian Paper's National Carbon Offset Standard (NCOS) Public Disclosure Summary for 2016 and adding the emission factor differentials between domestic

	recycled paper and other paper types, as provided by Indufor. The methodology for each paper type is as follows: **Imported recycled paper emission factor** $$EF_{IR} = EF_{DR} + ED_{IR}$$ Where: **EF_{IR}** = emission factor for imported recycled paper (kg.CO2-e/kg) **EF_{DR}** = emission factor for domestic recycled paper (kg.CO2-e/kg) **ED_{IR}** = emission factor differential between imported recycled paper and domestic recycled paper (kg.CO2-e/kg). **Domestic virgin paper emission factor** $$EF_{DV} = EF_{DR} + ED_{DV}$$ Where: **EF_{DV}** = emission factor for domestic virgin paper (kg.CO2-e/kg) **EF_{DR}** = emission factor for domestic recycled paper (kg.CO2-e/kg) **ED_{DV}** = emission factor differential between domestic virgin paper and domestic recycled paper (kg.CO2-e/kg). **Imported virgin paper emission factor** The emission factor differential between the domestic recycled and imported virgin paper was not provided in the Indufor report (see Reference below). As such, it was assumed that the differential between imported virgin and imported recycled paper could be adequately estimated by the differential between domestic virgin and domestic recycled paper. This was added to the emission factor calculated for imported recycled above to obtain the emission factor for imported virgin paper: $$EF_{IV} = EF_{IR} + ED_{DV}$$ Where: **EF_{IV}** = emission factor for imported virgin paper (kg.CO_2-e/kg) **EF_{IR}** = emission factor for imported recycled paper (kg.CO_2-e/kg) **ED_{DV}** = emission factor differential between domestic virgin paper and domestic recycled paper (kg.CO_2-e/kg).
Factors	**EF_i**: domestic virgin (2.65), domestic recycled (2.35), imported virgin (3.52), imported recycled (3.22) (kg.CO_2-e/kg).
Reference	Emission factor for domestic recycled paper: National Carbon Offset Standard Public Disclosure Summary (2018), Australian Paper. Emissions differentials: Recycled paper: A comparison of greenhouse gas emissions associated with locally made and imported paper products (2016), Indufor prepared for Australian Paper.
3.15 Catering services	
Activity data	Catering expenditure report from EPA's finance system – expressed in Australian currency ($).

Calculation method	$$Z = \sum \frac{Q_i \times EF_i}{1000}$$ Where: **Z** = scope 3 emissions measured in t.CO_2-e **Q_i** = expenditure ($) for each food and beverage type (i) **EF_i** = scope 3 emission factors for each food and beverage type (i) (kg.CO_2-e/$).
Assumptions	Expenditure on each food and beverage type was estimated by taking the proportions of EPA catering spend on each food and beverage type as per survey results from one material catering supplier and multiplying total spend by these proportions. EF_i from original source have been adjusted for inflation.
Factors	**EF_i**: meat and meat products =1.80, dairy products = 0.96, vegetable and fruit growing, hay, plant nurseries, flowers = 0.30, flour, cereal foods, rice, pasta and other flour mill products = 0.70, bread, cakes, biscuits and other bakery products = 0.34, other = 0.82 (kg.CO_2-e/$)
Reference	Emission factor per dollar spend was calculated using figures from SimaPro identified from the "Food, Grocery & Services" reference report published as part of the "Guide to Australian Greenhouse Calculator: Basic Features, Use, and Assumptions" (2011). The figures were adjusted for CPI.
3.16 Courier services	
Activity data	Courier services expenditure data from EPA's finance system including service type (courier, parcel or postage) and number of items.
Calculation method	$$Z = \sum \frac{Q_i \times EF_i}{1000}$$ Where: **Z** = scope 3 emissions (t.CO_2-e) **Q_i** = quantity of items for service type (i) **EF_i** = scope 3 emission factors for each item type (i) (kg.CO_2-e/item).
Assumptions	Invoices for services via each provider were reviewed to identify the number of items delivered and the type of items delivered (courier, parcel or postage). For one provider, invoices were received monthly and contained a large number of items. For this provider, the average number of items and average percentage represented by each type of item was calculated based on a sample of invoices. These averages were then applied to all invoices from this provider to estimate the number of each type of item delivered by this provider.
Factors	**EF_i**: courier = 3.338, parcel = 1.124 and postage = 0.066 (kg.CO_2-e/item).
Reference	Emission factors were obtained through consultation with Australia Post, which has developed an internal Carbon tool to estimate the emissions of its products and services.
3.17 Printing and publication services	
Activity data	Printing and publication expenditure data from EPA's finance system – expressed in

	Australian currency ($).
Calculation method	$$Z = Q \times \frac{EF}{1000}$$ Where: **Z** = scope 3 emissions (t.CO_2-e) **Q** = expenditure for printing and publications services ($) **EF** = scope 3 emission factors for the printing and publication services (kg.CO_2-e/$).
Assumptions	2015-16 EF_i is adjusted for inflation.
Factors	**EF_i**: 0.1076 (kg.CO_2-e/$).
Reference	Emission factor for 2015-16 obtained through consultation with Finsbury Green, as per Life Cycle Assessment study undertaken by the Carbon Reduction Institute across 12 printing companies.

Reduction measures

EPA undertakes initiatives to directly reduce its GHG emissions. Initiatives to reduce emissions sources include annual reduction targets supported by initiatives to improve operational efficiency and business and employee behaviours in EPA's inventory. Please refer to EPA's latest Annual Report for further information on these initiatives. These are automatically reflected in activity data and have led to a reduction in emissions intensity (tCO2-e/FTE) from 2017-18 to 2018-19 of 4%.

Offsets

In order to achieve carbon neutrality EPA purchases carbon offsets to an amount that results in zero net GHG emissions. EPA's selection of carbon offsets is guided by the National Carbon Offset Standard (NCOS) for Organisations, specifically Appendix A. Only eligible offsets outlined in the NCOS are purchased and retired in fulfilment of EPA's carbon neutrality commitment.

To facilitate the offsets purchasing process EPA has developed evaluation criteria found in the table below.

Criteria	Weight
Accreditation, methodology and additionality – preference to standards with rigorous processes for ensuring credibility of carbon offsets.	40%
Ownership and retirement – preference to suppliers with a robust registration and ownership process.	20%
Vintage – preference to carbon offsets that have occurred most recently.	15%
Co-benefits – preference to offsets with environmental, social and economic outcomes aligned with EPA's priorities.	15%
Location – where Australian offsets were not available or did not meet other EPA requirements, offsets from countries where Australia has had ongoing international cooperation.	10%

In addition to the above criteria EPA also considers the price of offsets in its decision-making process. This is a screening process that eliminates all offsets over \$10/t.CO_2-e. The cap of price is included for budget reasons.

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