Environmental Defender's Office New South Wales (Ltd)

Technical Fact Sheet: Measuring and reducing the greenhouse gas footprint of a small office

INTRODUCTION

The purpose of this fact sheet is to provide assistance to community organizations wanting to reduce the greenhouse gas footprint of their office. The fact sheet was prepared as a paper for the 2007 National Association of Community Legal Centres Conference 'Justice in a climate of change'.

This Fact Sheet has been prepared by Tom Holden, Scientific Director, and Kristy Graham, Scientific Officer, at the Environmental Defender's Office (EDO). It has been reviewed by a member of the EDO's Expert Register.

This fact sheet is a guide only. The information in it has been taken from a range of more detailed documents, which you should refer to when measuring and defining your GHG footprint. These are identified throughout the Fact Sheet under the heading 'References and further reading'.

KEY CONCEPTS

Many businesses today have recognized the need to address climate change and are seeking to reduce their GHG footprint and/or go 'carbon neutral'.

The term 'GHG footprint' refers to the total GHG emissions that an individual or organization is responsible for emitting into the atmosphere. A GHG footprint includes direct and indirect GHG emissions associated with the activities of an individual/organisation. Defining your GHG footprint is the first step in reducing your GHG footprint or going carbon neutral.

The term 'carbon neutral' refers to a situation where an individual or organization generates no net GHG emissions. This is achieved in a number of ways, including by reducing GHG emissions and by offsetting remaining emissions. The concept of carbon neutrality is easy to understand, but it is much more difficult to apply. A key reason for this is that it depends on how you define your GHG footprint.

For example, to truly go 'carbon neutral', your office needs to include the 'embodied energy' of office products and materials in your GHG footprint, which refers to the amount of energy consumed throughout the lifecycle of a product, including the extraction of resources, and the manufacture, transport, and disposal of the product or materials. In your office, each wall, door, desk, chair, computer, and your office paper has an amount of embodied energy associated with it.

Until recently it was thought that the embodied energy of an office was small compared to the energy used in operating the office over its lifetime. However, recent research has indicated the opposite to be true. For example, the CSIRO has recently found that the embodied energy in the products and materials of an average household is equivalent to about 15 years of operational energy use.

The embodied energy of office products and materials is rarely included in an office's GHG footprint because it is a complex task requiring the application of

'Life Cycle Assessment' (LCA). LCA examines the total environmental impact of a product through every step of its life, and can consider a range of impacts, including energy use, water use, waste generation, etc.

A description of how to undertake LCA is beyond the scope of this Fact Sheet. If you wish to include the embodied energy of office products in your GHG footprint, you should engage an energy consultant to calculate this for you. It is important to note that as a general rule, recycled materials contain far less embodied energy than new materials.

KEY STEPS IN REDUCING THE GREENHOUSE GAS FOOTPRINT OF YOUR OFFICE

The key steps in reducing the GHG emissions of your office and/or going carbon neutral are:

1. Define the GHG footprint of your office. This involves identifying all sources of GHG emissions associated with your office and deciding which sources you will include in your GHG footprint.

2. Measure the GHG footprint of your office. This involves collecting data on the activities that produce GHG emissions and using emissions factors to calculate the GHG emissions associated with each activity.

3. Reduce the GHG footprint of your office. This is done by:

    a. First, increasing energy efficiency.

    b. Second, replacing energy derived from fossil fuels with energy derived from renewable sources.

    c. Third, offsetting remaining GHG emissions.

The role of offsetting

Your office can easy reduce its GHG footprint without taking any action to increase energy efficiency by offsetting. However, this is not the preferred approach. Offsetting can delay real changes in behavior that are needed to move society towards a low carbon economy. Also, there are a number of issues with offsetting that may mean that your office's GHG footprint is not being offset to the extent presumed. Offsetting is discussed in more detail below.

DEFINING YOUR GREENHOUSE GAS FOOTPRINT

The first step in reducing the GHG emissions of your office and/or going carbon neutral is to define your GHG footprint. There are two steps in defining your GHG footprint:

1. Step 1: Identify all sources of GHG emissions associated with your office.

2. Step 2: Decide which sources of GHG emissions you will include in your GHG footprint.

Step 1: The main sources of GHG emissions associated with an office.

The main energy uses and GHG emissions associated with an office (excluding embodied energy) are related to:

1. The amount of electricity consumed by your office and associated with office activities, including electricity used in lighting, cooling and heating, office equipment, kitchen equipment, and electric hot water systems.

2. The amount and type of fuel consumed by your office and associated with office activities, including gas consumed in hot water heaters and fuel consumed in staff commuting to work and business travel.

You can get an idea of the relative amount of energy used by different office equipment by identifying the wattage (power requirements) of the equipment. The term 'watt' (W) refers to the rate equipment uses energy. Eg. A 100 W light bulb uses energy at a higher rate than a 50 W light bulb. The term 'watt hours' (Wh) or 'kilowatt hours' (kWh) refers to the amount of energy actually used by equipment over a one hour period.

The amount of energy used by equipment can be estimated as follows:

Energy use (kWh) = watts X hours equipment is used.

Note: 1 kW = 1,000 W, therefore kWh = W/1000 x hrs

Example

The energy used by a 75 watt light bulb per day =

Energy use (kWh) = 75 W X 8 hours per day = 600 W per day. To convert to kWh divide W by 1000 = 0.6 kWh per day.

You can get an idea of the relative amount of energy used by different forms of transport by identifying the fuel consumption rates of the transport. The GHG emissions associated with transport will depend on the type and amount of fuel consumed.

The main energy uses associated with an office are identified below. Typical wattages and fuel consumption rates are identified to give you a rough idea of the relative GHG intensity of the equipment or form of transport you use.

1. **Lighting:** May account for 50% of all energy used in an office. The main types of office lighting are:

    a. Incandescent lamps – These are the old standard light bulb, which may be used in desk lamps. Typical watts: 100 W.

    b. Fluorescent tubes – These are long fluorescent bulbs usually placed in pairs and housed within an office ceiling. Typical watts: 36 W per tube, with 2 tubes per unit. Note: Fluorescent tubes are attached to transformers, which also use energy. Eg. A 36 W fluorescent tube and transformer uses about 45 W.

    c. Compact fluorescent lamps - These are the new energy efficient light bulbs that can be used in replace of the old standard light bulbs and may be used in desk lamps. Typical watts: 9-20 W. 15 W compact fluorescent tube is the equivalent light of a 75 W incandescent bulb.

    d. Halogen lamps (high and low voltage) – These are small lights often fitted into a reflector in the ceiling and used as downlights. Typical watts for low voltage halogen lamps: 50 W. Note: Low voltage does not mean low energy use, the important thing to consider is the wattage of the equipment.

Halogen lamps are attached to transformers, which also use energy. Eg. A 50 W halogen bulb and transformer uses about 65 W.

2. **Cooling and heating:** Heating, ventilation, and air conditioning systems may account for 40% of all energy used in an office. Typical wattages for heating, ventilation, and air conditioning systems: over 7.5 kW. Typical wattages for ceiling and portable fans: 80 – 120 W.

3. **Hot water system**, including hot water used in bathroom taps and showers. Your hot water system may be powered by electricity or gas. Typical wattages: a few kW.

4. **Office equipment:** May account for 20-30% of energy used in an office.

    a. **Computers and monitors:** May use about 70% of energy used in all office equipment.

        i. Desktop computers: Typical wattages: 50 W in use.

        ii. Monitors: Typical wattages: 50-100 W in use.

        iii. Laptop computers: Typical wattages: 15-25 W in use.

    b. **Photocopiers:** May use about 15% of energy used in all office equipment. The majority of energy use in a photocopier is due to the heating of the components that fuse the toner to the paper. Often this process continues when the photocopier is on stand-by.

        i. Small photocopier: Typical wattages: 150-300 W in use

        ii. Large photocopier: Typical wattages: 300 W – 2kW in use.

    c. **Printers:** May use about 10% of energy used in all office equipment.

        i. Laser printers: Typical wattages: 100 – 200 W in use.

        ii. Inkjet printers: Typical wattages: 50 W in use.

        iii. Colour printers: Typical wattages: 400 – 800 W in use.

    d. **Fax machines:** May use about 5% of energy used in all office equipment. Typical wattages: 40-100 W in use. Laser faxes use more energy than ink-jet faxes.

    e. **Scanners:** Typical wattage: 80 W in use.

    f. **Projectors:** Overhead and slide projectors: Typical wattages: 300-350 in use.

5. **Kitchen equipment:**

    a. **Toaster:** Typical wattage: 1000 W in use.

    b. **Microwave:** Typical wattage: 1000 W in use.

    c. **Kettle:** Typical wattage: 2,400 W in use.

6. **Travel:** Office travel includes staff commuting to work and business travel.

    a. **Cars.** Cars consume an average of 10.7 L of petrol per 100 km, which is 2.7 L per passenger per 100 km assuming 4 passengers (full). For comparison:

        i. A Toyota Prius consumes 4.4 L per 100 km;

        ii. A 1.8 L Holden Astra (a typical small car) consumes 7.4 L per 100 km;

        iii. A 2.4 L Toyota Camry sedan (a typical large car) consumes 8.9 L per 100 km;

        iv. A 4.7 L Toyota Landcruiser (a typical 4 wheel drive) consumes 16.1 L per 100 km.

    The Australian Government has published a 'Green Vehicle Guide', which identifies the fuel efficiency of all cars sold in Australia: **www.greenvehicleguide.gov.au**.

    b. **Motorcycles.** Motorcycles consume an average of 5.7 L of petrol per 100 km, which is 5.7 L per passenger per 100 km assuming 1 passenger.

    c. Buses. Buses consume an average of 14.3 L of petrol per 100 km, which is 0.4 L per passenger per 100 km assuming 36 passengers (full).

    d. Airplanes. Lufthansa identifies that the average fuel consumption of its passenger fleet in 2006 was 4.4 L per passenger per 100 km (this figure takes into account the average occupancy of the flights). Some things to note:

        i. Airplanes have a greater effect on climate change than the effect of the release of CO2 from the combustion of aviation fuel alone. This is because airplanes also release other pollutants, including nitrogen dioxides, methane, ozone, and water vapor direct into the upper atmosphere, which has an additional warming effect. The IPCC has estimated the magnitude of this additional warming effect is 2.7 times greater than the warming effect of the release of CO2 alone.

        ii. Airplanes consume more fuel when taking off and landing than when in flight, which means that the fuel consumption per km is larger for short flights than it is for long flights.

7. **Paper.** Paper may be a significant source of GHG emissions for a small office. The GHG emissions associated with paper occur as a result of the harvesting, transport, production, and disposal of paper. Emissions due to disposal occur when paper decomposes in landfill, which produces methane gas, and or when paper is incinerated, which produces CO2.

***References and further reading*:**

1. National Appliance and Equipment Energy Efficiency Committee (2001) 'Green Office Guide. A guide to help you buy and use environmentally friendly office equipment': **www.energyrating.gov.au**

2. Australian Greenhouse Office. Greenhouse Challenge Plus Fact Sheets: **www.greenhouse.gov.au/challenge/publications/**

3. Carbon Trust (2006) 'Office equipment: Introducing energy saving opportunities for business': **www.carbontrust.co.uk**

4. Australian Greenhouse Office (2006) 'Factors and Methods Workbook': **www.greenhouse.gov.au**

5. AGO Green Vehicle Guide: **www.greenvehicleguide.gov.au**

6. IPCC (1999) *Aviation and the Global Atmosphere.* Available online at: **www.grida.no/climate/ipcc/aviation/index.htm**

7. Lufthansa website – see sustainability report: **//konzern.lufthansa.com/en/html/verantwortung/index.html**

8. Energy Australia – see 'energy usage guide': **www.energyusage.energyaustralia.com.au/ea_energysaver.pdf**

Step 2: Deciding which sources of GHG emissions to include in your GHG footprint

There are two key documents that provide guidance on deciding which sources of GHG emissions to include in your GHG footprint. These are:

1. The Greenhouse Gas Protocol (GHG Protocol), published by the World Business Council for Sustainable Development and the World Resources Institute. This is a widely used and recognized standard for companies to identify, measure, and manage GHG emissions.

2. Australian and International Standard, AS ISO 14064, which is based on the Greenhouse Gas Protocol.

The GHG Protocol requires that you categorize the GHG emissions of an organization as follows:

1. Direct emissions (Scope 1). These are emissions from sources owned or controlled by an organization.

2. Indirect emissions (Scope 2). These are emissions from the generation of electricity consumed by an organization.

3. Indirect emissions (Scope 3). These are emissions that are a consequence of the activities of a company, but that occur from sources not owned or controlled by an organization.

Categorizing the GHG emissions of your office will help you decide which sources of emissions to include in your GHG footprint. The GHG Protocol requires that Scope 1 and Scope 2 emissions be included in the GHG footprint of an organization, while including Scope 3 emissions is optional but recommended because Scope 3 emissions often provide significant opportunities for emissions reductions.

The purpose of categorizing emissions is to avoid double counting of emissions by different organizations. This is particularly important as governments begin to increasingly regulate the GHG emissions of organizations. There is significant potential for double counting of Scope 3 emissions. However, Scope 3 emissions are unlikely to be regulated by governments and will likely only be subject to voluntary emissions reductions programs only so this issue is less important.

Table 1 identifies the typical sources of GHG emissions of an office and the relevant category in accordance with the GHG Protocol.

Table 1 Typical sources of GHG emissions associated with an office and the relevant GHG Protocol category

Direct emissions (Scope 1)	**Indirect emissions (Scope 2)**	**Indirect emissions (Scope 3)**
Combustion of fuel in equipment owned by your office. Eg. Use of gas in gas heaters or gas hot water systems.	Electricity consumed by your office. Eg. Electricity used in lighting, cooling and heating, office equipment, kitchen equipment, and electric hot water systems.	Combustion of fuel in equipment not owned by your office. Eg. Use of gas in gas heaters or gas hot water systems.
Work travel in vehicles owned by your office. Eg. Cars		Work travel in vehicles not owned by your office. Eg. Cars, trains, buses, airplanes.
Staff commuting to work in vehicles owned by your office. Eg. Cars		Staff commuting in vehicles not owned by your office. Eg. Cars, trains, buses.
		Embodied energy in office products and materials. Eg. Office furniture, office equipment, paper, etc
		Outsourced activities. Eg. couriers, printing.

Most GHG emissions from an office are indirect (Scope 2 and Scope 3) emissions. Scope 3 emissions are a very broad category and include emissions from almost any activities to which your office is connected.

You will need to make decisions as to which scope 3 emissions you will include in your GHG footprint. In general, the more scope 3 emissions you include in your GHG footprint, the more opportunities you will have to make emissions reductions. Some decisions that you may be required to make include:

1. Will you include the GHG emissions associated with the embodied energy of office products and materials in your GHG footprint? Eg. Office furniture, office equipment, paper, etc.

2. Will you include GHG emissions from staff commuting to work in cars not owned by your office or on public transport in your GHG footprint?

3. Will you include business travel by staff from another company who are engaged to work for you? Eg. In cases where you engage an expert to give a presentation to a seminar that you have organized.

4. Will you include travel by the public to seminars that you have organized?

5. Will you attribute GHG emissions from business travel only to staff, or will you also include non-staff if they are traveling in the same vehicle? Eg. In cases where staff travel with non-staff to a work meeting.

The GHG Protocol provides some guidance on deciding what to include in your GHG footprint, including consideration of the following questions:

1. Is the scope 3 emission large relative to your scope 1 and scope 2 emissions?

2. Is the scope 3 emission crucial to the operation of your company? Eg. paper is crucial to the operation of an office.

3. Can your company reduce the scope 3 emission?

4. Does your company now outsource an activity that would have previously been categorized as a scope 1 emission?

5. Can you reliably measure the scope 3 emission?

***References and further reading*:**

1. World Resources Institute (2002) 'Working 9 to 5 on Climate Change: An office guide': **www.wri.org**

2. GHG Protocol: **www.ghgprotocol.org**

MEASURING YOUR GREENHOUSE GAS FOOTPRINT

The second step in reducing the GHG emissions of your office and/or going carbon neutral is to measure your GHG footprint. There are three steps to measuring your GHG footprint. These are:

1. Collect activity data for all sources of GHG emissions included in your GHG footprint.

2. Identify emissions factors for all sources of GHG emissions included in your GHG footprint.

3. Calculate emissions.

Activity data

Activity data is data that quantifies an activity that produces GHG emissions in units that help you calculate the emissions associated with that activity.

Eg. An activity in your office that produces GHG emissions is electricity consumption. The activity data for electricity consumption is the amount of electricity consumed by your office in kilowatt hours (kWh). If you can identify this amount, you can then calculate the GHG emissions associated with your electricity consumption.

You should establish a database that records activity data for all activities that produce GHG emissions included in your GHG footprint. Guidance on establishing a database for activity data is provided in World Resources Institute (2002) 'Working 9 to 5 on climate change: an office guide': **www.wri.org**

Key types of activity data required for a small office are:

1. **Electricity use in kWh:** The activity data you need is the amount of electricity consumed by your office in kWh. This is identified on your electricity bill.

2. **Gas use in GJ:** The activity data you need is the amount of gas consumed by your office in Gigajoules (GJ). This is identified on your gas bill.

   If your office does not receive a separate electricity or gas bill, you will have to estimate your electricity and gas use by obtaining information on i) the total floor space of the building ii) the floor space occupied by your office iii) the total electricity or gas use for the building. You can do this by applying the following formula:

   > *Formula:* Area of office space ÷ total floor space of building X total building usage of electricity or gas = approximate amount of electricity or gas used by your office.

3. **Airplane travel in km:** The activity data you need is i) the number of airplane kilometers traveled by staff in your office per person per flight ii) the type of flight taken classified into short haul, medium haul, or long haul flights. The GHG Protocol defines a short flight as < 500 km, a medium flight as 500 – 1600 km, and a long flight as > 1600 km. You can calculate the distance of flights on-line at Climate Friendly: **www.climatefriendly.com/flight**

4. **Car and bus travel:** The activity data you need is i) the number of car and bus km traveled by staff in your office ii) the type of fuel used (petrol, diesel or LPG) iii) the fuel consumption of the vehicle used.

   a. The number of car km traveled can be obtained from the car odometer or from a distance calculator.

   b. The number of bus km traveled can be estimated using an on-line distance calculator.

   c. The fuel consumption of a car can be obtained from the AGO website: **www.greenhouse.gov.au/fuelguide**. Alternatively, you can use the average fuel consumption for passenger cars in Australia, which can be obtained from the AGO Factors and Methods Workbook.

   d. The fuel consumption of a bus can be obtained from the AGO Factors and Methods Workbook, which identifies the average fuel consumption for buses in Australia.

5. **Train travel:** The activity data you need is the number of train km traveled by staff in your office and type of train (intercity rail, commuter rail, or tram).

6. **Paper use:** The activity data you need is the weight of paper used by your office in tonnes (t). This should include the paper used in the office and the paper used in outsourced printing jobs such as for office publications. You can calculate the weight of paper by:

   a. Checking the cover of the paper ream, which should identify the weight of the paper in grams/m2. A ream of paper comprises 500 sheets. A4 paper measures 0.297 m X 0.21 m and normally weighs 80g/m2.

b. Converting the weight from grams/m2 to kg/ream. For example, a ream of Canon 100% recycled paper identifies that the paper weighs 80g/m2.

    i. The size of 1 sheet of paper = 0.297 m X 0.21 m = 0.06237 m2.

    ii. The number of sheets of paper in 1m2 = 1/0.06237 = 16.03335 sheets.

    iii. The weight of 1 sheet of paper = 80/16.034 = 4.9896 g.

    iv. The weight of 1 ream of paper = 4.9896 X 500 = 2.4948 kg.

c. You can identify the number of reams of paper used in your office by checking the paper counter on the printer or by keeping track of the number of reams of paper used.

d. If you outsource your printing jobs, the organization that does your printing should be able to tell you the weight of the paper used or you can weigh the box(s) containing the publication yourself to get an estimate.

Emissions factors

An emission factor is a number that is used to convert activity data to GHG emissions.

Eg. The emissions factor for the combustion of petrol in Australia is 2.5 t CO2-e per kilolitre (kL) of petrol consumed. If you can identify the activity data – the amount of petrol consumed in kL - you can then use the emissions factor to calculate the GHG emissions generated from the combustion of that petrol.

It is important to choose the correct emissions factor for your activity data. Emissions factors are different for each activity that produces GHG emissions because different activities produce different amounts of GHG emissions. Eg. The emissions factor for the combustion of coal is higher than the emissions factor for the combustion of gas because the combustion of coal generates more GHG emissions.

It is important to choose the emissions factor that applies to your country or state if possible. Emissions factors are generally national or state averages and differ between countries and/or states. Eg. The emissions factor for the consumption of electricity in NSW is lower than in Victoria. This is because NSW mainly uses black coal to generate electricity while Victoria mainly uses brown coal to generate electricity and brown coal generates more GHG emissions per unit of energy. Emissions factors for the consumption of electricity would be much lower in countries or states that generate electricity mainly from renewable energy.

Emissions factors are provided in specific units. It is important to convert your activity data to the units used by the emissions factor. Eg. The emissions factor for the combustion of petrol in Australia is 2.5 t CO2-e/kL and so your activity data for petrol needs to be converted to kL.

Emissions factors are published by various organizations, including state and national government agencies and international organizations. The AGO publishes and frequently updates emissions factors for Australia.

Sources of emissions factors relevant to the GHG inventory of an office may be obtained from:

1. The AGO for:
    a. Consumption of electricity.
    b. Consumption of gas.
    c. Car travel.
    d. Bus travel.
2. The GHG Protocol for:
    a. Air travel.
    b. Train travel.
3. The Environmental Defense Fund for paper use.

Calculate emissions

On-line calculators

It is now possible to calculate the GHG emissions associated with many office activities using on-line calculators. These are provided by various organizations, including international non-government organizations and many Australian offset providers. If you choose to use an on-line calculator, you need to be aware of the following:

1. Different on-line calculators use different underlying data and different emissions factors. Eg. Some on-line calculators provided by Australian offset providers use AGO emissions factors and some use IPCC emissions factors. The data and assumptions underlying on-line calculators are often not made clear.

2. There may not be on-line calculators for all activities that you may wish to include in your office's GHG footprint. The AGO provides an on-line calculator for offices, which estimates the GHG emissions associated with a large range of office activities, including public transport, waste generation and food consumption: **www.cc.greenhouse.gov.au**

3. In terms of air travel on-line calculators, only some account for the additional warming effect of air travel (considered by the IPCC to be 2.7 times greater than the warming effect of the release of CO2 alone) and may not distinguish between short, medium, and long haul flights. Climate Friendly provides an on-line calculator that takes into account the additional warming effect of air travel: **www.climatefriendly.com/flight**

Calculating GHG emissions yourself

The GHG emissions for each GHG emission source included in your GHG footprint are calculated as follows:

Formula: Activity data X emissions factor = GHG emissions.

The method for calculating the GHG emissions for each activity/GHG emission source included in your GHG footprint is shown below.

1. **Electricity use:**

Activity data: The amount of electricity consumed by your office in kWh. This is identified on your electricity bill.

Emissions factor: The emissions factor for electricity is provided in kWh and for NSW is currently 0.893 kg CO2-e/kWh.[1]

Your electricity bill may calculate the GHG emissions associated with your electricity consumption for the billing period and may also compare this to previous billing periods. If it does not, you can calculate the GHG emissions from your electricity use by applying the following formula:

> *Formula:* GHG emissions (t CO2-e) = Electricity consumed by your office in kWh X emissions factor for your State/Territory / 1000

Example

> Your office consumes 5 000 kWh of electricity in the last billing period.
>
> GHG emissions = (5 000 kWh x 0.893 kg CO2-e/kWh) / 1000 = 4.47 t CO2-e

2. **Gas use:**

Activity data: The amount of gas consumed by your office in million joules (MJ). This is identified on your gas bill.

Emissions factor: The emissions factor for gas is provided in gigajoules (GJ) (1 billion joules) and for NSW is currently 51.7 kg CO2-e/GJ.[2] To convert from MJ to GJ, divide MJ by 1000.

You can calculate the GHG emissions from your gas use by applying the following formula:

> *Formula:* GHG emissions (t CO_2-e) = Gas consumed by your office in GJ X emission factor for your State / 1000

Example

> Your office uses 17000 MJ of natural gas in the last billing period. To convert MJ to GJ, divide 17000/1000 = 17 GJ
>
> GHG emissions = 17 GJ x 51.7 / 1000 = 0.879 t CO2-e.

3. **Air travel:**

Activity data: i) The number of airplane kilometers traveled by staff per person per flight ii) the type of flight taken classified into short haul, medium haul, or long haul flights.

Emissions factors: There are currently no published emissions factors for air travel in Australia. You can use the GHG Protocol emissions factors:[3]

[1] Australian Greenhouse Office (2006) Factors and Methods Workbook, AGO, Canberra
[2] Australian Greenhouse Office (2006) Factors and Methods Workbook, AGO, Canberra
[3] www.ghgprotocol.org

Method of travel	Emissions factor (kg CO_2-e per km per passenger)
Short haul (<500km per flight)	0.15
Medium haul (500 – 1600 km per flight)	0.12
Long haul (>1600 per flight)	0.11

You can calculate the GHG emissions from your air travel by applying the following formula:

> *Formula:* GHG emissions (kg CO_2-e per passenger) = km traveled X emissions factor for km traveled X IPCC radiative forcing value (2.7).

Example

> Your total work airplane flights for the year were 2 staff members taking 3 return trips from Sydney to Brisbane and 1 staff member taking 1 return trip from Sydney to Los Angeles.
>
> Short haul flights (500 km) = 0 km.
>
> Medium haul flights = 6 flights Sydney to Brisbane, km traveled = 4485 km per person x 2 persons = total 8970 km.
>
> GHG emissions (kg CO2-e per passenger) = 8970 x 0.12 x 2.7 = 2906 kg CO_2-e (2.9 t).
>
> Long haul flights = 2 flights Sydney to Los Angeles, km traveled = 24,125 km per person x 1 person = total 24,125 km.
>
> GHG emissions (kg CO2-e per passenger) = 24,125 x 0.11 x 2.7 = 7,165 kg CO_2-e (7.17 t).

4. Car and bus travel

Activity data: i) The number of car and bus km traveled ii) the type of fuel used (petrol, diesel or LPG) iii) the fuel consumption of the vehicle used.

Emissions factors: Emissions factors for petrol, diesel, and LPG are provided in kilolitres (kL) (1 thousand litres). To convert from L to kL, divide L by 1000.

You can calculate the GHG emissions from your car and bus travel by applying the following formula:

> *Formula:* GHG emissions (t CO2-e/kL) = km traveled X fuel consumption (L/km) X emissions factor / 1000

Example

> Your office car km for the year were:

	Distance	Fuel consumption	Fuel type/ corresponding emissions factor
Trip 1	100 km	Unknown – AGO default consumption = 0.107 L/km	Petrol/2.4 t CO2-e/kL

	Distance	Fuel consumption	Fuel type/ corresponding emissions factor
Trip 2	150 km	Unknown – AGO default consumption = 0.107 L/km	Petrol/2.4 t CO2-e/kL
Trip 3	200 km	Toyota Landcruiser - 0.161 L/km	Diesel/2.7 t CO2-e/kL

Trips 1 and 2: GHG emissions = 250 km x 0.107 x 2.4 ÷ 1000 = 0.064 t CO_2-e.

Trip 3: GHG emissions = 200 km x 0.161 x 2.7 ÷ 1000 = 0.087 t CO_2-e.

5. Train travel

Activity data: The number of train km traveled by staff in your office.

Emissions factors: There are currently no published emissions factors for train travel in Australia. You can use the GHG Protocol emissions factors:[4]

Type of train	Emissions factor (kg CO_2-e/passenger km)
Intercity rail	0.195
Transit rail e.g. subway/tram	0.105
Commuter rail	0.101

You can calculate the GHG emissions from your train travel by applying the following formula:

Formula: GHG emissions (t CO_2-e) = km traveled X emissions factor / 1000

Example

Your office train km for the year were all taken on commuter rail systems and totaled 2030 km.

GHG emissions = 2030 x 0.101 / 1000 = 0.205 t CO_2-e

6. Paper

Activity data: The weight of paper used by your office.

Emissions factors: There are currently no published emissions factors for paper use in Australia. You can use the Environmental Defense Fund emissions factors:[5]

[4] www.ghgprotocol.org
[5] www.environmentaldefense.org

Type of paper and method of disposal	Emissions factor (kg CO_2-e/tonne of paper)
100% recycled paper and disposed by recycling	1791
Virgin paper and disposed at landfill	3332.25
100% recycled paper and disposed at landfill	3358.55
Virgin paper and disposed by recycling	1764.75
50% recycled paper and disposed by recycling	1777.9
50% recycled paper and disposed at landfill	3345.4
75% recycled paper and disposed by recycling	1784.48
75% recycled paper and disposed at landfill	3351.98

You can calculate the GHG emissions from your office paper use by applying the following formula:

Formula: GHG emissions (t CO_2-e) = weight of paper used (t) X emissions factor / 1000

Example

Your office used 360 reams of 100% recycled paper with an average weight of 2.49 kg each ream in a year. All this paper is disposed of by recycling.

Your office also outsourced printing of publications, which generated 1,000 kg of 50% recycled publications paper. You do not know how these publications are disposed of after use, but decide to assume they are sent to landfill.

Use of office paper = 360 x 2 = 896 kg (0.9 t)

Emissions factor for office paper = 1791

GHG emissions for office paper = 0.9 t x 1791 / 1000 = 1.61 t CO2-e

Use of publications paper = 1,000 kg (1 t)

Emissions factor for publications paper = 3345.4

GHG emissions for publications paper = 1 t x 3345.4 ÷ 1000 = 3.35 t CO2-e

Total GHG emissions associated with the use of paper = 4.64 t CO_2-e.

***References and further reading*:**

1. World Resources Institute (2002) 'Working 9 to 5 on Climate Change: An office guide': **www.wri.org**

2. Australian Greenhouse Office (2006) 'Factors and Methods Workbook': **www.greenhouse.gov.au**

3. GHG Protocol: **www.ghgprotocol.org**

4. Environmental Defense Fund (1995) A new way to buy paper: A lifecycle approach to reducing the environmental impacts of paper use: **www.environmentaldefense.org**

5. AGO on-line office calculator: **www.cc.greenhouse.gov.au**

6. Climate Friendly on-line air travel calculator: **www.climatefriendly.com/flight**

REDUCING YOUR GREENHOUSE GAS FOOTPRINT

The third step in reducing the GHG emissions of your office and/or going carbon neutral is to look at ways you can reduce your GHG footprint.

The carbon hierarchy

The concept of a 'carbon hierarchy' has recently developed, which is similar to the waste hierarchy of first 'reduce', then 'reuse', then 'recycle'. The carbon hierarchy provides guidance on how to prioritize the steps that you should take to reduce the GHG footprint of your office. A simplified version of the carbon hierarchy is:

1. First, reduce your GHG emissions by increasing energy efficiency.

2. Second, replace energy derived from fossil fuels with energy derived from renewable sources.

3. Third, offset your remaining GHG emissions.

STEP 1: INCREASE ENERGY EFFICIENCY

There are a few key easy steps you can take to increase energy efficiency and reduce the GHG emissions of your office. These include:

1. **Switch off**

    a. Switch off lights when not required. Place 'switch off' labels on light switches. In particular, switch off lights in areas where lighting is not regularly required if possible, such as storage rooms and stationary cupboards.

    b. Switch off the cooling and heating system at the end of the day and on weekends. You will need to approach your building manager. This can reduce energy use by over 50%. You can install a timer on cooling and heating systems to turn the system on and off as required.

    c. Switch off the hot water system at the end of the day and on weekends. You will need to approach your building manager. Your office is unlikely to require hot water outside working hours. This can reduce energy use by over 50%. You can install a timer on cooling and heating systems to turn the system on and off as required.

    d. Switch off office equipment when not in use.

i. Switch off computer hard-drives when you are away from your desk for an hour or more and switch off monitors when you are away from your desk for more than 10 minutes.

ii. Switch off office equipment at night and during weekends at the power point. Much office equipment still uses energy when only switched off at the equipment and not at the power point. For example:

a. Photocopiers use up to 50 W when switched off only at the equipment.

b. Desktop computers and monitors use 1-2 W when switched off only at the equipment.

2. Use energy efficient lights and reduce unnecessary lighting

a. Replace energy inefficient light globes with energy efficient light globes:

i. Compact florescent light globes use up to 75% less energy than incandescent light globes for the same light output.

ii. Standard fluorescent tubes use up to 70% less energy than incandescent light globes for the same light output.

iii. Triphosphor fluorescent tubes use up to 18% less energy than standard fluorescent tubes for the same light output.

iv. Light emitting diode (LED) exit lamps use up to 70% less energy than standard exit lamps.

b. Reduce unnecessary lighting levels.

i. Use a light meter ('lux meter') to measure light levels in your office and compare these with Australian Standard 1680, which specifies minimum light levels for a range of situations, including office work. Light meters are available from most electronic shops.

ii. Reduce light levels in areas that exceed Australian Standard 1680. This can be done by 'delamping' (removing lights or light globes) and replacing high wattage globes with low wattage globes. Eg. If you have fluorescent tube systems, remove 1 of the 2 tubes in each unit.

c. Establish a maintenance schedule to ensure that lampshades and coverings are clean. Dirt and dust build-up can reduce light output by 50%.

3. Turn down your thermostats

a. Turn down thermostats on cooling and heating system. You will need to approach your building manager. AGO recommends thermostats should be set at around 18-20ºC in winter and 24-25ºC in the summer.

b. Turn down thermostats on the hot water system. Many hot water thermostats are set at unnecessarily high levels. You will need to approach your building manager and check relevant regulations that specify minimum temperatures for hot water systems depending on the end use of the water.

4. Reduce your hot water use

a. Install flow restrictors or aerators in taps and low flow showerheads. The less water that needs to be heated, the less energy is used. Using water efficient taps can save up to 60% on heating costs when compared to conventional taps.

b. Wash your hands with cold water and not hot water.

5. Activate 'sleep mode' on office equipment

a. Most office equipment has a 'stand-by' or 'sleep mode' mode, which can be set to activate after a certain period. Office equipment in sleep mode uses significantly less energy. For example:

   i. Desktop computers use 30 W in sleep mode compared to 50 W in use and monitors use 10 W or less in sleep mode compared to 50-100 W in use.

   ii. A large photocopier uses 15-400 W in sleep mode compared to 300 W – 2 kW in use.

   iii. Laser printers use 10-50 W in sleep mode compared to 100-200 W in use.

b. Activate sleep mode features on computers rather than using a screen saver, as these do not save energy. You can do this by going to 'Start', 'Settings', 'Control Panel', 'Display', 'Power' and then choose the options that best suit you.

6. Purchase energy efficient equipment

a. Purchase Energy Star office equipment.

   The Energy Star program is an international energy efficiency standard for office equipment, which was begun by the US Environment Protection Agency in 1992. The Energy Star program in Australia is managed through a joint initiative of the Australian and State and Territory Governments: **www.energystar.gov.au**

   Energy Star office equipment meets certain energy efficiency standards. The main way standards are met is through mechanisms that enable Energy Star equipment to 'power down' and enter sleep mode within a certain period after the last use. For example, to meet Energy Star requirements, a 200 W computer must have a sleep mode of < 15 W and a deep sleep mode of < 8 W.

   All Energy Star office equipment meets a certain efficiency standard, but there is still variation in efficiency between different Energy Star brands. You can check and compare the power requirements (wattage) of the different Energy Star brands by looking at the specification sheet for the equipment.

   Using Energy Star equipment generally reduces energy use from office equipment by around 50%.

b. Check and compare the energy efficiency of Energy Star office equipment.

The energy efficiency of Energy Star office equipment varies between different brands. You should check the power requirements of Energy Star office equipment in different modes (use mode, stand-by and sleep-modes, and when switched off at the equipment). Then choose the equipment with the lowest power requirements and match the power requirements with the equipment's predicted use in your office. For example, choose a fax machine with a very low wattage in sleep mode, as it will typically be in sleep mode for the majority of the time. Information on power requirements in different modes will be provided on the specification sheet for the equipment.

c. Use the 'Energy All Stars' website to check the energy efficiency of office equipment.

   Energy All Stars is an initiative of the AGO that identifies the top performing energy efficient products in a range of categories, including office equipment. This is a useful resource to assist you in choosing the best performing office equipment: **www.energyallstars.gov.au**

d. When purchasing computers, consider:

   i. A laptop computer uses up to 80% less energy than a desktop computer.

   ii. An LCD flat screen monitor uses significantly less energy than a standard monitor.

   iii. A 17 inch screen may use up to 30% more energy than a 15 inch screen.

e. When purchasing photocopiers and printers, choose one that has:

   i. A 7 day clock that allows it to be automatically switched off after hours.

   ii. An 'energy save' button in additional to programmable sleep mode features so that users can put the machine into low power immediately after use.

   iii. A quick warm-up time, which allows you to switch it off more often when not in use.

f. When purchasing printers, consider an ink jet printer, which uses up to 90% less energy than a laser printer.

g. Purchasing energy efficient office equipment not only reduces energy use in your office directly, but also indirectly by generating less heat in the office. Energy efficient office equipment may reduce the energy required for cooling your office by up to 20-30%.

7. Enable energy efficiency features of Energy Star equipment

Your office may already have some Energy Star office equipment. To work, Energy Star equipment must have its energy efficiency mechanisms enabled. Often suppliers of the equipment do not enable the equipment and you may have to do this yourself. The Energy Star website gives you step by step instructions on how to enable your equipment: **www.energystar.gov.au**

8. Use less paper

a. Use recycled paper and recycle your paper. The amount of energy required to produce recycled paper is up to 50% less than required to produce virgin paper. Also, sending used paper to landfill creates more GHG emissions than required to produce virgin paper.

b. Set your print default options to double-sided and make it your office policy to print 4 pages per sheet where possible.

c. Reduce the size of your document margins. Common default settings on computers are 12 point type and 3.175 cm left and right had margins. By using 11 point type and 2.54 cm margins and 1.27 cm right hand margins you increase the amount of text on a page by 27%. These margins still allow ample room for binding and filing.

9. Reduce the GHG emissions of your business travel

a. Reduce the number of airplane flights you take. Airplanes consume aviation fuel at a very high rate, particularly on short flights (< 500 km), and have a greater effect on climate change than the effect of the release of CO2 from the combustion of aviation fuel alone. Use teleconferencing instead of face to face meetings. Teleconferencing facilities can be relatively cheap compared to travel costs.

b. Use the most fuel efficient and smallest car suitable for your needs when hiring a car for business travel. Check the fuel efficiency of cars on the AGO 'Green Vehicle Guide': **www.greenvehicleguide.gov.au**. If possible hire a Toyota Prius. Many large hire car companies now rent the Toyota Prius, usually at no extra cost. Eg. A 500 km trip in a Toyota Prius consumes 22 L of petrol and creates 0.05 t CO2-e. The same trip in a Toyota Camry consumes 45 L of petrol and creates 0.12 t CO2-e.

c. Encourage staff to use public transport and walk or ride bicycles to work. The EDO Sydney office encourages staff to take public transport through a 'salary sacrifice' system. This involves the EDO paying for yearly or half yearly public transport passes out of the staff's pre-tax income, which means that staff do not pay tax on their public transport costs.

References and further reading

1. National Appliance and Equipment Energy Efficiency Committee (2001) 'Green Office Guide. A guide to help you buy and use environmentally friendly office equipment': **www.energyrating.gov.au**

2. Australian Greenhouse Office. Greenhouse Challenge Plus Fact Sheets: **www.greenhouse.gov.au/challenge/publications/**

3. Carbon Trust (2006) 'Office equipment: Introducing energy saving opportunities for business': **www.carbontrust.co.uk**

4. Carbon Trust (2004) 'Better business guide to energy saving': **www.carbontrust.co.uk**

5. Energy Star: **www.energystar.gov.au**

6. Energy All Stars: **www.energyallstars.gov.au**

7. Green Vehicle Guide: **www.greenvehicleguide.gov.au**

STEP 2: USE RENEWABLE ENERGY

Along with increasing the energy efficiency of your office, you can replace the electricity you use in your office generated from coal-fired and gas-fired power plants with electricity generated from renewable sources.

You purchase renewable energy through your energy retailer. You need to ensure that you purchase your renewable energy through the Green Power program.

The Green Power program

The Green Power program is a voluntary national accreditation program for renewable energy products and projects, which was begun in NSW in 1997. A key aim of the program is to facilitate consumer demand for new renewable energy projects in Australia. The Green Power program is managed through a joint initiative of State and Territory Governments: **www.greenpower.com.au**

The Green Power program accredits both renewable energy products (or packages) sold by energy retailers to customers and renewable energy projects owned by energy generators.

In terms of renewable energy products sold by energy retailers, the Green Power program requires that independent annual audits are undertaken to ensure that energy retailers purchase the amount of electricity you requested from Green Power accredited renewable energy generators.

In terms of renewable energy projects, Green Power only accredits projects that meet certain criteria and environmental standards. Projects must be:

1. An eligible renewable energy project. These include solar power, wind power, biomass power, existing hydro-electric power, geothermal power, and wave and tidal power.

2. A renewable energy project that was built since 1997. This ensures that when consumers purchase accredited Green Power they are encouraging investment in new renewable energy projects.

A few things to note on eligible projects:

1. An eligible biomass project includes power generated from burning methane gas at landfills and sewerage treatment plants and power generated from burning organic matter such as municipal solid waste, agricultural waste, sugar case waste, and wood waste. Wood waste can only be sourced from sustainably managed plantation forests and not old growth forests.

2. An eligible hydro-electric project does not include existing projects that do not provide for adequate environmental flows or from new projects that involved construction of dams or the diversion of rivers.

Your office can purchase accredited Green Power through your energy retailer or a limited number of non-government organizations such as Climate Friendly and Ark Climate. When you purchase Green Power you need to choose the percentage (between 10% and 100%) of your electricity consumption that you want your energy retailer to purchase from Green Power accredited renewable energy generators on your behalf. Your energy retailer then purchases that amount of energy from a renewable energy generator, which then feeds that amount of energy into the national electricity grid.

The Green Power program sits separately to mandatory renewable energy programs and targets, which are set by Australian governments. For example, the

Australian Government's Mandatory Renewable Energy Target (MRET) requires energy retailers to purchase a small percentage of their electricity from renewable energy sources. Under the Green Power program, energy retailers are not able to count purchases of accredited Green Power electricity towards their requirements to purchase renewable energy under MRET.

When purchasing Green Power you need to be aware that some energy retailers offer to sell you 'green electricity' that is not sourced from an accredited Green Power project. This electricity is usually sourced from existing renewable energy projects such as old hydro-electric schemes, which means that you are not contributing to investment in new renewable energy projects. Also, it may be counted towards meeting mandatory renewable energy targets. You need to make sure you only purchase an accredited Green Power product.

Each year, Green Electricity Watch, which is a joint initiative of the Total Environment Centre, the Australian Conservation Foundation, and WWF, rates accredited Green Power products offered by energy retailers in accordance with a number of criteria. These cover:

1. The extent to which the product drives the development of new renewable energy projects in Australia additional to mandatory targets.

2. The extent to which the product increases the uptake of Green Power.

3. The clarity of the advertisement and promotion of the product.

You can use the Green Electricity Watch report as a guide to deciding which retailer and which Green Power accredited product you should choose: **www.greenelectricitywatch.org.au**

***References and further reading*:**

1. GreenPower: Accredited Renewable Energy: **www.greenpower.com.au**

2. Green Electricity Watch: **www.greenelectricitywatch.org.au**

STEP 3: OFFSETTING

Once you have increased the energy efficiency of your office and replaced the electricity you use in your office generated from coal-fired and gas-fired power plants with electricity generated from renewable sources, you may choose to offset your remaining GHG emissions. If you have purchased 100% accredited Green Power, your remaining emissions will likely be associated only with emissions from travel.

A carbon offset is a project or activity that avoids the release of GHG emissions into the atmosphere or absorbs/sequesters GHGs from the atmosphere, which is used to compensate for the GHG emissions of activities elsewhere. The amount of GHG emissions avoided or absorbed is equivalent to the amount of GHG emissions released elsewhere. An offset may also promise to avoid or absorb an equivalent amount of GHG emissions in the future.

An offset may occur at a different location to where GHGs are being emitted because the climatic impacts of GHG emissions are the same regardless of their source and origin. A tonne of CO2 emitted from a coal-fired power station in Australia has the same climate impact as a tonne of CO2 emitted from driving a car in China.

The concept of carbon offsets is controversial in some circles, with critics seeing it as a licence to continue to do business as usual or to pollute. We believe that provided you follow the carbon hierarchy and only offset after you have increased energy efficiency and purchased accredited Green Power, then offsetting can play a legitimate role in reducing the GHG footprint of an office.

Carbon offsets are used to meet both regulatory GHG emission reduction targets set by governments and voluntary GHG emission reduction targets set by individual organizations. In Australia, a large voluntary offset market has recently developed, which is driven by organizations wanting to reduce their GHG footprint or go carbon neutral.

Types of carbon offsets

Offset projects can be classified into two broad types – those that avoid GHG emissions and those that absorb/sequester GHGs from the atmosphere.

Table 2 Types of carbon offsets

Projects that avoid GHG emissions	
Type	***Examples***
Renewable energy projects	Wind Solar Biomass Hydro
Energy efficiency projects	Installing energy efficient lighting Increasing energy efficiency in industry
Gas recovery or destruction projects	Burning of methane gas at landfills or sewerage treatment plants
Fuel switch projects	Oil to natural gas Diesel to natural gas Diesel to biodiesel
Projects that absorb/sequester GHGs from the atmosphere	
Type	***Examples***
Carbon sinks	Reforestation – This involves the forestation of land previously forested Afforestation – This involves the forestation of land not previously forested Avoided deforestation – This involves protecting existing forests from being cleared, which avoids the release of the carbon stored in the forests

Sourcing your carbon offset

You can source your carbon offset through Australian offset providers. An offset provider invests the money you give them to offset your GHG emissions in offset projects. There are currently about 17 voluntary offset providers in Australia, and new providers are entering the market on a regular basis.

You need to be aware that:

1. The voluntary offset market in Australia is currently largely unregulated and lacks consistent quality assurance standards, although recognized standards do exist.

2. Different offset providers use different quality assurance standards or may not use any at all.

3. Different offset providers offer different types of offset projects that may be located in different areas both inside and outside Australia.

4. Different offset providers charge different prices for offsetting. The price of an offset depends largely on the type of offset project offered and the level of administration required by any standard used.

What makes a good carbon offset?

There are 5 main characteristics that determine the quality of an offset project. These are:

1. Additionality: The GHG reductions created by an offset project should be additional to what would have happened in the absence of the project.

2. Verification: The GHG reductions created by an offset project should be verified by an accredited independent third party in accordance with an established standard.

3. Permanence: The GHG reductions created by an offset project should be maintained over time and/or permanent.

4. Leakages: The offset project should not result in increases in GHG emissions elsewhere. Eg. A reforestation project may displace agriculture from one area to another with no overall reduction in GHG emissions.

5. Double counting: The GHG reductions from an offset project should not be counted more than once.

Based on these characteristics, you should ask yourself and your offset provider the following questions when choosing an offset:

1. Additionality:

    a. Does the offset project go beyond current regulatory requirements?

    b. Does the offset project go beyond common practice in the sector or region where the project is carried out?

    c. Does the offset project face economic or technical barriers that would prevent its implementation without the investment generated by my offset?

2. Verification:

a. Does the offset project comply with a recognized standard?

b. Does the standard include a procedure to verify the GHG emissions reductions from the offset project?

c. Does the standard require the verification of GHG emissions reductions by an accredited independent third party?

3. Permanence:

   a. What are the risks that the offset project will fail to result in permanent GHG emission reductions?

   b. Does the offset provider have a strategy in place in case the offset project fails?

   c. Does the offset provider guarantee that if the offset project fails, the offset will be replaced by an offset that provides equivalent GHG emissions reductions?

4. Leakages:

   a. Is the project likely to cause any significant off-site (upstream or downstream) GHG emissions and have these been considered and incorporated in determining emissions reductions?

5. Double counting:

   a. Does the offset provider operate a registry of GHG emission reductions where credits from reductions get quantified, registered to buyers, and then retired?

The Australian Conservation Foundation has a consumers guide to going carbon neutral, which can be found at: **www.acfonline.org.au/carbonneutral**

The Total Environment Centre is currently preparing a guide on the voluntary carbon offset market in Australia, which will rank carbon offset providers and their products according to their contribution to GHG emissions reductions. **www.tec.org.au**

***References and further reading*:**

1. RMIT University 'Carbon Offset Providers in Australia 2007': **www.global.rmit.edu.au**

2. Total Environment Centre 'Carbon Neutral Watch – Corporates, Consultants, and Credibility': **www.tec.org.au**

3. Carbon Trust 'The Carbon Trust three stage approach to developing a robust offsetting strategy': **www.carbontrust.co.uk**

4. Australian Conservation Foundation 'Consumers guide to going carbon neutral': **www.acfonline.org.au/carbonneutral**

November, 2007