Greenfleet

CarbonCover 365

Research Guide

Version 1.1 May 2021

Introduction

Greenfleet is excited to introduce CarbonCover 365 – our response to the many requests we have received for a simple way of absorbing the average carbon emitted by an individual over a year.

CarbonCover 365 is also a response to the situation we find ourselves in with climate change. It is well known that we must reduce the carbon we emit. What is now clear is that it is not enough to reduce emissions, we must also absorb carbon that has been emitted. Planting trees – and better still planting protected, biodiverse forests – is now recognised as the fastest and quickest way to absorb carbon.

Speaking in the Guardian about recent research, Professor Crowther from the Swiss university ETH Zürich said, '*This new quantitative evaluation shows [forest] restoration isn't just one of our climate change solutions, it is overwhelmingly the top one...I thought restoration would be in the top 10, but it is overwhelmingly more powerful than all of the other climate change solutions proposed*.'[1]

CarbonCover 365 builds on nearly 25 years of Greenfleet experience planting and protecting native vegetation.

The first aim of this *Research Guide* is to introduce the decisions behind CarbonCover 365, provide the evidence we used and support the CarbonCover 365 online and promotional materials.

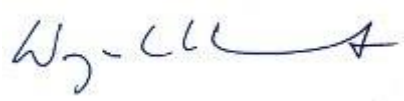
The second aim is to fill what we believe are some knowledge gaps about our personal carbon impact.

We have assumed that in 2021, most people have a reasonable general knowledge about climate change. Based on this assumption, we have not provided an explanation of the mechanism of global warming, attempted to describe the likely impacts of increased warming or discussed the rate of change that is occurring.

We have also assumed that informed people are ready to do something practical, immediate and meaningful. For this reason, the *Guide* does not include any motivational content.

On the other hand, conversations with supporters suggest that many people are uncertain about the amount of carbon emissions we produce per person in Australia, how much their own actions might reduce that amount and what might still be emitted by even the most diligent low-carbon lifestyle. We hope that the *Guide* will begin to fill these knowledge gaps.

We would love to hear your comments through carboncover365@greenfleet.com.au or call us on (03) 9642 0570.



Wayne Wescott CEO

[1] The research can be found here https://science.sciencemag.org/content/365/6448/76

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Quick Questions

1. **Why are you trying to absorb carbon – shouldn't we be trying to reduce emissions?**
   Time is tight and we must do both. As individuals we need to reduce our carbon emissions wherever possible. However, on our own, we cannot reduce our emissions to zero. Around half of total emissions are – at the moment – unavoidable. The carbon emissions from street lighting and the manufacture of concrete are good examples. Carbon absorption mechanisms, such as planting trees, absorb the carbon that is emitted even when we have implemented our own low-carbon solutions.

2. **How did you decide the per-person total is 23 CO_2-e tonnes?**
   The calculation is based on our research into Australia's National Greenhouse Gas Inventory update for December 2018. We have been assisted by researchers at the Energy Transition Hub, University of Melbourne. We both agree that 23 CO_2-e tonnes per person is an appropriate number.

3. **Do 23 CO_2-e tonnes include everything?**
   No, in accordance with national standards. The calculation does not include long-distance international flights - these can bump the average up significantly! If you are off on a big trip, you can cover your above average use by clicking into our Custom Carbon Fitting Room. [It also doesn't cover emissions in other countries burning our fossil fuel exports and manufacturing goods we import and use. But that's because the internationally agreed accounting approach allocates those emissions to the countries where they occur]

4. **I have solar panels and an electric car – surely my carbon emissions are lower than 23 CO_2-e tonnes?**
   Yes, your carbon emissions are likely to be lower than the Australian average. If you go to the Custom Carbon Fitting Room, you can explore the impact of the steps you have taken to reduce your personal carbon footprint. In the Fitting Room you can choose to reduce (or increase) the amount of carbon of your CarbonCover 365.

5. **Why are you planting trees to absorb carbon?**
   Planting trees (and legally protecting them for generations) is the best way to absorb carbon that has already been emitted. As they grow, trees absorb carbon from the air as well as accumulating and holding carbon in the soil. For as long as they grow, not only do they hold this carbon, they also become part of a resilient, native ecosystem, providing biodiverse habitat for native species. Forests also provide valuable side benefits such as cooler temperatures, filtered water and cleaner air. You can find more about Greenfleet biodiverse forests here.

6. **Is CarbonCover 365 based on the carbon being absorbed by existing forests?**
   No, we need to get more trees into the ground. Your CarbonCover 365 contribution will put new trees on land that was cleared at some time in the past (usually for farming). CarbonCover 365 creates future forests legally protected into the next century.

7. **How do you protect the trees into next century?**
   We protect the forest from land clearing, harvesting and house construction, as well as removal by a new owner if the property is sold, through a legal mechanism called a Carbon Abatement Interest (CAI). The forest area is registered on the land title (by agreement with the owner) which provides statutory and enforceable protection. When

we began twenty years ago, we could only get protection for a couple of decades. Today our CAIs are usually in force for one hundred years.

8. **Can I go and see my trees?**
   No, unfortunately. As donations come in, we collect all contributions and identify and prepare suitable parcels of land. The plantings go ahead across many sites. Sometimes we must replant or swap out a poorly performing site and start again in another location. We keep meticulous records of all this so that we know where your contribution went, how the plantings are performing and how much carbon is being absorbed. But, having 'bundled' all the contributions, it is not possible to 'unbundle' them and link certain trees with individual contributions. What you can do is track the planting projects across the country through our eNews and annual Impact Report .

9. **Are there any additional maintenance or insurance fees?**
   No, your contribution covers our regular on-site checks while the forest is getting established. It includes a guarantee that if the trees we have planted for you are damaged during the period of the agreement, then we will replant. If the trees are eaten back or get damaged by fire, flood or drought, we replace them with enough trees to meet the commitment we have made to you.

10. **Do I get a progress report?**
    Yes. We provide supporters with Before & After photos of the forests and other updates including an annual Impact Report .

11. **I have never heard of Greenfleet. Who are you?**
    We are an Australian Charity that has been planting forests for more than 23 years. In our early years we mainly worked with far-sighted businesses who wanted to ensure that their carbon emissions were absorbed by diverse native forests planted and protected by law in Australia and New Zealand. Alongside our business supporters we are now developing new solutions for individuals who want to take real climate action by covering their entire year of carbon emissions. Here is a link to our annual Impact Report .

Chapter One – How carbon is absorbed through CarbonCover 365

Your CarbonCover 365 contribution is part of a complex and well-established system.

Greenfleet receives donations from many supporters. These include both corporate contributions and tax-deductible donations from individual supporters.

Suitable parcels of land with high-carbon absorption potential are passed through our legal process. With the consent of the landowners, we establish a legal mechanism called a Carbon Abatement Interest (CAI). The CAI is a legally binding 'encumbrance' on the title of the property which protects the forest even if the land is sold. This on-title protection lasts for up to three generations.

The CAI ensures that the forest is protected from land clearing, harvesting and house construction. As this legal protection is on title, it continues to protect the forest even if the land passes through the hands of new owners.

When the land is protected, we prepare it for planting by removing weeds and non-native species. The money from supporters is pooled and used to purchase seedlings, pay the planting contractors, and monitor the emerging forest over the critical period of establishment, which is usually around five years. From this point the trees become more resilient and begin to become forest ecosystems.

We use aerial photography and regular return visits to track the development of the new forest canopy. We are ready to replant or relocate a forest that is growing too slowly or has been damaged by fire, drought or browsing animals.

We keep meticulous records of the flows of money, land, and carbon to ensure that we know which contributions went to which plantings and how much carbon has been absorbed.

Greenfleet is a trusted Australian environmental charity. For nearly 25 years, we have been offsetting carbon by recreating native ecosystems, planting over 9.6 million native trees and creating more than 500 biodiverse forests in Australia and New Zealand.

We are registered with the Australian Charities and Not-for-profits Commission (ACNC) and eligible tax-deductible donations (including CarbonCover 365) have Deductible Gift Recipient (DGR) status with the Australian Tax Office.

Chapter Two - High level decisions behind CarbonCover 365

This section outlines some of the high-level decisions we have made about the carbon in CarbonCover 365.

1. **We decided that in public we would talk about 'carbon' rather than use the more precise term of carbon dioxide equivalents or CO_2-e**
   Many gases contribute to climate change. Some gases such as methane (CH_4) and nitrous oxide (N_2O), although smaller in quantity than carbon dioxide, have a significant impact. In the Government estimate and in most technical conversations about climate change, these 'other gases' are all converted to their equivalent in CO_2 to arrive at a total of CO_2-e – where the 'e' stands for equivalent. When we talk about 'carbon' we are referring to CO_2-e.

2. **We have used a population average**
   In calculating individual carbon emissions, we have used a population average. We recognise that any average will underestimate the emissions from a high carbon lifestyle and overestimate the emissions of people, including many supporters, who have taken substantial steps to reduce their emissions.
   On the other hand, what the average does represent well are the unavoidable carbon emissions for which we all share responsibility – the carbon emitted by street lighting is a good example. Even someone who is personally frugal about activities associated with high carbon emissions, has an unavoidable carbon footprint.
   We believe that, for many, the average will be a useful rule of thumb and will support their decision to cover their annual emissions through CarbonCover 365.
   [Emissions per person are also used in some global comparison approaches, such as the 'contraction and convergence' model. This is based on equitable allocation of emissions over time across the global population.]

3. **We have provided an opportunity to adjust contributions below or above the average**
   We recognise that some people may not be comfortable with the population average and may want their emission reduction efforts recognised. Others may be faced with unavoidable additions to the average emissions, such as international plane flights. To meet these two needs, we have established the Carbon Fitting Room. Here people can explore the impact of the carbon-spending reductions they have in place and reduce the size of their carbon saving forests proportionately. Others can extend their cover, extending the size of their carbon-saving forests to absorb their above-average emissions.
   People who already hold a current offset with Greenfleet or another provider can use the Fitting Room to adjust their contribution to take that into account.

4. **We have partnered with the Energy Transition Hub at the University of Melbourne.**
   To ensure the integrity of our calculations and decisions, we have partnered with the Energy Transition Hub at the University of Melbourne. Researchers at the Hub have checked and endorsed our decisions and calculations. (If you are looking online for the Hub, their 2021 website can be found here)

5. **An up-to-date, evidence-based, defensible number of tonnes per person each year**
   Our research, analysis and calculations have been as thorough as we can make them. We recognise however, that for something as large, complex, and difficult to

measure as emissions, we will not be able to find 'the perfect number'. What we have aimed to achieve is what we describe as an 'up-to-date, evidence-based, defensible number'.

6. **We decided to base our carbon calculation on the Australian Government estimate**
Each year, the Government publishes an annual national greenhouse gas emissions estimate using internationally agreed methodologies[2]. The latest estimate is for the year ending December 2018.[3] This is our starting point.

7. **We have decided to make one change to the Government estimate**
Many, including Greenfleet, are uncomfortable about the section of the estimate that considers the impact of land use, land-use change and forestry (LULUCF)[4]. This sector used to be calculated to be a negative factor – increasing total emissions. Recently, after a change of policy, farming and tree clearing is now seen as being carbon positive. As we are uncomfortable with that change and with the evidence and calculations behind it, we have removed this category from our total national emissions. This has had the impact of raising the level of total emissions in our calculation above the Government estimate by around 6%.

8. **We have provided a calculation for the emissions from international flights**
The Government estimate does not include provision for international flights. Since these flights have a high impact and because they are taken by many supporters, we have provided a calculation of their impact per average person living in Australia, but not included these emissions in the annual average.

9. **We have looked at other calculations of annual carbon emissions**
In our efforts to establish a reliable measure of carbon 'tonnes per person' in Australia we have considered the figures arrived at by others.
The Climate Council (Australia) calculation, which like Greenfleet does not include LULUCF in its estimates, provides a similar estimate to us.[5] Climate Watch includes LULUCF and comes to a slightly higher figure[6], while others reach lower annual carbon estimates. Based on these comparisons, the value used by Greenfleet is within the range of values used by other organisations.

10. **The calculations are not linked to any international targets**
The amount of carbon in CarbonCover 365 is not based on Australia's Nationally Determined Contributions under the 2015 Paris Agreement. These commitments aim to reduce national emissions by 26-28% below 2005 levels by 2030[7].
CarbonCover 365 is based on the principle of absorbing 100% of present-day annual carbon emissions, where possible.

11. **Within the per person emission value used in CarbonCover 365, there are 3 major contributors related to personal activities. In Chapter 3 we have provided some contextual information about them.**
As concern rises about climate change, people are interested to learn about all the

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[2] https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/national-inventory-submissions-2019 & https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/reporting-requirements
[3] NGGI. (2018). Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2018.
[4] NGGI. (2018). Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2018.
[5] *https://www.climatecouncil.org.au/resources/australias-emissions-are-we-on-track/*
[6] *Source: https://www.climatewatchdata.org/countries/AUS?calculation=PER_CAPITA*
[7] Climate Watch (2015). Australia's Intended Nationally Determined Contribution to a new Climate Change Agreement https://www.climatewatchdata.org/ndcs/country/AUS/full?document=indc-EN

ways that carbon is emitted so that they can do something to reduce their own emissions.

Unfortunately, we have been unable to provide a comprehensive description of all emissions, mainly because the evidence around some of the lower impact sectors such as agriculture and waste is not yet robust.

Nor have we provided adjustment opportunities for all types of emissions. We have decided we will not provide adjustment options for minor emissions factors or where there is no evidence. Nor will we offer adjustments for major factors that are not well understood or minor factors that have been well studied. But each CarbonCover 365 donor can choose to adjust the level of emissions (and associated cost) they wish to offset to reflect their own judgements about their own emissions in the Fitting Room.

What we have done below is to identify and explore the three main sectors/areas of activity that collectively account for nearly ¾ of all Australian emissions. This information will help readers to cut emissions from those activities. Other sectors will provide valuable opportunities for savings, but these three sectors are where we must make substantial reductions in carbon emissions in the next few years.

Chapter Three – the carbon calculations behind CarbonCover 365

This section provides our high-level calculation, reviews the sources of information that have been used, and then each of the three main sectors: electricity, transport, and stationary energy. These are followed by a summary of the approach to the estimation of emissions from international flights before looking ahead to future research and analysis.

23 tonnes of carbon per person in Australia each year

In 2019, CarbonCover 365 is based on 23 tonnes of carbon (CO_2-e).

This estimate is based on two main factors:

- The annual national greenhouse gas emissions estimate to December 2018.[8]
- The Australian Bureau of Statistics (ABS) population estimate for December 2018 of 25,168,800.[9]

The national estimate[10] is based on emissions from:

- The combustion of fuels for energy, including electricity production
- Fugitive emissions from the extraction of coal, crude oil and natural gas
- Industrial processes such as producing cement and steel
- Waste management
- Other smaller sectors

When emissions are divided by population, the result is 21.5t CO_2-e per person per annum.[11]

[8] NGGI. (2018). Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2018.
[9] ABS data is probably the best source of consistent population estimates. It is consistently calculated and regularly updated. Australian Demographic Statistics, https://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0
[10] Heating and Cooling (DoEE, 2019d)
[11] Including LULUCF (NGGI, 2018, p. 21).

In our calculation for CarbonCover 365, we have removed the category of land use, land-use change and forestry (LULUCF). This has had the impact of raising the level of total emissions in our calculation above the Government estimate by around 6% to 22.1 tonnes of CO_2-e [12].

Table 1 Summary of per capita emissions

Dec 2018 NGGI (excluding LULUCF)	557.7Mt CO_2-e
Australian Bureau of Statistics Population[13]	25,168,800
Per capita CO2-e	22.1t CO_2-e
Rounding up to acknowledge uncertainties	0.9t CO_2-e
CarbonCover365	**23t CO_2-e**

In addition to the 22.1 tonnes, we have added a 0.9 tonne buffer, ensure we plant enough trees to cover everyone's footprint, rounding up the total to 23 tonnes. The rounding up provides some leeway to allow for uncertainties in the government's calculation of emissions, for example in relation to fugitive emissions from fossil fuel production. We then included a notional global citizen contribution.

Commentary on the high-level figure

Evaluation of our conclusion to choose a total of 23 tonnes per person should consider the following observations.

- When estimating the size of something as diverse, large-scale and difficult to measure as emissions it is important to realise that a definite or 'perfect' number cannot be identified. All calculations will be based on assumptions and imperfect data and will lead to an estimate.
- CarbonCover 365 is based on a 'one size fits all' population average. It is recognised that average emissions may be higher (or lower) in some States and regions.[14] A total population average also obscures individual differences including variations in the segments of the population[15] and in the carbon emissions of individuals.[16]
- The Australian Government data is not complete:
    - One of the areas that is outside current estimates and calculations (and one where we all need a better understanding) is the emissions associated with the overseas production of goods and services, including, for example, the emissions associated with the manufacture of solar panels.[17] These emissions are sometimes referred to as 'footprint', 'embodied' or 'lifecycle' emissions. The internationally agreed accounting approach allocates these emissions to the countries where they occur.
    - Another important category of emissions currently outside the Government estimates are the emissions from the global trade of goods and services. Currently the estimates do not include the carbon released when Australian export gas and coal is burnt in another country. This category is significant

[12] NGGI. (2018). Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2018.
[13] Australian Demographic Statistics, https://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0
[14] The emissions from electricity generation are an example of a factor that varies from State to State
[15] Population averages possibly overstate the contribution of the very young and understate the contribution of visitors.
[16] For example, the difference in emissions between a frequent flyer with Platinum 1 status who makes frequent ultra-long international flights over 10,000km in length and someone who does not use any form of transport powered by an internal combustion engine.
[17] Pehl, M., Arvesen, A., Humpenoeder, F., Popp, A., Hertwich, E. G., & Luderer, G. (2017). Understanding future emissions from low-carbon power systems by integration of life-cycle assessment and integrated energy modelling

and merits inclusion in assessments. However, the internationally agreed accounting approach allocates these emissions to the countries where they occur

- A key omission from the national emission accounts is international aviation. Since international travel (both air and shipping) cross country boundaries, they are treated separately from country-level emissions in the international approach. This sector is important as the emissions are significant and the ability for organisations and individuals to avoid or moderate their emissions is high. On this basis we have prepared our own calculation for this sector and provided for international flights in the adjustments available for CarbonCover 365.

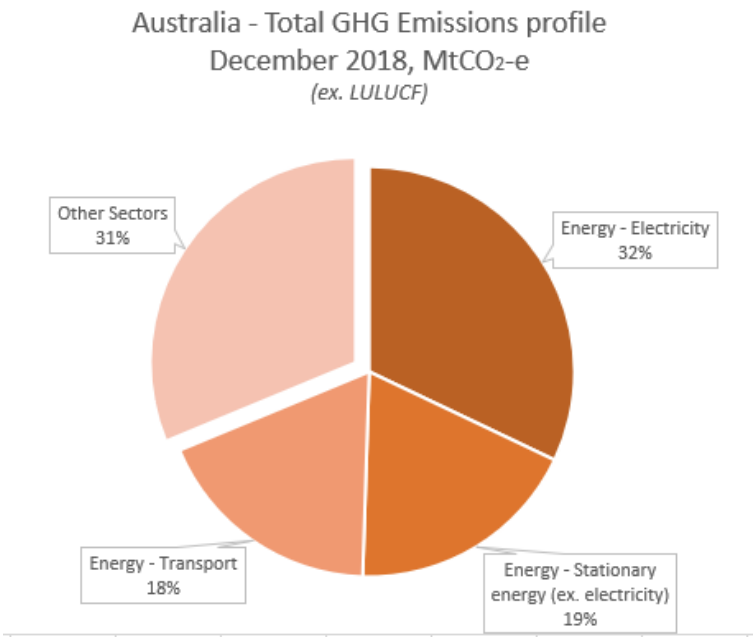
- We have omitted LULUCF emissions. Although LULUCF emissions undoubtedly occur, measuring the associated emissions has proven problematic, with significant associated uncertainty.[18] LULUCF has also been omitted from the national estimate by The Climate Council – Australia, based on similar concerns about the calculation of emissions.[19]

Sector overview

Most of the emissions in Australia (68%) come from three sectors: electricity generation (32%), transport (18%) and stationary energy other than electricity (mainly gas) (19%). Households directly generate about a quarter of electricity-related emissions, over half of transport and around a sixth of emissions from non-electric stationary energy.

[18] Jonas, M., Zbigniew, N., Marland, G., Gusti, Mykola, & Danylo, O. (2019). Quantifying greenhouse gas emissions
[19] Bourne, G. S., A. Steffen, W. Stock, P and Brailsford, L. (2018). *Australia's rising greenhouse gas emissions*.

Figure 1 Emissions by sector 2018



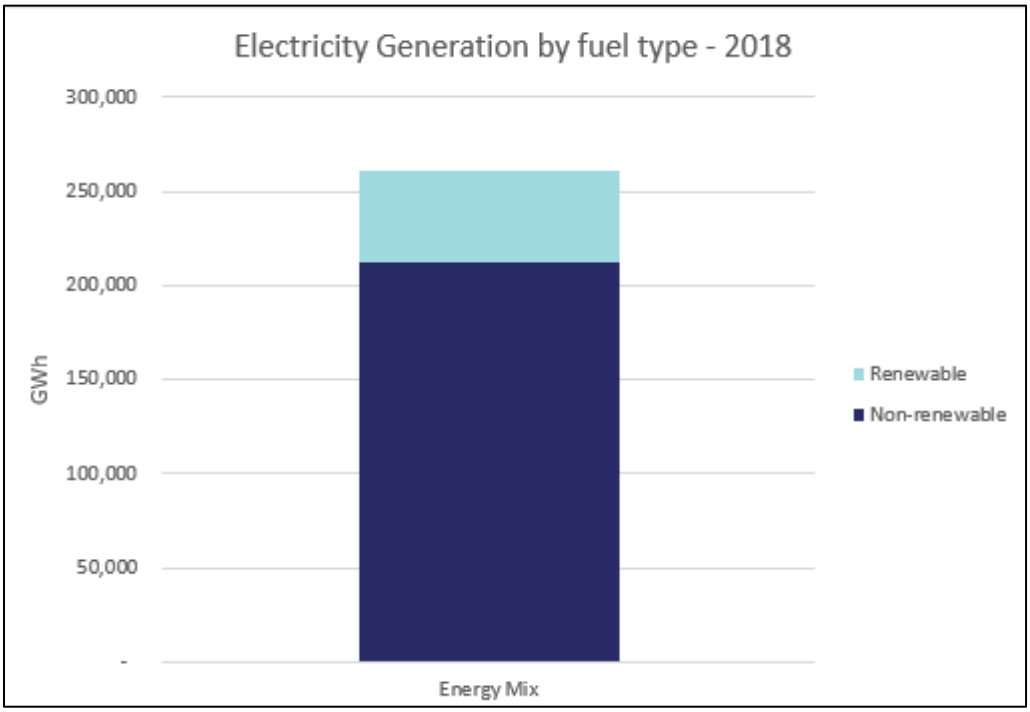
Source: Greenfleet

Emissions from electricity (32% of total)

The emissions from the generation of electricity in Australia are the highest of any sector. Of the 23 tonnes of average per capita annual emissions, around one third or 7 tonnes comes from electricity generation. This is because most (80%) of electricity generation in Australia is non-renewable.[20] The share of renewable electricity is growing rapidly.

[20] Clean Energy Council - June 2018 (CEC, 2018a).

Figure 2 Emissions by sector 2018



Source: energy.gov.au

An individual's electricity consumption does not occur only at home. Consideration must also be given to electricity used at the workplace, childcare centre or place of study. An important (and currently unavoidable) proportion of electricity consumption is in the category of public infrastructure and services such as street lighting.

CarbonCover 365's Fitting Room recognises that individuals and households are making investments and changes in behaviour that reduce emissions from electricity generation.

The use of electricity and other energy can be avoided by increasing energy efficiency. Unfortunately, Australia, performs poorly on measures of energy efficiency. Research conducted in 2018 ranked Australia the worst developed country in terms of energy efficiency policy and performance. [21] Some of this poor performance is attributable to the average dwelling area of the typical Australian home. Our dwellings are twice the size of average dwellings in some developed nations.[22]

Today, over two million Australian homes have rooftop solar.[23] Small-scale household solar PV panels accounted for almost four per cent of total electricity generation as at June 2018 [24].

Organisations and individuals are also increasingly purchasing 'green power' and avoiding electricity generated from fossil fuels through mechanisms such as Power Purchase Agreements. This is not yet at a sufficient scale to markedly reduce overall emissions in the sector. But it is growing fast, as more businesses use this model to avoid electricity

[21] Castro-Alvarez, F., Vaidyanathan, S., Bastian, H., & King, J. (2018). *The 2018 International Energy Efficiency Scorecard*
[22] Castro-Alvarez, F., Vaidyanathan, S., Bastian, H., & King, J. (2018). *The 2018 International Energy Efficiency Scorecard*
[23] Clean Energy Council - December 2018 (CEC, 2018b)
[24] Clean Energy Council - December 2018 (CEC, 2018b)

price volatility and increases. Resources like the Business Renewables Centre[25] offer help and link providers with buyers.

Emissions from transport (18% of total)

The emissions from the transport sector in Australia are the third-highest of any sector but are the fastest growing. Of the 23 tonnes of average annual emissions, around one fifth or 4 tonnes comes from transport based on internal combustion engines.

CarbonCover 365's Fitting Room recognises that individuals and households are making investments and changes in transport behaviour that reduce emissions from transport. This includes reducing and avoiding car ownership, using public transport, walking and bicycle riding, and selecting locations for homes and businesses that minimise travel and car dependence.

People are also switching from internal combustion to electric propulsion. Currently, the market share for these vehicles is less than 2% of the total Australian light vehicle fleet.[26] The beneficial impact of these vehicles is reduced when they are charged overnight using coal-fired electricity. But over time, the emission intensity of grid electricity is declining, and smart management of battery charging will take advantage of cheap renewable electricity and help to manage electricity supply and demand.

Public transport can provide low emission transport trips. Currently, Australia has a low percentage of public transport use. Only 12% of the population use public transport to get to work (ABS, 2016).

Most transport in Australia is based on 'light vehicles' such as vans and cars. This category accounts for 10% of total emissions.[27]

Australia is a developed economy that does not have fuel economy standards for passenger vehicles.[28] This is partly because our refineries produce a fuel high in sulphur that cannot be used in lower emissions vehicles. As a result, our internal combustion fleet is of a low environmental quality by international standards. Even our new passenger vehicles have higher emissions than new cars in Europe. [29] The proportion of older vehicles in our fleet is high and heavier vehicles with more powerful engines are more popular [30]. The impact of these choices is compounded when diesel combustion is chosen.

All these factors have a direct impact on transport emissions.

The approach taken in the CarbonCover 365 transport calculation for ease of use is to assume that everyone has the same vehicle and same level of use. Variations in the weight and fuel type or other factors that influence fuel consumption such as road surface, weather conditions and traffic conditions such as peak hour are not considered.

The calculation does not distinguish between personal and business travel.

[25] https://businessrenewables.org.au/

[27] DoEE. (2019a). Energy.gov.au - Transport.
[28] Castro-Alvarez, F., Vaidyanathan, S., Bastian, H., & King, J. (2018). *The 2018 International Energy Efficiency Scorecard*
[29] DoEE. (2018a). *Australian Energy Update 2018*.
[30] DoEE. (2018a). *Australian Energy Update 2018*.

Statistically the average vehicle kilometres travelled (VKT) each year according to the Australian Bureau of Statistics is 13,400km. In practice, individuals may use their vehicles more or less.

The national transport emissions estimate includes domestic commercial aviation.[31] The use of this type of transport is increasing. Between November 2015 and November 2018, total domestic passenger numbers in Australia increased by around three million.[32]

Further analysis of emissions associated with aviation are discussed in the international aviation section below.

Emissions from stationary energy other than electricity (19% of total)

Stationary energy describes the emissions from direct combustion of fuels (except electricity), predominantly from the manufacturing, mining, residential and commercial sectors.

The emissions from this sector in Australia are of approximately the same scale as the transport sector. Of the 23 tonnes of average annual emissions, around one fifth or 4 tonnes comes from stationary energy such as natural gas. Overall natural gas dominates non-electric stationary energy consumption in Australia and accounted for 25% of total energy consumption for the period 2017-18.[33]

In households, most 'stationary energy' emissions come from burning natural gas, usually for space heating, domestic hot water and cooking.

Household water heating contributes roughly a quarter of overall residential energy consumption[34].

In 2013, 48% of Australian households used mains natural gas for their hot water service.[35] The level of emissions from domestic gas use vary by household depending for example on the amount of hot water consumed, and whether the hot water system is storage or instantaneous. Gas storage systems are particularly inefficient, especially in cold climates as it is not possible to insulate the gas flame heating the tank [36].

Natural gas boosted solar may be the type of hot water appliance with the lowest annual emissions – as little as 165 kg/year for a well-designed and maintained unit.[37] This compares well to the use of grid-sourced electricity to heat water. Electric storage HWS appliances may have emissions as high as 3,935 kg/year[38]– up to 23 times higher than a natural gas boosted solar hot water. The trend towards high efficiency electric heat pump hot water services and use of rooftop solar electricity to boost solar-electric HWS units is reducing emissions from electric HWS units. Declining emission intensity of electricity grids is also reducing climate impacts of electric hot water.

[31] The estimate is based on the use of airline fuel and therefore includes overseas visitors as passengers.
[32] BITRE. (2019a). *Domestic aviation activity December 2018*.
[33] DoEE. (2018a). *Australian Energy Update 2018*.
[34] EnergyConsult. (2015). Residential Energy Baseline Study: Australia. http://www.energyrating.gov.au/document/report-residential-baseline-study-technical-appendix
[35] YourHome. (2013). Hot water service
[36] DoEE. (2019c). Hot water systems.
[37] CANSTAR. (2019). Hot Water Systems Compared.
[38] CANSTAR. (2019). Hot Water Systems Compared.

Natural gas is also used for space heating. One assessment found that gas heaters convert 85% of the gas consumed into usable heat[39]. However, this applies only to the most efficient space heaters. Central heating, with losses from ducting, and many existing gas heaters have significantly lower efficiencies.

Increasing numbers of households are shifting off gas [refer to Renew.org.au studies]. High efficiency electric technologies such as reverse cycle air conditioners, induction cooking and solar or heat pump water heaters, and increasing utilisation of renewable electricity, mean that electricity can achieve zero emissions. Gas is a fossil fuel, with unavoidable emissions although, in the long term, renewable hydrogen, biogas and carbon capture and storage may cut emissions from its use.

These estimates do not consider the climatic region. Individuals living in southern states are likely to have higher heating emissions and associated costs than people in the north. (Higher emissions from cooling appliances in northern states are likely be captured under electricity emissions.)

Nor do these estimates consider the inefficiencies and additional emissions introduced in some homes by some users. On-site variations include the thermal efficiency of the home, as well as flow rates from shower heads, water temperature settings and length of shower.

It should also be noted that these assessments of emissions from natural gas do not include the emissions generated 'upstream' in the production and distribution of natural gas.

Emissions from international flights

The national emissions accounts do not include the emissions from international flights. This exclusion avoids national carbon accounts having to include emissions that occur beyond their borders.[40]

International flights are significant in Australia due to the relatively long distances involved. Flights within the Asia/Pacific region emitted 25% of the global total of air passenger transport-related CO_2. This region contains four out of the 10 nations with the highest revenue passenger kilometres: China, Japan, India, and Australia.[41]

Recent research[42] found CO_2 emissions from aviation may be increasing 1.5 times faster than UN estimates. This investigation found that on a departure-per-country measure Australia was the equal tenth highest country for CO_2 emissions from passenger air transport in 2018, responsible for 2.5% of the global total.[43]

In recognition of the impact of the sector, the International Civil Aviation Organisation's (ICAO) has established the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) which aims to mitigate 164 million tonnes of CO_2 each year between 2021 and 2035 (IATA, 2019). Reporting obligations under CORSIA came into effect from 1 January 2019 and include the Australian carrier QANTAS.

[39] DoEE. (2019b). Heating and Cooling
[40] "Sixty-two per cent of aviation emissions are in international air space, and as a result they are currently not attributable to the national GHG accounts of any given nation" (Cames, Graichen, Siemons, & Cook, 2015, p. 10).
[41] Graver, B., Zhang, K., & Rutherford, D. (2019). *CO2 emissions from commercial aviation, 2018*
[42] Conducted by the International Council on Clean Transportation (ICCT)
[43] Graver, B., Zhang, K., & Rutherford, D. (2019). *CO2 emissions from commercial aviation*

Calculating the emissions from international flights

CarbonCover 365's standard emission value does not include the emissions from international flights. It does, however, provide individuals with the option of using the Fitting Room to add to the 23-tonne average to cover the emissions from any international flights during the year. We decided to provide the option to add the amount of an average international return flight (7.1 tonnes, based on a short and long international return flight offset with Greenfleet).

Looking ahead

The research and analysis effort behind CarbonCover 365 will continue. We expect to be able to provide at some stage emissions calculations for other sectors such as waste and food. Food is widely considered to be a material emissions source. However, results from studies vary widely, and the impacts of a given food type can vary greatly, due to many factors such as production methods, and distance and type of transport.

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Further reading:

- Explanation of different ways of looking at Greenhouse Gas Emissions from a global perspective: http://paris-equity-check.org/
- (Selecting the 'equity map' option shows the outcome of contraction and convergence by 2040, built by http://www.gci.org.uk)