Organisational Carbon Accounting for Local Governments

Learner Guide

Prepared for:

Sustainability Victoria

16 August 2018

DISCLAIMER

The content of this publication is provided for educational purposes only. No claim is made as to the accuracy or authenticity of the content. The information in this publication is proved on the basis that all persons accessing it undertake responsibility for assessing the relevance and accuracy of its content. No responsibility is taken for any information or services which may appear on any linked websites. If using any information provided in this manual, please ensure proper acknowledgement is noted.

Neither Sustainability Victoria nor Point Advisory accept any liability to any person for the information or advice (or the use of such information or advice) that is provided in this publication or incorporated into it by reference.

If you believe that information of any kind in this publication is an infringement of copyright, in material in which you either own copyright or are authorised to exercise the rights of a copyright owner, then please advise us by contacting Sustainability Victoria at info@sustainability.vic.gov.au.

Sustainability Victoria and Point Advisory value input from Industry groups and Educational organisations into the development of learning resources. The area of sustainability is a rapidly evolving field, which creates challenges in providing up to date resources. If you feel that certain information could be included or removed from future editions, please contact Sustainability Victoria at info@sustainability.vic.gov.au.

VERSION CONTROL

Version	Date	Author	Project Director
DRAFT v.1	15/06/2018	Brett McKay Marisa Sánchez Urrea	Charlie Knaggs
DRAFT v.2	06/08/2018	Brett McKay Marisa Sánchez Urrea	Charlie Knaggs
FINAL	16/08/2018	Brett McKay Marisa Sánchez Urrea	Charlie Knaggs

CONTENTS

COURSE INFORMATION

Name of the course	**Organisational Carbon Accounting for Local Governments**
Nominal duration of the course	40 hours Nominal duration of course is 40 hours, including 20.5 hours of supervised learning and 19.5 hours of unsupervised learning (including online modules, quizzes and assessment, and time for data gathering to support successful course completion).
Copyright owner of the course	Sustainability Victoria Copyright of this document is held by Sustainability Victoria. No part of this document may be reproduced by any process except with express written permission.
Course objectives	The course objectives are to: • provide specialised and relevant training services to local government staff which aligns with relevant legislation and recognised standards regarding the preparation of greenhouse gas inventories related to councils' operations • provide participants with skills and knowledge on how to report on their GHG inventories and use the outcomes for management purposes including: – measurement and monitoring of greenhouse gas emissions and energy use for all activities of the organisation – GHG reporting to assist councils to use it within their tactical / strategic business planning environment.
Learning outcomes	The course is designed to upskill participants in the following aspects of organisational carbon accounting: • Determining emissions reporting boundaries, including the organisational boundary (operations to be included in the inventory) and the operational boundary (sources of emissions to be included in the inventory). • Understanding and applying the concepts of relevance (in particular related to Scope 3 emissions sources) and materiality. • Calculating the carbon inventory, including data collection and collation and relevant sources of emissions factors. • Documenting the carbon inventory results in a way that is easily replicated and maintained, and that enables local governments to maintain their emissions inventories and track their progress year-on-year. • Understanding the mechanics and options for setting targets, using inventories as a basis for visualising level of effort and ambition. • Understanding how carbon inventories can be used to inform strategic planning and investment in energy management opportunities.
Course structure	To be awarded the Statement of Attainment for the Carbon Accounting Course, participants must successfully complete two units: • Unit 1: Develop an organisational carbon inventory (20 hours) • Unit 2: Reporting and planning (20 hours) In order to undertake Unit 2, participants must complete Unit 1 as a pre-requisite. Participants must complete both units in the course to be awarded a Statement of Attainment.

USING THE LEARNER GUIDE

This Learner Guide has been developed to assist you to meet the requirements for Sustainability Victoria's *Organisational Carbon Accounting for Local Governments*. The guide is divided into two learning units and their respective modules, and contains icons to help you navigate through the guide.

Learner Guide Icons

Webinars. A series of webinars have been developed as part of this course. This icon indicates instances when the content of this guide has been further explained through a webinar. Log into your OpenLearning account here to access recorded webinars.

Optional background reading and reference materials. These additional readings and references are optional, and can provide you with further detail on certain topics. They may include articles, texts, technical specifications, legislation, webpages and reports.

Learning activities are provided to assist you to consolidate your learning, check your progress in the unit and understanding of the material covered. Activities are not formally assessed.

Quizzes and assessments. This icon indicates a module-specific quiz or a unit-specific assessment that needs to be completed to successfully complete the module / unit. Log into your OpenLearning account here to access quizzes and assessments.

Terminology

Carbon

Readers should note that in the general literature (and also in places throughout this guide), the term *carbon* is used for both the element carbon as well as an abbreviation to represent emissions such as *carbon dioxide* and *greenhouse gas (GHG)* and terms such as *carbon trading*, *carbon footprint* and *carbon emissions*. Care should be taken as the abbreviation may not always be appropriate. For example, 1 tonne of actual carbon (the element, for example in a tree) will release 3.7 tonnes of carbon dioxide (the emission) into the air when oxidised (burnt).

CO_2 vs CO_2-e

Other greenhouse gases such as methane, nitric oxides etc, are measured in terms of their CO_2 equivalent (CO_2-e) global warming potential. For example, the global mean CO_2 level in 2013 was 395 parts per million (ppm); however, when all the greenhouse gases in the atmosphere are included and expressed as equivalent CO_2, the levels reached 480 ppm in 2013[1].

Climate change glossaries

- https://www.climatechangeinaustralia.gov.au/en/support-and-guidance/glossary/
- https://www.ipcc.ch/publications_and_data/publications_and_data_glossary.shtml

References and links

References and links are correct and available at the time of publication, but may be invalid where web addresses have changed.

[1] State of the Climate 2014 (Bureau of Meteorology and CSIRO).

INTRODUCTION

Climate change and the related issues facing government, industry and the community represent some of the biggest challenges currently facing Australia and the world. Scientific consensus supports the assertion that anthropogenic (human-created) sources of greenhouse gases are driving these changes to the climate. As research and observations improve our knowledge and understanding, there is increasing concern about the speed at which these changes are taking place.

The emphasis for action on climate change is to minimise our production of greenhouse gas emissions. In some countries, such as those of the European Union, regulations have mandated reductions by large emitters. A range of drivers are encouraging many others to voluntarily decrease emissions at the organisational, household or individual level. As a result, many organisations measure their carbon footprint and establish pathways to reduce their carbon emissions.

It is now commonly understood that claims of carbon neutrality or carbon reduction must be substantiated and supported by best practice carbon accounting and reporting methods. If such standards are not followed, organisations' claims may be subject to criticisms of 'greenwashing'. This may result in a general undermining of public confidence in environmental claims, and serious breaches could lead to interventions by the Australian Competition and Consumer Commission (ACCC).

The advantages of credibly quantifying greenhouse gas emission include enhanced reputation, cost savings, risk reduction, marketing opportunities and influencing sustainable growth strategies. With this in mind, organisations are developing formal approaches to their carbon accounting practices.

Climate change action in Australia is rapidly expanding among private organisations and in the public sector. The development of the National Carbon Offset Standard (NCOS) now enables organisations, buildings and events to be certified carbon neutral. Carbon markets in Australia are also maturing and may soon be linked with international markets.

As such, local governments are encouraged to build or revise their carbon inventories in accordance with the latest standards and guidance. Local governments have an important role in the community to lead from the front in climate action and support its community from the harmful impacts of climate change through both adaptation and mitigation. This training course seeks to deliver the most relevant and up-to-date carbon accounting and reporting skills and knowledge to participants.

UNIT 1: DEVELOP AN ORGANISATIONAL CARBON INVENTORY

Unit description

This unit describes the skills and knowledge required to develop an organisational greenhouse gas emissions inventory. Participants will apply accepted methodologies for accounting for carbon emissions and produce an inventory for their organisation.

This unit comprises the following modules:

Module	Objectives
1. Foundations	• Understanding the business case for carbon accounting. • Understanding carbon accounting standards and guidelines, in particular the National Greenhouse and Energy Reporting (NGER) scheme (for Scope 1 and 2 emissions sources) and the GHG Protocol (for Scope 3 emissions sources). • Understanding sources of emissions factors and their application, including the National Greenhouse Accounts.
2. Accounting boundaries	• Determining emissions reporting boundaries, including the organisational boundary (operations to be included in the inventory) and the operational boundary (sources of emissions to be included in the inventory). • Understanding the concepts of relevance (in particular related to Scope 3 emissions sources) and materiality.
3. Develop a carbon inventory	• Calculating the carbon inventory, including data collection and collation, relevant sources of emissions factors, and the application of carbon measurement methodologies.

Module 1. Foundations

The drivers for carbon accounting

Why would an organisation decide to develop a carbon inventory? What is the intent behind the exercise? What are the risks and opportunities present? The reasons can be grouped in two primary areas:

Risk management

- **Regulatory requirements**– Australia has committed to reduce its emissions by 26-28% below 2005 levels by 2030 in its Nationally Determined Contribution. Victoria's *Climate Change Act 2017* provides a legislative foundation to drive Victoria's transition to a net zero emissions. While these two developments have not yet imposed targets or costs on local governments, such targets could be imposed in the future (including a future potential carbon price).
- **Future reporting requirements** – The Essential Services Commission (ESC) regulates aspects of local government operations to protect the long-term interests of Victorian consumers regarding the price, quality, and reliability of services. The ESC developed the *Local Government Performance Monitoring Framework* in 2010, which proposed greenhouse gas emissions as an indicator for corporate environmental responsibility. The *Local Government Performance Reporting Framework and Indicators* in 2013 included a sustainability objective to assess Councils' capacity to "*deliver services, absorb changes and shocks and make decisions in the best interests of the community over the long-term*". While the ESC framework for reporting was not adopted, councils may be required to disclose the risks posed by climate change to their financial stability and ability to provide community services in the near-future.
- **Liability** – An organisation with significant emissions may want to protect itself from other possible future litigation regarding carbon pollution.
- **Costs** – Energy prices are increasing. Adding in a carbon price signal would increase prices even further. Other (non-energy) input costs may increase too. Furthermore, there is a close relationship between energy consumption and GHG emissions, and emissions reduction measures will often result in lowering energy costs.
- **Revenue** – Australia may re-instate a price on carbon, and if this is the case, an organisation may be liable for additional costs.
- **Access to capital/lending** – Lending institutions in the future are likely to show a higher sensitivity to an organisation's climate risk. This has been demonstrated by numerous divestment strategies from financial institutions in recent years. Any organisation attempting to borrow money will benefit from a good reputation and low carbon risk profile.
- **Supply chain** – Organisations may take a proactive approach by choosing to push their upstream supply chain (suppliers) towards taking responsibility for carbon emissions. In doing so, the organisation will need to report its own emissions to set an example. Alternatively, organisations may react to pressures from their own (downstream) customers to report on carbon as part of their own supply chain management.

Opportunities

- **Community support** – Assist the community to adapt to the worst impacts of climate change and lead by example to mitigate climate change.
- **Reduce operational costs** – Free up Council budgets in the future to spend on community support services and new infrastructure.
- **Recruitment –** Hire and retain the best staff. Studies show that staff are attracted to organisations which values are aligned with their own.
- **Carbon management –** An inventory is the first step in the Carbon Management framework.
- **Voluntary reporting –** The organisation may choose to voluntarily report its emissions through one of the various schemes available, such as the Carbon Disclosure Project (covered in more detail in Unit 2: Module 1 *Voluntary reporting*). It may also wish to report internally for reasons such as supporting an energy or resource efficiency plan.

- **Carbon market –** To develop and supply or trade in carbon offsets. Local governments (especially regional governments) may be able to derive income from carbon offsets from operating landfills and possible future forestry/native vegetation practices.
- **Moral/ethical concerns –** It may be part of the organisation's policy or the drive of a leader to 'do the right thing' – for purely altruistic reasons.

These lists are not exhaustive and some of the items overlap. Local governments may be able to state one clear driver, but several others may be present and not stated or not considered. The risks and opportunities will be driven by community expectations, Councillors and Executives, and the wider support staff within each local government. Definition and understanding can only come from discussing such issues with Council and the community. Some drivers may be implicit and must be derived from Council's culture, its direction and business strategies. They may be implicit because leaders have not considered a list such as that outlined above. In this case, it is worth discussing risks and opportunities with stakeholders to define what their true drivers are.

Specific considerations for local governments:

Local governments typically own a large number of facilities around cities and towns and setting carbon reduction targets for these urban areas is vital. Half the world's population live in urban areas, accounting for 80% of global GDP generated, and two thirds of the world's energy consumed (CDP, 2017).

'Foundations' webinar. Log into your OpenLearning account here to access the recorded webinar on Module 1 Foundations.

Optional background reading and reference materials.

- The GHG Protocol. Chapter 2: Business Goals and Inventory Design http://www.ghgprotocol.org/standards/corporate-standard

Carbon accounting terminology

The Kyoto gases

The Kyoto Protocol nominates seven natural and synthetic (man-made) greenhouse gases to quantify emission limitations and reduction obligations. These are the most significant gases in terms of anthropogenic emissions and global warming.

They are:

1. Carbon dioxide
2. Methane
3. Nitrous oxide
4. Hydrofluorocarbons (HFCs)
5. Perfluorocarbons (PFCs)
6. Sulphur hexafluoride (SF_6)
7. Nitrogen trifluoride (NF_3).

The PFCs, HFCs, and sulphur hexafluoride are all synthetic gases manufactured for use in industry. PFCs and HFCs are groupings of gas types and cover a large number of individual gases. Sulphur hexafluoride is one such gas but is singled out because of its high global warming potential. HFCs are mostly used as refrigerants in air conditioners. A phase-down of HFCs begun in January 2018 and finishes in 2035. The phase-down allows for the continued use of HFCs for low volume users where alternatives are difficult.

NF_3 is the seventh GHG to be added to the international accounting and reporting rules under the Kyoto Protocol. This seventh gas was added to the second compliance period of the Kyoto Protocol, beginning in 2012 and ending in either 2017 or 2020. NF_3 is now a reportable gas under the international frameworks, but has not yet been filtered down into Australia's methodologies and frameworks.

For local governments, the first four Kyoto gases listed above are the most important to identify and understand.

Note that chlorofluorocarbons (CFCs) are also significant greenhouse gases but were not included in the Kyoto agreement as their emissions are covered under the Montreal Protocol. CFCs are responsible for depletion of the ozone layer and the Montreal Protocol exists to address that issue. This is one example of a successful emissions intervention by global governments.

Global warming potential (GWP)

Each greenhouse gas has a different warming effect on the atmosphere. In order to compare the relative effects of various GHGs, a global warming potential (GWP) figure is calculated for each, relative to carbon dioxide. CO_2 is nominated because it is the most prevalent anthropogenic GHG. The GWP is determined by the Intergovernmental Panel on Climate Change (IPCC)[2] and reviewed from time to time.

GWP factors in the life expectancy of the gas in the atmosphere and its warming effects within a given time horizon. The horizon currently factored for is 100 years – believed to be relevant to action on emissions reductions.

> ***For example:***
>
> *The GWP for methane is 28. This means that a tonne of methane released into the atmosphere will have the warming effect equivalent to 28 tonnes of CO_2 over a 100 year period.*

Table 1 lists the seven Kyoto gases above with their GWP from the IPCC Fifth Assessment Report (AR5). The reference gas, carbon dioxide, has a GWP of '1' by definition (because it is being compared to itself).

Kyoto GHG	Chemical formula	GWP (AR5)	Major uses/sources of emissions
Carbon dioxide	CO_2	1	Fossil fuel combustion, land use change, cement.
Methane	CH_4	28	Natural gas, emissions from coal mines, enteric fermentation, anaerobic decomposition (landfill gas), wastewater handling, flaring.
Nitrous oxide	N_2O	265	Fertilisers, combustion.
Hydrofluorocarbons	CHF_3 (example)	12,400	Refrigerants.
Perfluorocarbons	C_3F_8 (example)	8,900	Electronics, cathodes for aluminium manufacture.
Sulphur hexafluoride	SF_6	23,500	High voltage switchgear, manufacture of magnesium.
Nitrous fluoride	NF_3	16,100	Manufacturing of semi-conductors, new generation solar panels, flat-screen television sets, touch-sensitive screens, electronic processors.

Table 1 - Kyoto GHGs with global warming potentials

A more detailed list of GWPs is available in the National Greenhouse Accounts Factors workbook[3], noting that both the National Greenhouse and Energy Reporting Scheme and the National Greenhouse Accounts Factors still refer to the GWP values released in the Fourth Assessment Report issued by the IPCC (AR4). While using

[2] Info: http://www.ipcc.ch

[3] Ref: http://www.climatechange.gov.au/publications/greenhouse-acctg/national-greenhouse-factors.aspx

the AR4 values is in line with Australia's current reporting framework, the IPCC and the GHG Protocol recommend the use of the most up to date values available, hence this course refers to IPCC AR5 values. However, local governments may wish to use the values contained in the National Greenhouse Accounts Factors for consistency.

Carbon dioxide equivalents

"A measure used to compare the emissions from various greenhouse gases based upon their global warming potential". [4]

In the context of carbon accounting, we need to record and report GHG emissions in a consolidated, standardised manner. Consolidation, in this sense, means that the effects of all six Kyoto gases (where applicable) are included. By standardising the units used. GWP calculations enable any group of emissions to be reported in a single, calibrated unit.

To achieve this, we use 'carbon dioxide equivalents' as the measure to record and report all GHG emissions. Calculation of the emissions uses the GWP for each gas measured. The emissions are then expressed as amounts of 'carbon dioxide equivalent' (CO_2-e).

The formula is:

Mass of Kyoto GHG (in g, kg, t) x the GWP for that gas = X (g, kg, t) of CO_2-e

Examples:

1. ***We release 1 tonne of methane to the atmosphere.***
   What are the carbon dioxide equivalent (CO_2-e) emissions resulting from that release?

$$CO_2\text{-e} = \text{mass of methane} \times \text{GWP for methane}$$

$$CO_2\text{-e} = 1 \text{ tonne} \times 28$$

$$\underline{28\ tCO_2\text{-e}}$$

2. ***We release 1 tonne of methane + 2 tonnes of carbon dioxide + 4 tonnes of nitrous oxide to the atmosphere.***
   What are the carbon dioxide equivalent (CO_2-e) emissions resulting from that release?

$$CO_2\text{-e} = (1t \times 28) + (2t \times 1) + (4t \times 265)$$

$$CO2\text{-e} = 28 + 2 + 1{,}060$$

$$\underline{1{,}090\ tCO2\text{-e}}$$

'Foundations' webinar. Log into your OpenLearning account here to access the recorded webinar on Module 1 Foundations.

Optional background reading and reference materials.

- The GHG Protocol – Glossary: https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf
- Carbon Dioxide Information Analysis Centre – Glossary: http://cdiac.ornl.gov/pns/glossary.html
- Wikipedia – Glossary of climate change: http://en.wikipedia.org/wiki/Glossary_of_climate_change

[4] Ref: http://stats.oecd.org/glossary/detail.asp?ID=285

Carbon accounting frameworks and methods

Carbon accounting methodologies are agreed processes by which carbon emissions are identified, categorised, quantified and reported. Methodologies should be used in carbon accounting to create a consistent, appropriate and credible carbon inventory and/or report.

All inventories should be guided by the GHG Protocol principles of relevance, completeness, consistency, transparency, and accuracy. Local governments may want to calculate an approximate carbon footprint to establish materiality and highlight key areas of focus before undertaking a full carbon inventory.

For carbon accounting, the various methods can be divided into two broad areas:

1. Accounting and reporting standards

The frameworks and standards within which the emissions (and removals) are identified, categorised, quantified and reported. These include:

- The Greenhouse Gas Protocol: Corporate Accounting and Reporting Standard (GHG Protocol)[5].
- ISO 14064-1 Greenhouse gases: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals (ISO 14064-1)[6].
- National Greenhouse and Energy Reporting (NGER) (Measurement) Determination 2008[7].
- National Carbon Offset Standard (NCOS)[8].
- The Science-based Target initiative (SBTi).

2. Emissions factors

The numbers used to estimate carbon emissions from specific activities. Sources include:

- National Greenhouse Accounts (NGA) Factors. For general use in Australia – but with exceptions[9].
- National Greenhouse and Energy Reporting (NGER) Technical Guidelines. For use with NGER reporting[10].

Some emission factors are not available from the NGA Factors. These are generally available on the internet from a wide range of sources and are covered in more detail on page 27.

The GHG Protocol

The GHG Protocol is a framework developed by the World Resources Institute (WRI)[11] and the World Business Council for Sustainable Development (WBCSD)[12] for both private and public sector organisations, including local governments. The Calculation Tools are a complement to the Corporate Standard and assist organisations in quantifying emissions from their activities and operations.

The GHG Protocol cannot be considered a formal standard when compared with ISO 14064. An entity can be internationally certified as compliant with the ISO standard, but cannot be certified with the GHG Protocol. However, the GHG protocol is globally accepted and widely employed as a framework for GHG emissions reporting. Many localised implementations and applications, e.g. EPA Victoria's Greenhouse Inventory Management Plan[13] and regulations, e.g. NGER[14] are based on this standard. It is available for free download from http://www.ghgprotocol.org/standards.

The following five principles underpin and guide the GHG Protocol accounting and reporting:

[5] http://www.ghgprotocol.org/files/ghg-protocol-revised.pdf

[6] http://infostore.saiglobal.com/store/Portal.aspx?publisher=ISO&gclid=CJKol_qUlaMCFRMYewodYSsrqw

[7] http://www.climatechange.gov.au/government/initiatives/national-greenhouse-energy-reporting/reporting-legislation/progress/determination.aspx

[8] http://www.climatechange.gov.au/government/initiatives/low-carbon-australia/ncos-carbon-neutral-program.aspx

[9] Info: IMPORTANT NOTE. The NGA Factors have no standing in the application of the NGER legislation. Instead use the NGER Technical Guidelines. http://www.climatechange.gov.au/publications/greenhouse-report/nger-technical-guidelines.aspx

[10] Info: http://www.climatechange.gov.au/government/initiatives/national-greenhouse-energy-reporting/~/media/publications/greenhouse-report/nger-technical-guidelines-2010.ashx

[11] Info: http://www.wri.org

[12] Info: http://www.wbcsd.org

[13] Info: https://epanote2.epa.vic.gov.au/EPA%5Cpublications.nsf/PubDocsLU/1356?OpenDocument

[14] Info: http://www.climatechange.gov.au/reporting

- **Relevance** – fit for purpose.
- **Completeness** – include all emissions within the chosen inventory boundary.
- **Consistency** – apply the same methodology across processes and over time.
- **Transparency** – provide an audit trail, disclose assumptions.
- **Accuracy** – reduce uncertainties.

The GHG Protocol also provides supplementary materials and amendments to its Corporate Standard:

- Accounting for Scope 2 emissions - GHG Protocol: Scope 2 Guidance (2015)[15]
- Accounting for Scope 3 emissions - Corporate Value Chain (Scope 3) Accounting and Reporting Standard (2011)[16]
- Supplement to the Corporate Value Chain - Technical Guidance for Calculating Scope 3 Emissions (2013)[17]
- Quantifying greenhouse gas reductions - The GHG Protocol for Project Accounting (2005)[18]
- Specific guidance for local governments on defining the boundary, monitoring reductions and reporting can be found within the Greenhouse Gas Protocol for the U.S. Public Sector (2013)[19].

ISO 14064.1 (2006)

Referred to as ISO 14064.1-2006[20] in Australia, this standard specifies principles and requirements at the organisational level for quantification and reporting of greenhouse gas (GHG) emissions and removals. It includes requirements for the design, development, management, reporting and verification of an organisation's GHG inventory. It is 'harmonised' with the GHG Protocol and is almost identical in its requirements.

Note that ISO 14064.2 is similar to 14064.1, but covers project-level accounting. 14064.3 covers the verification of inventories and reports. The GHG Protocol provides guidance on verification in its Corporate Standard and provides guidance on the project level in a separate document[21].

NCOS

The National Carbon Offset Standard (NCOS) for Organisations was released on 1 July 2010. It provides guidance on what constitutes a genuine, additional voluntary offset. It sets minimum requirements for the verification and retirement of voluntary carbon credits and provides guidance for calculating the carbon footprint of an organisation or product for the purpose of achieving 'carbon neutrality'. It specifies the GHG Protocol as the underpinning approach to carbon 'footprinting' for an organisation.

NGER

The National Greenhouse and Energy Reporting (NGER) Scheme is discussed in more detail at the end of this guide. NGER is based on the GHG Protocol methodologies.

NCOS and NGER will be discussed in further detail in later sections of this Unit.

Aside from setting principles and standards to follow, methodologies help us through the carbon accounting processes of:

- Alignment with organisation goals.
- Setting boundaries.
- Identifying and calculating emissions and energy reductions.
- Managing quality.
- Reporting emissions.

[15] Accessed here: https://ghgprotocol.org/sites/default/files/standards/Scope%202%20Guidance_Final_0.pdf

[16] Accessed here: https://ghgprotocol.org/sites/default/files/standards/Corporate-Value-Chain-Accounting-Reporing-Standard_041613_2.pdf

[17] Accessed here: https://ghgprotocol.org/sites/default/files/standards/Scope3_Calculation_Guidance_0.pdf

[18] Accessed here: https://ghgprotocol.org/sites/default/files/standards/ghg_project_accounting.pdf

[19] Accessed here: https://ghgprotocol.org/sites/default/files/standards/us-public-sector-protocol_final_oct13.pdf

[20] Info: http://infostore.saiglobal.com/store2/Details.aspx?ProductID=342525

[21] Info: http://www.ghgprotocol.org/standards/project-protocol

- Verification.

Science-based targets

A science-based target (SBT) is an emissions reduction target that is aligned to the level of decarbonisation required to keep global temperature increase below 2°C of pre-industrial levels. Over time, the expectation of what constitutes a science-based target (SBT) may change to reflect advances in economic modelling, climate science, and global emissions reduction efforts.

The key components of an SBT method are the carbon budget, the emissions scenario and the allocation approach. The SBTi recognises different methods to set targets and the Science-based Target Setting Manual Version 3.0 provides guidance on selecting methods. Two methods that could be used for local governments include the Sectoral Decarbonisation Approach (SDA) method and the Absolute Emissions Contraction (AEC) method.

At present, SBTs are mostly defined for corporations or corporate operations of organisations such as councils. It is not mandatory to get an SBT verified and approved by the SBTi; however, submitting it for review and approval is required if organisations want to be recognised on the SBTi website.

'Foundations' webinar. Log into your OpenLearning account here to access the recorded webinar on Module 1 Foundations.

Optional background reading and reference materials.

- The GHG Protocol. Introduction and Chapter 1: GHG Accounting and Reporting Principles:
  http://www.ghgprotocol.org/standards/corporate-standard
- Science-based Target Setting Manual:
  http://sciencebasedtargets.org/wp-content/uploads/2017/04/SBT-Manual-Draft.pdf
- National Carbon Offset Standard for Organisations: http://www.environment.gov.au/system/files/resources/d24bb1e1-3c93-4a78-98b0-61a8e506821c/files/ncos-organisations.pdf

Quizzes and assessments. Log into your OpenLearning account here to access Unit 1 Module 1 quiz.

Module 2. Accounting boundaries

The inventory boundary

One of the principles of the GHG Protocol is 'completeness', in which it states: *"All relevant emissions sources within the chosen boundary need to be accounted for so that a comprehensive and meaningful inventory is compiled."*[22]

The GHG Protocol describes **two types of boundaries, organisational and operational** – refer to Figure 1.

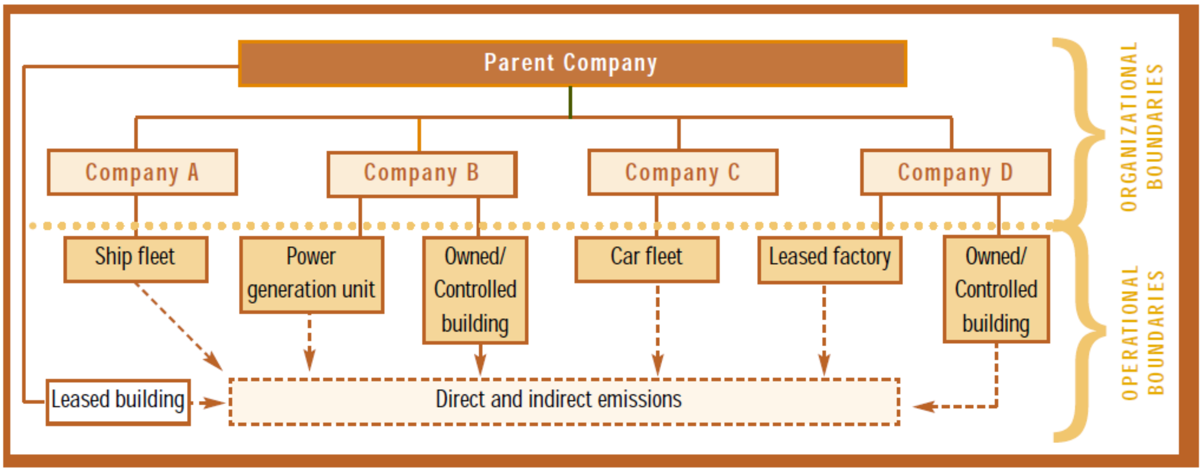


Figure 1. Organisational and operational boundaries (for a complex organisation)[23]

Organisational boundaries provide clarification when organisations vary widely in their structures, operations and ownership. Operational boundaries define the Scope of direct and indirect emissions within the established organisational boundary. The combination of the organisational and operational boundaries together constitutes the **inventory boundary**.

The selection of the boundaries is dependent on the characteristics of the company, the intended purpose of information and the needs of the inventory users/audience. When deciding on the inventory boundary, a number of factors should be considered, such as:

- Organisational structures: control (operational and financial), ownership, legal agreements, joint ventures, etc.
- Operational boundaries: on-site and off-site activities, processes, services, and impacts.
- Business context: nature of activities, geographic locations, industry sector(s), purposes of information, and users of information.

Organisational boundaries

The organisational boundary defines which organisations or parts of organisations are included or excluded for the purposes of GHG accounting and reporting. Two approaches that can be used to set organisational boundaries are ownership or control. They are described below.

- **The Control approach**
  Under the control approach, a company accounts for 100% of the GHG emissions from operations over which it has control. It does not account for operations in which it owns an interest but has no control. When selecting this approach, organisations must choose between 'operational control' and 'financial control'. The difference between operational and financial control for government entities is examined in the *GHG Protocol for the U.S. Public Sector*[24].

[22] Ref: The GHG Protocol: http://www.ghgprotocol.org/files/ghgp/public/ghg-protocol-revised.pdf, p.8

[23] Source: The GHG Protocol: http://www.ghgprotocol.org/files/ghgp/public/ghg-protocol-revised.pdf, p.25.

[24] Refer to Table 3.1 of the Standard on page 20

Under NGER, the entity with operational control is deemed responsible for reporting of emissions from that organisation. This is defined as an organisation which has the authority (or greatest authority) to introduce and implement operating policies, health and safety policies or environmental policies.

- **The Equity Share approach**
  Under the equity share approach, a company accounts for GHG emissions from operations according to its share of the equity (ownership/economic interest) in the organisation. Other equity holders will account for GHGs associated with their own shares.

  Where the percentage of equity share is different to the percentage of legal ownership, the percentage of equity overrides the legal form. This approach is not commonly used to determine the organisational boundary for local governments.

More details on the definitions are available on page 18 of the *GHG Protocol Corporate Standard*.

Setting organisational boundaries: an example

Council A owns over 200 facilities and assets on Council-owned land and wants to assess whether to include several leased premises in its boundary: Sports Pavilions A and B, Child-care centre C, Community hall D and Commercial building E.

Council decides to adopt the operational control measure since it owns all premises listed above. As Council A funds all building upgrades and sets the terms of the lease for buildings A, C and D, these are all included in the boundary. Council does not have any control over health and safety policies at building E and is not required to manage the building, and thus excludes E from its inventory.

Council is unsure whether it has operational control over building B, and elects to consult with community members whose general expectations were for Council to include this building in its inventory. The building also contributes 3% of Council's total GHG emissions, therefore Council decides to include it in the boundary.

Operational boundaries

The operational boundary defines which emissions sources are included or excluded and how those sources are categorised. They are set after the organisational boundaries have been defined.

This involves the following **steps**:

1. identifying emissions associated with the organisation's operations;
2. categorising them as direct and indirect emissions;
3. choosing the Scope of accounting and reporting for indirect emissions.[25]

Having first identified the various sources of emissions (see *Emissions sources in the workplace*), they then need categorisation. There are two primary categories of emissions:

- **Direct** – emissions from sources owned or controlled by the organisation.
- **Indirect** – emissions due to the organisation's activities, but occurring from sources owned or controlled by another organisation.

Setting operational boundaries requires the use of carbon accounting **Scopes**.

[25] Ref: GHG Protocol: http://www.ghgprotocol.org/files/ghgp/public/ghg-protocol-revised.pdf, ch 4, p. 24.

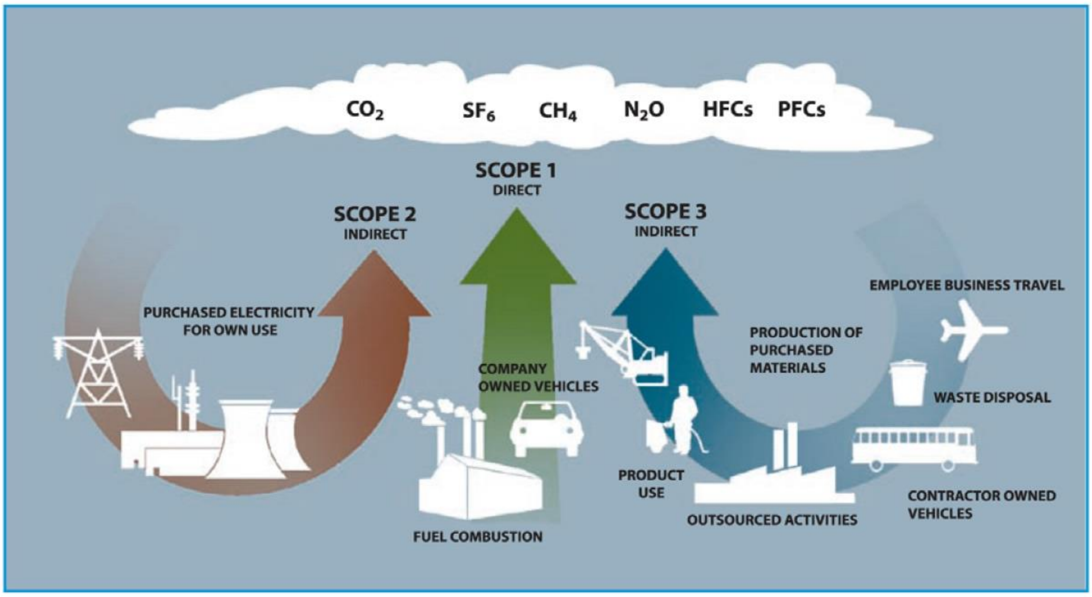


Figure 2. Scopes with example GHG emissions [26]

Scopes

The concept of Scopes has been introduced by the GHG Protocol to:

- categorise direct and indirect emissions;
- avoid double counting of emissions (i.e. more than one organisation reporting the same emissions);
- improve transparency;
- provide utility for different reporting needs and goals.

There are three Scopes defined for carbon accounting and reporting purposes. Together they provide a comprehensive accounting framework for managing and reducing direct and indirect emissions.

> ***The Scopes are defined as:***
>
> *Scope 1: Direct GHG emissions – emissions from sources owned or controlled by the organisation.*
>
> *Scope 2: Electricity/Energy indirect GHG emissions – emissions from the generation of electricity, steam, heating/cooling which is purchased or imported by the organisation.*
>
> *Scope 3: Other indirect GHG emissions – emissions from other sources related to the activities of the organisation.*

Table 2 expands on these definitions:

Scope	Emissions type	GHG Reporting	Includes emissions from the following types of activities
1	Direct	Mandatory	• **Generation of electricity, steam and heating/cooling.** *Emissions resulting from the combustion of fuels in stationary sources inside the organisational boundary, such as natural gas combustion for heating.* • **Transportation of materials, products, waste and employees.** *Emissions resulting from combustion of fuels in company owned/controlled plant and vehicles.*

[26] Source: The GHG Protocol: http://www.ghgprotocol.org/files/ghgp/public/ghg-protocol-revised.pdf, p.26.

			• **Fugitive emissions.** *Emissions resulting from intentional or unintentional releases of GHGs, such as methane emissions from landfills or refrigerant leaks from air conditioning units.*
2	Indirect	Mandatory	• **Purchase of electricity, steam and heating/cooling.** *Emissions resulting from the combustion of fuels in stationary sources outside of the organisational boundary.*
3	Indirect	Optional – but increasingly considered a key component of carbon inventories	• **Materials and fuels.** *Emissions resulting from the extraction, production and distribution of purchased materials and fuels.* • **Transport related activities.** *Emissions resulting from the transportation of goods, employees, products and waste.* • **Electricity related activities (not included in Scope 2).** *Emissions resulting from the extraction, production and transportation fuels consumed in the generation of electricity. Also resulting from electricity transmission and distribution losses.* • **Leased assets, franchises and outsourced activities.** *Emissions resulting from contractual arrangements. These may be Scope 1, depending on whether the Equity or Control approach was applied in setting the Organisational boundary.* • **Waste disposal.** *Emissions resulting from the disposal of waste generated by: operations, production of materials or fuels, end of life disposal of sold goods.*

Table 2 - The three Scopes for setting operational boundaries[27]

Scope 3 sources: an in-depth look

Scope 3 emissions include 'all other' indirect emissions sources and have no pre-set boundaries. The *Corporate Value Chain (Scope 3) Accounting and Reporting Standard* (World Resources Institute & WBCSD, 2013) outlines a list of categories of Scope 3 sources that should be considered in a carbon inventory. When considering which of these sources to report on, one must set appropriate limits (inclusions and exclusions) to obtaining data with regard to effort, time and cost. Inclusions and exclusions will be set in accordance with the intentions (carbon accounting drivers) of the organisation and the relevance and materiality of each emissions source.

For example, if an organisation is reporting its emissions to comply with Australian regulations, it may choose not to include any emissions under Scope 3. If an organisation is reporting for voluntary reasons, it may choose to include as many Scope 3 sources as it can reasonably measure.

Identifying Scope 3 emissions requires consideration of the organisation's supply chain or value chain[28], including both upstream and downstream activities:

1. **Upstream** – the activities of suppliers of goods and services to your organisation, including outsourcers.
2. **Downstream** – the activities of consumers who receive the goods and services of your organisation.

These two would be in addition to your own organisation's activities which may be included under Scope 3.

[27] Ref: The GHG Protocol: http://www.ghgprotocol.org/files/ghgp/public/ghg-protocol-revised.pdf, p.p.27-30.

[28] Info: http://en.wikipedia.org/wiki/Value_chain & http://en.wikipedia.org/wiki/Supply_chain

Decisions on which sources are to be included in the inventory should take into account the following factors:

- The **size** of the Scope 3 emissions from a given source, relative to Scope 1 and 2 emissions. source.
- The **contribution** of those emissions towards the organisation's risk exposure.
- The **interest** of stakeholders in that particular source.
- The **potential** for the organisation to reduce those emissions or influence their reduction.

Data for Scope 3 emissions sources may often be collected from outside of the organisation or from less reliable documentation internally. It is therefore accepted by the GHG protocol that it may tend to be of lower quality and accuracy. Data availability and reliability may influence which Scope 3 activities are included or excluded from the inventory.

For non-regulatory reporting, exclusions may be made from any Scope if those exclusions are justified and transparently reported. Justifications for including or excluding sources are given below.

All exclusions must be clearly stated and justified when documenting or reporting on the carbon inventory. A table is a suitable format for such information, or it may be included in the boundary diagram.

The concepts of relevance and materiality

Two tests guide the inclusion or exclusion of emissions sources within the operational boundary of an organisation:

- The materiality of a source – applicable to both direct and indirect emissions (Scope 1, 2 and 3)
- The relevance of a source – applicable to Scope 3 emissions only.

Materiality

According to the NCOS for Organisations, if a relevant emissions source is material, it must be included in the boundary unless sufficient justification is provided to show that the source cannot feasibly be assessed. The NCOS states that an emissions source that constitutes 1% of the total inventory is considered to be material. In addition, the total amount of emissions to be excluded from the boundary must not exceed 5% of the total carbon accounts.

The availability of data can be considered when assessing materiality. If data from an emission source is not available, an approximation of data (such as using known case studies or input-output factors) can be used to assess materiality in the absence of more reliable data. If the source is estimated to be material, the organisation may put steps in place to gather better data. Interim estimates of emissions can be used in the meantime to include the source in the inventory. Conversely, if the source is deemed immaterial, the organisation can choose not to include it in the inventory, provided justification for exclusion is appropriately documented.

If a Scope 1 or 2 emissions source is deemed material, it must be included in the inventory.

Most emissions from local governments will be attributed to emissions from landfill, electricity and gas use from facilities and parks, plant and vehicle fuel use, contractor fuel use, employee commuting and purchased goods and services.

Relevance

The NCOS for Organisations further defines the **relevance principle** included in the GHG Protocol to specify a test to decide which Scope 3 emissions sources are to be considered 'relevant'. Under the 'Relevance Test', sources are deemed relevant when any two of the following conditions are met:

- the Scope 3 emissions from a particular source are likely to be large relative to the organisation's Scope 1 and Scope 2 emissions
- the Scope 3 emissions from a particular source contribute to the organisation's greenhouse gas risk exposure
- the Scope 3 emissions from a particular source are deemed relevant by key stakeholders
- the responsible entity has the potential to influence the reduction of Scope 3 emissions from a particular source

- the Scope 3 emissions are from outsourced activities that were previously undertaken within the organisation's boundary or from outsourced activities that are typically undertaken within the boundary for comparable organisations.

If a Scope 3 emissions source is deemed relevant AND material (see below), it should be included within the emissions inventory.

Example of inclusion

Emissions from flights are a Scope 3 source (unless the organisation is an airline). A sales organisation which flies its staff for meetings might find the emissions related to those flights could constitute 50% of its total GHG emissions if included in its inventory. They might therefore choose to include emissions sourced from air travel within their inventory, and consider opportunities for emissions reductions through alternative travel modes or increasing the use of video conferencing.

Example of exclusion

Scenario: emissions related to leakage of refrigerant from a single refrigerator in the organisation's canteen cannot be calculated because no data is available and the fridge cannot be moved.

Since the emissions from this fridge are likely to be less than 1% of their total emissions inventory and there aren't any reasonable options available to reduce those emissions, it may be worth declaring them 'immaterial'. They may thus be excluded.

Documenting your inventory boundaries

Organisational and operational boundaries should be clearly reported so that stakeholders can clearly identify what the boundary encompasses. If emissions sources have been excluded from the boundary based on materiality or a lack of viable data, this should also be clearly documented. By documenting data gaps, an organisation can plan procedures and systems to fill these gaps in future emissions inventories. For guidance on filling data gaps, refer to *Emissions sources in the workplace* below to understand what data needs to be collected for each source.

An example of a representation of a Council's operational boundary is provided below.

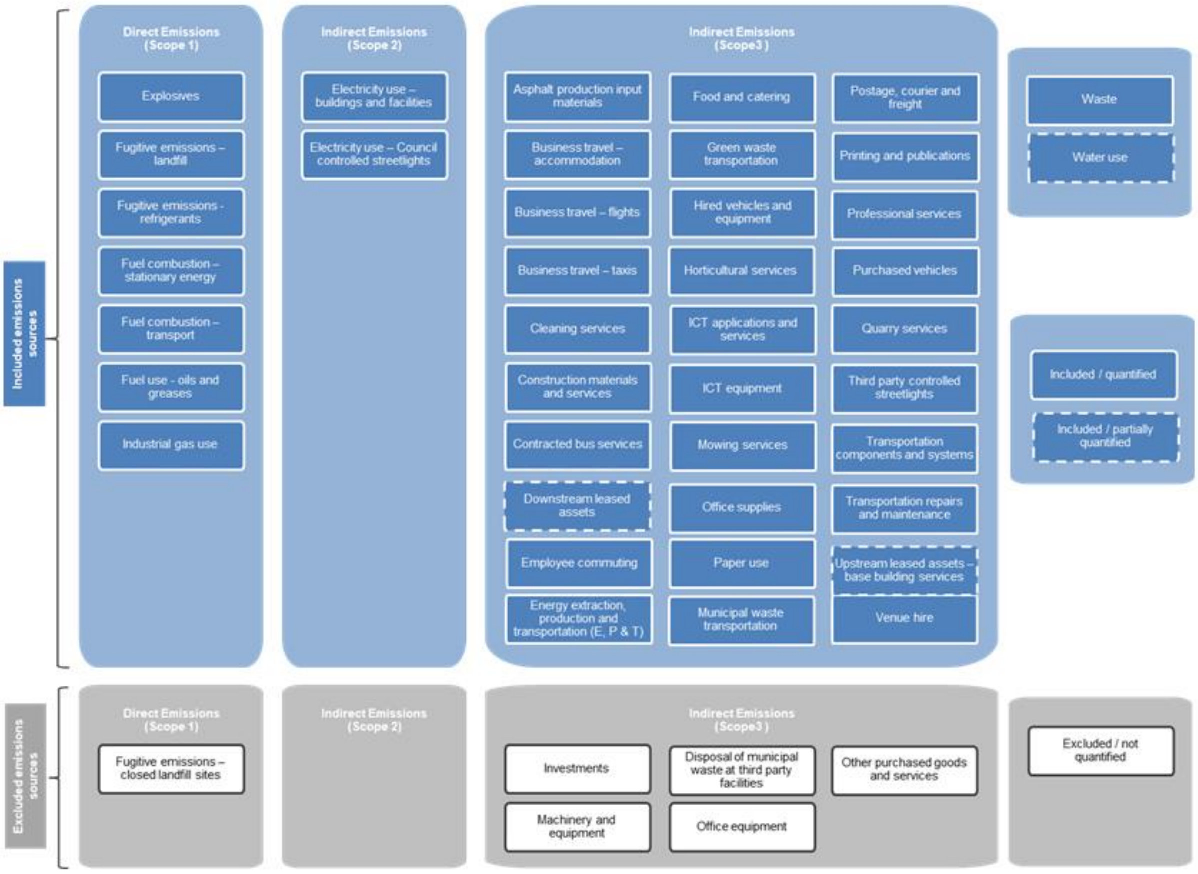


Figure 3. Example of operational boundary representation

'Accounting boundaries' webinar. Log into your OpenLearning account here to access the recorded webinar on Module 2 Accounting boundaries.

Optional background reading and reference materials.

- The GHG Protocol. Chapter 1: GHG Accounting and Reporting Principles – Completeness; Chapter 3: Setting Organisational Boundaries; Chapter 4: Setting Operational Boundaries: http://www.ghgprotocol.org/standards/corporate-standard
- The GHG Protocol. Corporate Value Chain (Scope 3) Accounting and Reporting Standard: https://ghgprotocol.org/standards/Scope-3-standard

Categorising carbon reductions, removals and offsets

Emissions are categorised within the three Scopes as described in '*Organisational and operations boundaries*'. But how do we categorise carbon reductions, removals and offsets within an inventory?

Emission reductions are recorded separately (see 'Reduction measures' in Figure 7). Some examples of these carbon reductions, removals and offsets include:

- The purchase of accredited GreenPower[29]
- The purchase of carbon offset certificates
- The purchase of certified offsets from local or international markets.

The principle being applied here is that we first account for (and report) an organisation's emissions within the three Scopes. This results in a total carbon footprint. We then separately account for actions which have been undertaken to reduce, remove or offset any of those emissions.

We would not include reductions such as "we now use less electricity because we turn off the lights more often, so that's a carbon emissions reduction". Since turning off the lights reduced the actual emissions activity in the first place, this reduction would already be reflected in your Scope 2 values (for electricity). This is a concept better understood through the carbon management principles which we will come to later.

Optional background reading and reference materials.

- The GHG Protocol. Chapter 8: Accounting for GHG Reductions http://www.ghgprotocol.org/standards/corporate-standard

Emissions sources in the workplace

In this section we review the specific sources of carbon emissions related to the operations of organisations/workplaces, and in particular, local governments.

Emissions sources are defined as those activities which result in the release of carbon dioxide (or other GHGs) to the atmosphere. These emissions may occur directly from that source (e.g. on site burning of natural gas) or indirectly (emissions sourced from the use of purchased electricity).

Once identified, all emissions sources must be documented and considered for inclusion in the carbon inventory (known as operational boundary).

Scope 1 and 2 emissions sources relevant to local governments

An important skill necessary for developing a carbon inventory for an organisation is to identify their emissions sources. This may involve consultation with key stakeholders including management, staff and accountants. It may also involve site visits and walk-around audits and some other forms of research.

There are many potential emissions sources in the workplace. Each workplace will be slightly (or very) different depending on a range of factors such as its role, primary function, location, management etc. For local governments, common Scope 1 and 2 emissions include:

- **Purchased electricity**

  Council's operation of its facilities, parks, and public lighting is dependent on purchased electricity. Emissions associated with purchased electricity are often the dominant source of emissions in local government inventories. Note that 'purchased' indicates that it is generated off site (usually at a central power station) and delivered by the grid.

  In Victoria, most electricity is generated by centralised, coal-fired power stations[30]. The emissions result from the burning of coal which heats water to create steam. The steam drives turbines, which turn the generators to produce electricity.

[29] Note: NCOS provides the methodology for reporting GreenPower as part of a GHG inventory in Australia.

[30] Ref: http://www.australiancoal.com.au/coal-and-its-uses_coal-uses-overview_electricity-generation.aspx

Emissions from purchased electricity are not created at the point of use. Compare this with burning gas in the canteen oven or burning fuel in the company car. For this reason, electricity is defined as a Scope 2 emissions source[31]. It is used within the consumer's premises or location, but the emissions are created elsewhere, by the generator.

Two 'Deep dives' (number 1 and 2) are provided in Module 3 with information on how to estimate emissions from:

- Electricity use in office buildings and other facilities; and
- Electricity use for public lighting.

- **Natural gas**

  Natural gas is usually burned on site to heat the workplace, provide hot water or to operate a cooktop in the canteen. Note that natural gas is actually methane, one of the six Kyoto gases.

- **Waste and landfill emissions**

  If a local government operates a landfill within the local government area, emissions from the landfill could account for a substantial proportion of total emissions. Emissions from landfill occur when organic matter in disposed waste decomposes, forming (predominantly) methane and carbon dioxide. These greenhouse gases seep through the ground into the atmosphere as fugitive emissions.

  Landfills that:

  - are owned and operated by Council are a Scope 1 emissions source to be included in the inventory.
  - are operated by a third party are likely to be a Scope 3 emissions source if Council previously operated the landfill, or if the landfills accepts municipal solid waste (MSW). This should be confirmed using the Relevance Test.

  If Council does not operate a landfill within its municipality, it should include corporate waste emissions as Scope 3 emissions in its GHG inventory.

  Information on how to calculate emissions from landfills or from corporate waste is provided in 'Deep Dive 3' in Module 3.

- **Transport fuels**

  Diesel, petrol, LPG and biofuels used in company vehicles such as cars, trucks, tankers, vans and buses.

- **Refrigerants**

  Refrigerants are usually hydrofluorocarbons (HFCs) (refer to table 1) and are often powerful GHGs with long lifetimes in the atmosphere. Refrigerants are found in domestic (canteen) fridges, commercial and retail chillers and fridges, office air conditioning systems and air-conditioned cars. Examples of common refrigerants found in the workplace are R22 and R134a. Appliances purchased after ~2015 onwards may use less harmful 'natural' refrigerants such as ammonia (R717) and carbon dioxide (R744). HFCs in cooling appliances can be removed by decommissioning the unit (by a qualified contractor), or reduced by treating existing refrigerants (to ensure minimal leakage). Retrofitting units to replace the HFC refrigerant with a natural refrigerant is also possible, but often expensive and not as common.

  Information on how to calculate fugitive emissions from refrigerants is provided in 'Deep Dive 4' in Module 3.

Scope 3 sources relevant for local governments

Once the Scope 1 and 2 emissions have been identified and quantified, Councils might want to investigate other sources which may be applicable to the organisation.

Other areas to scrutinise for emissions sources are within the supply chain: Scope 3 emissions sources. This involves looking upstream at the organisation's suppliers and downstream at the customers and outsourcers, contractors and other service providers. One considers what activities in these areas may be included in its own inventory for reasons of completeness or compliance with the intentions (drivers) of the inventory exercise.

[31] Note: this is for grid supplied electricity and does not apply to electricity generated onsite by (for example) a stand-alone petrol powered generator.

The following Scope 3 sources have been reported by local governments under NCOS in Victoria:

- Leased assets
- Business travel of employees
- Waste created from Council operations
- Paper use
- Contractor fuel use (including waste contractors, road construction, horticulture services, etc)
- Asphalt and cement production
- Corporate water use (explained in more detail below).

In addition, the following sources are likely to be reported by local governments in the future:

- Employee commuting
- Purchased goods and services, such as vehicles purchased, consulting services of Council, etc.

Further detail on the major sources listed above is included below.

Leased assets

Local governments typically own numerous sites and assets that are leased to community groups and other organisations. These facilities are generally included in the organisational boundary. As a landlord, whether a facility is included under Council's direct or indirect emissions will depend on operational control, as described above.

At these sites, local governments may be responsible for building maintenance and management, and setting conditions on the lease (operating hours, policies, and fees). Community use typically includes sports clubs, pre-schools, community centres, and halls. Conversely, if Council leases a building to a for-profit business under a commercial agreement, the facility may not be deemed relevant to the inventory.

Local governments may have difficulty in obtaining utility bills when they are paid by a lessee. A potential solution to reduce the time and resource burden associated with collecting this data would be to require lessees to record and submit their bill data as a condition in the leasing arrangement. It is also important to remember that data collection efforts should always be reflective of how material an emissions source is. When data is not available for the most recent reporting period, a local government should consider developing a data management plan to start collecting this information for future reporting periods.

Business travel of employees

This covers all staff travel for work purposes including flights, public transport use, taxis, and rental cars.

Emissions from flights can be calculated by tracking all flights made by staff over the year and entering the flights into https://calculator.carbonfootprint.com/calculator.aspx?tab=3.

Emissions from public transport, taxis, and rental cars can be calculated by estimating the total distance travelled by staff in each mode. For taxis, distance could be based on spend (assuming around $1.80 per kilometre, minus a $5 flag fall per trip). An average trip distance (around 10-20 km) can be assumed for public transport and rental car trips if the actual trip distance is unknown. EPA Victoria (publication 1562, page 29)[32] provides emission factors for these transport modes.

Waste created from Council operations

This source is discussed in further detail in 'Deep Dive 3' in Module 3.

Paper use

Organisations often track the number of reams of paper purchased for business operations. EPA Victoria provides emission factors for paper use in publication 1374[33].

The key information required to account for emissions from paper use is as follows:

- Total reams of paper used, noting that one ream of paper is equal to 500 sheets of paper

[32] Accessed here: https://www.epa.vic.gov.au/~/media/Publications/1562.pdf

[33] Accessed here: https://www.epa.vic.gov.au/~/media/Publications/1374%201.pdf

- The total weight of paper used – this can be calculated by assuming each ream of A4 paper weighs 2.5 kg, and one A3 sheet is equal to two A4 sheets.
- Whether the paper is imported or Australian made, as different emissions factors apply
- The recycled content of the paper, i.e. 50% recycled, 100% recycled, etc.

When the purchased paper is certified carbon neutral, there is no emissions associated with its use.

Contractor fuel use

Emissions from contractor fuel use are often a significant component of a local government's Scope 3 inventory. The most practical way to estimate emissions is to get contractors to report on their total quantities of fuel used for Council work. For example:

- Asphalting contractor A reports a total of 4,500 litres of diesel used over 12 shifts of asphalt laying
- Waste contractor B reports 9,400 litres of diesel used for its waste trucks
- Horticulture contractor C reports 400 litres of ULP used during its shifts servicing Council's parks

Total fuel use would be the sum of all listed items above, totalling 13,900 litres diesel and 400 litres ULP.

NGA emissions factors can be applied to the quantity of fuels calculated. Best practice is for Councils to use both Scope 1 and Scope 3 emissions factors when calculating emissions from contractor fuels.

Asphalt and cement production

Emissions from asphalt production input materials comprise two main sources:

- From the embodied energy content of the bitumen (a crude oil) – with emission factors sourced from NGA factors Table 3 (Scope 1) and Table 40 (Scope 3)
- From the embodied energy of recycled asphalt, sand, and aggregate used in the asphalt – with emissions factors per tonne used provided in Transport Authorities Greenhouse Group, Greenhouse Gas Assessment Workbook for Road Projects (2013)[34].

Corporate water use

An emissions factor for water use can be calculated according to the method used by EPA Victoria in its Greenhouse Gas Inventory, referenced in *Guidance for Scope 3 Calculations* (Department of Environment, 2016).

The method combines water and wastewater and calculates an emission factor by dividing total water use from the relevant water authority by their total reported emissions. For local governments across multiple water authorities, carbon emissions and total water use should be summed across the authorities.

For example, North-East Water published net greenhouse gas emissions in their 2016-17 report as 37,737 tCO_2-e and total water use as 13,824 ML. Hence the factor would be:

$$37{,}737\ tCO_2\text{-e} / 13{,}824\ ML = \underline{2.73\ tCO_2\text{-e/ML}}.$$

A local government would then sum potable water use (in ML) and multiply this by the emissions factor.

Employee commuting

A travel survey issued to all staff is the best way to estimate emissions from staff commuting to and from work. The travel survey should, at a minimum, identify the number of trips by mode of transport for every employee (scaling trips per week to average trips per year). The survey could also identify the travel distance of each trip and along user-preferences to help understand how Council can influence mode choice (for example, by building end-use facilities for cyclists to encourage more active transport).

When the total travel distance of all employees is calculated, emissions factors from EPA Victoria (publication 1562 – referenced above under business travel) can be applied to estimate emissions.

Purchased goods and services

Emissions from services can be obtained in a relatively straightforward way – by requiring all service contractors to report their Scope 1 and 2 emissions from their energy use, transport fuel, waste, and any other

[34] Accessed here: http://www.rms.nsw.gov.au/documents/about/environment/greenhouse-gas-assessment-workbook-road-projects.pdf

activities generating a large amount of emissions. Local governments can also require contractors to manage and reduce their emissions over time. Supporting contractors to do this will make the process easier for everyone.

Embodied energy from purchased goods is the hardest source to estimate Scope 3 emissions. The upside is that accounting for these emissions will allow Council to influence its entire supply chain. You have already accounted for embodied emissions associated with asphalt production above!

Purchased goods by local governments include new vehicles, building materials (timber, cement, etc) and office equipment. Products can be purchased in the market that have been certified carbon neutral – thus no emissions result from these goods.

To estimate emissions from purchased goods, refer to the *GHG Protocol – Category 1: Purchased Goods and Services* guidance[35]. By managing your emissions from purchased goods and services, you are helping to amplify market demand for carbon neutral goods and services.

'Accounting boundaries' webinar. Log into your OpenLearning account here to access the recorded webinar on Module 2 Accounting boundaries.

Optional background reading and reference materials.

- The GHG Protocol. Chapter 4: Setting Operational Boundaries: http://www.ghgprotocol.org/standards/corporate-standard
- The GHG Protocol. Corporate Value Chain (Scope 3) Accounting and Reporting Standard:

  https://ghgprotocol.org/standards/Scope-3-standard

Quizzes and assessments. Log into your OpenLearning account here to access Unit 1 Module 2 quiz.

[35] Accessed here: https://ghgprotocol.org/sites/default/files/standards_supporting/Chapter1.pdf

Sustainability Victoria   Point. Advisory

Module 3. Develop a carbon inventory

Data collection and collation

Calculating emissions requires the use of activity data related to the emissions source. Activity in this context is the amount of consumption (or generation), by the organisation, associated with that source. For example, if electricity (Scope 2) is identified as a source of carbon emissions, then it will be necessary to collect data to find out how much electricity was used. The inventory will cover a given time period, usually one year, which could be a financial year or a calendar year.

If Council does not have data on direct sources of emissions, it may be possible to estimate emissions based on informally kept information.

The format, quality, completeness, accuracy and availability of that data will depend on the type of organisation, how large it is, the availability and efficiency of its systems and processes, how the data is stored (electronic or physical) as well as who controls the data. Local governments should collect and assess data based on materiality and accuracy, focusing on quantifying major emission sources first and those sources where one particular method is preferred over a high-level estimate.

Time

Data collection and collation can be a time-consuming exercise. As explained in Module 2, inventories should focus on those emissions sources that are material to the organisation. Therefore, Councils should bear in mind the materiality of each emissions source when deciding how to better spend their time in collecting relevant data. Obtaining accurate data for more material emissions sources should be prioritised over less material ones.

Process

Returning to our electricity example: our organisation will be the customer of an electricity retailer and will receive regular bills which provide not only the billed amount in financial terms ($), but also provide other relevant details, such as how much electricity has been consumed. As such, in collecting the data for this source we now know we need to:

- Contact the relevant department within the organisation.
- Ask for all of the electricity bills for a given period (e.g. the last financial year). Or ask the retailer for that information.
- Record and total the amounts of those bills.
- Calculate the emissions.

But, what data do we need from those bills and what data will be available from the organisation? The data we need will be dictated by the Emissions Factor (EF, see the next topic). If the emissions factor requires activity data for electricity to be in kilowatt hours (kWh), then the value of the bills in dollars is of little use. That’s OK because electricity bills usually provide that kWh figure.

So, we ask for all electricity bills for the appropriate time period. You are directed to the finance department and they provide you a spreadsheet with a table showing how much their electricity costs (in $) for the required period. You know this is no good, so you ask for copies of the original bills. You may need to be persistent as they may tell you they don’t keep them, or the bills are archived in storage, or they have them to hand and will copy them for you.

Once you have copies in hand, you then sift through them and extract the data you need. Not too difficult. But what if the bills are in archives and the finance department is too busy to help you, or the head of finance does not support the idea of building an emissions inventory? There are numerous organisational, political or personnel reasons why getting the data from the organisation may not be straightforward. One broad solution to this is to get a mandate from the top management of the organisation to conduct the exercise of building the inventory. Having this communicated to all relevant staff would help oil the wheels. But this aspect of data collection will very much depend on the organisations drivers for initiating the project. It will also depend on who initiated the project.

Nonetheless, there is always a way to navigate through the type of data that can be provided. Some local governments have agreements in place to obtain utility data directly from a retailer to assist in compiling the emissions inventory. In these setups, the retailer will have a list of the National Meter Identifiers (NMIs) associated with all of its electricity accounts covering all of its facilities.

Missing data

Back to our electricity example again: we get over the organisational restrictions and we have the data in hand, but find some of it is missing – two months out of the year cannot be accounted for. To make a complete data set in such a case, we could use the meter readings shown on the bills. The meter reading on the final bill minus the meter reading on the first bill will give us the kWh consumption for the whole period. This will apply to other forms of fuel billing, such as natural gas, but not to all forms.

If billing data is missing and cannot be calculated from hard data, one must extrapolate or interpolate[36] the data as best we can. Having done so, it is a requirement of the GHG Protocol that we transparently and clearly declare this as part of the inventory being reported.

If data is extrapolated or interpolated, factors such as seasonality should be considered. If gas data is missing for winter, interpolating data based on summer gas use may underestimate gas consumption. This could happen where the organisation uses gas to heat its premises during winter and the consumption increases dramatically for those few months of the year. On the other hand, if the facility is an outdoor pool which closes for the winter season, then no gas is used during the period and consumption would be overestimated. Other cycles include the use of sports clubs for summer/winter sports only, pre-schools and school holidays, and corporate office closures over summer. No matter the approach to gathering, reconstruction or estimation of data, we must work to eliminate uncertainties. In other words, the fewer assumptions we make, the better the quality and reliability of the data.[37]

Data in the wrong units

What if there are no bills and the only data we have is in dollars? Then we must find a way to convert from dollars to kWh. How do we do that? We must find the tariff (rate of charge) for 1 kWh and divide that into the billed amounts. But the billed amounts also contain service and other charges not related to consumption. Therefore, we have to deduct the monthly standing charges in order to work out how much of the cost is consumption related. This may require some research, such as contacting the supplier to ask for more details. Or try asking the supplier for copies of their own records on behalf of your organisation.

So far, we have used electricity and gas as examples. Think about how the above situations could apply to gathering data around other examples, such as:

Scope 1 – Leakage of refrigerants - take for example air conditioners and other appliances.

Scope 3 - Business travel - flights, taxis, personal cars, expenses, hotel bills.

Scope 3 – Waste – the amount and type of waste which is generated by the organisation and whether it is recycled or sent to landfill.

Data quality & transparency

It is important that we use data that is as accurate and authentic as possible to develop the carbon inventory. Poor data may result in misrepresentation of the situation and be open to criticism from third parties. Take your data from the most reliable source possible. The finance department is often a good place to start. Even then, taking data from original bills rather than a printout of the financial accounting system is best. The purchasing department or facilities manager may also be appropriate sources of information.

[36] Info: *Extrapolation* and *Interpolation* are mathematical terms referring to the construction of new data points based on a set of existing data.

[37] Ref: The GHG Protocol: http://www.ghgprotocol.org/files/ghgp/public/ghg-protocol-revised.pdf, p.p. 53-56.

Where independent verifiers are involved in checking the inventory, they will check a sample of records by contacting suppliers. These suppliers are also an option available to us when gathering our data.

Whatever data you do collect, it is recommended to retain a copy of the information for future reference. This will be particularly important for future verification or if the organisation is reporting publicly. There should be a clear and complete audit trail from the data presented in the final inventory back to the original sources. Where this is not possible for operational or other reasons, this must be stated in the inventory notes and/or report.

The extent to which this process of quality and transparency is applied will depend very much upon the drivers behind the initiative.

Data for Scope 3 items is gathered from various points in the supply chain where the organisation may have little control or influence. For this reason, the GHG Protocol accepts that data accuracy for many Scope 3 items may be lower than for Scopes 1 and 2. Estimation of Scope 3 items is acceptable as long as there is transparency with regard to the estimation approach and the data used is adequate for the purposes of the inventory.

Benefits of effective data collection

Effective data collection over several years will enable a Council to:

- Measure progress on targets and identify sectors and emissions sources to focus on;
- Compare organisational and operational control boundaries when these boundaries change;
- Track the year-on-year performance of facilities (changes in electricity and gas use);
- Track the results of facility upgrades and other emission reduction measures across all sectors;
- Minimise errors in calculations and reporting; and
- Reduce the time taken to collate data and prepare the carbon report.

Summary

We can see that there are organisational and practical aspects to data gathering which must be considered when preparing to develop an inventory. These considerations need to be taken into account when, for example:

- setting the organisational and operational boundaries;
- deciding what emissions sources to include and exclude;
- deciding what level of 'materiality' is relevant;
- deciding what level of contact is appropriate (i.e. senior management or shop floor).

The bottom line here is that gathering data for the inventory is likely to be the most difficult and time consuming part of the carbon accounting process. The ability to work effectively with people and within organisations is an important skill in this regard.

Optional background reading and reference materials.

- The GHG Protocol. Chapter 7: Managing Inventory Quality – Data, Activity Data; and Chapter 6: Identifying and Calculating GHG Emissions – Collect activity data: http://www.ghgprotocol.org/standards/corporate-standard

Selecting emissions factors

Before completing the emissions calculations, emissions factors are required for each emissions source being included in the inventory.

An emissions factor (EF) is a number which allows us to convert a unit of an emissions related activity into a mass (weight) of GHGs released.

Examples of emissions factors[38]:

- Electricity (Victoria) – **1.08 kg CO_2-e/kWh** (Kilowatt hour);
- Natural Gas – **51.53 kg CO_2-e/GJ** (Gigajoule);
- Transport petrol - **67.62 kg CO_2-e/GJ.**

These examples show a mass of emissions per a given unit of activity. Please refer to *Using Emissions Factors* to understand the importance of units in this regard.

Emissions factors are developed by specialists in a number of ways, primarily by:

- calculations based on the chemical composition of the fuel being burned;
- estimations based on a life cycle analysis (LCA) of the activity.

They are available from a wide range of sources. There is no single authoritative source of EFs because of the wide range of emissions sources and local conditions throughout the world. An example of this is the EF for electricity consumption which varies widely depending on whether it was generated from renewable or fossil fuel energy sources. In Australia, each state and territory have a different factor based on this and the type of coal being burned.

Where emissions factor gaps exist, these may be filled by researching scientific studies to find or establish suitable factors. This is outlined below.

The order of preference for sourcing emissions factors:

Site specific data.

Governmental publications/regulations in the country of origin.

Scientific sources in the country of origin.

Credible commercial/non-commercial sources in the country of origin.

GHG Protocol Tools.

Factors from governments and other organisations in other countries.

As a new and evolving area of science, we may expect new and increasingly robust factors to emerge. For this reason, one should continue to monitor various information sources for the latest available information.

Carbon emissions calculators (such as for flights) are now frequently available on the internet and are provided by all types of organisations ranging from energy retailers, carbon offset providers and carbon consultants. These may or may not be:

- accurate
- relevant to a local situation
- apply the appropriate methodologies
- be transparent regarding the methodologies used.

For these reasons they are not recommended as tools to be used in developing an organisational carbon inventory in accordance with the GHG Protocol or ISO 16064-1. Hence, they are excluded from the list above.

In Australia, the federal government's Department of Climate Change and Energy Efficiency produces the **National Greenhouse Accounts (NGA) Factors**. The publication is available free on the internet and is updated approximately once a year.

[38] Source: NGER Measurement Determination (July 2017) Schedule 1. The factors used here are correct at time of writing, but are subject to change. Please refer to the latest version of the NGER Measurement Determination or NGER Technical Guidelines.

This is the primary source of emissions factors used on the course and when performing carbon accounting in Australia. This publication will provide the majority of the factors required for most Australian workplaces, but does not include third party/Scope 3 services such as taxi and airline travel, paper and water use. A sample table can be seen in Figure 4. NGA Factors is a summary of common factors extracted from the very comprehensive NGER Technical Guidelines.[39]

The NGA factors help calculate an inventory's Scope 1 and 2 emissions but not all of the Scope 3 emissions. This is because Scope 3 emissions sources are dependent upon the operations of upstream and downstream organisations. Those organisations should have the primary data available to calculate the emissions related to their products and services, based on their own use of the NGA factors.

Table 3: Fuel combustion emission factors - liquid fuels and certain petroleum based products for stationary energy purposes

Fuel combusted	Energy content factor (GJ/kL unless otherwise indicated)	Emission factor kg CO_2-e/GJ (relevant oxidation factors incorporated)		
		CO_2	CH_4	N_2O
Petroleum based oils (other than petroleum based oil used as fuel, eg lubricants)	38.8	13.9	0.0	0.0
Petroleum based greases	38.8	3.5	0.0	0.0
Crude oil including crude oil condensates	45.3 GJ/t	69.6	0.1	0.2
Other natural gas liquids	46.5 GJ/t	61.0	0.1	0.2
Gasoline (other than for use as fuel in an aircraft)	34.2	67.4	0.2	0.2
Gasoline for use as fuel in an aircraft (avgas)	33.1	67	0.2	0.2
Kerosene (other than for use as fuel in an aircraft)	37.5	68.9	0.0	0.2
Kerosene for use as fuel in an aircraft (avtur)	36.8	69.6	0.02	0.2
Heating oil	37.3	69.5	0.03	0.2
Diesel oil	38.6	69.9	0.1	0.2

Figure 4. NGA Factors July 2018 - sample table[40]

Optional background reading and reference materials.

- The GHG Protocol. Chapter 6: Identifying and Calculating GHG Emissions: http://www.ghgprotocol.org/standards/corporate-standard
- National Greenhouse Accounts Factors: https://www.environment.gov.au/system/files/resources/5a169bfb-f417-4b00-9b70-6ba328ea8671/files/national-greenhouse-accounts-factors-july-2017.pdf

[39] Ref: http://www.environment.gov.au/climate-change/climate-science-data/greenhouse-gas-measurement/nger/technical-guidelines

[40] Source: NGA Factors: http://www.environment.gov.au/system/files/resources/80f603e7-175b-4f97-8a9b-2d207f46594a/files/national-greenhouse-accounts-factors-july-2018.pdf, July 2018.

Scope 3 emissions factors

Generally, emissions factors are provided to account for the calculation of direct emissions, i.e. Scope 1, and indirect emissions from purchased electricity, i.e. Scope 2.

Can we use those direct emissions factors for Scope 3? The answer is yes.

> ***For example:***
>
> *a. Emissions from a petrol engine car, owned and operated by the organisation. They are calculated and recorded in Scope 1 using the emissions factor of 67.62 kg CO_2-e / GJ for petrol.*
>
> *b. Emissions from a petrol engine car, owned and driven by a staff member commuting to and from work. The emissions are calculated and reported in Scope 3 using the same factor as above.*

What about shared facilities and services which are not owned or operated by the organisation? In this case they report the emissions from their share of the usage by time, floor space, etc. These emissions are calculated using the direct Scope 1 factors (again, Scope 2 indirect in the case of electricity). But they are recorded in Scope 3.

> ***For example:***
>
> *Electricity used by the lift, lobbies and common areas in a shared building is billed to the management company. The company shares the costs of the bill amongst the tenants based on the size of their rented floor space. The tenants record their share of the emissions in Scope 3 of their carbon inventory.*

However, there are some emissions factors which are designed for use in Scope 3 <u>only</u>, known as 'Scope 3 emissions factors'[41]. They generally apply to fuels and electricity. These are for use in inventories which have recorded Scope 1 emissions for a fuel(s) (and/or Scope 2 emissions for electricity) and wish to add into their inventory any additional emissions associated with that consumption. The emissions result from the extraction, production/generation, distribution and losses of those fuels BEFORE they reach our site. In other words, before we bought them.

Figure 5 illustrates this concept using natural gas as an example. Let us assume we use natural gas in our facility for cooking meals – the staff canteen or kitchen:

- On the right side of the diagram, we have the usual Scope 1 emissions source – the cooktop burning the gas to generate heat for cooking. The gas is supplied to the cooktop by the gas meter which is situated on the boundary of the property. The meter records all consumption downstream (after) of itself. Whatever happens to the gas after the meter, the consumption is recorded. Whether we burn gas, it leaks, or we simply open the taps and let it flow into the air, the meter records that consumption and we include the data as 'activity data' for our carbon inventory.
- On the left side of the diagram (Scope 3) is what happens BEFORE the gas arrives at the meter. Whatever happens here is NOT recorded, we do not get the data and we do not pay for it or record it in our inventories as Scope 1. But a lot occurs on the left side (upstream of the meter). For example, the gas is extracted by a rig at sea in the Bass Straight; it is piped to a refinery to clean it up. It is then piped to our homes across hundreds of kilometres. All of the way through this process/system:
    - gas leaks to atmosphere;
    - energy is used in the processing;
    - energy is used in the transportation (pumping);
    - energy is used in building and maintaining the infrastructure (pipes, rigs, facilities).

[41] Info: They can be found in the National Greenhouse Accounts Factors workbook. Appendix 4.

These leaks and the energy used produce GHG emissions. So, for every cubic metre of gas we buy, a small proportion of those upstream emissions can be attached to our consumption. This is an indirect emission source, so it is recorded in Scope 3. The proportion is calculated to work out an emissions factor for it.

Scope 3 emissions factors are usually relatively small compared with Scope 1 factors, often around 10%.

Energy distributors are responsible for reporting these emissions as their Scope 1, so why would the consumer choose to include these in their Scope 3? Doing so provides a more complete picture of their carbon emissions profile. It also reflects the true emissions of certain fuels and is especially significant for electricity and large fuel users. In fact, if we were to add the Scope 1 and Scope 3 factors for a fuel and use them combined in an emissions calculation, we would arrive at what is known as the 'full fuel cycle' emissions for that fuel.

They should be included if the activity or emissions are relevant and/or material to the inventory needs.

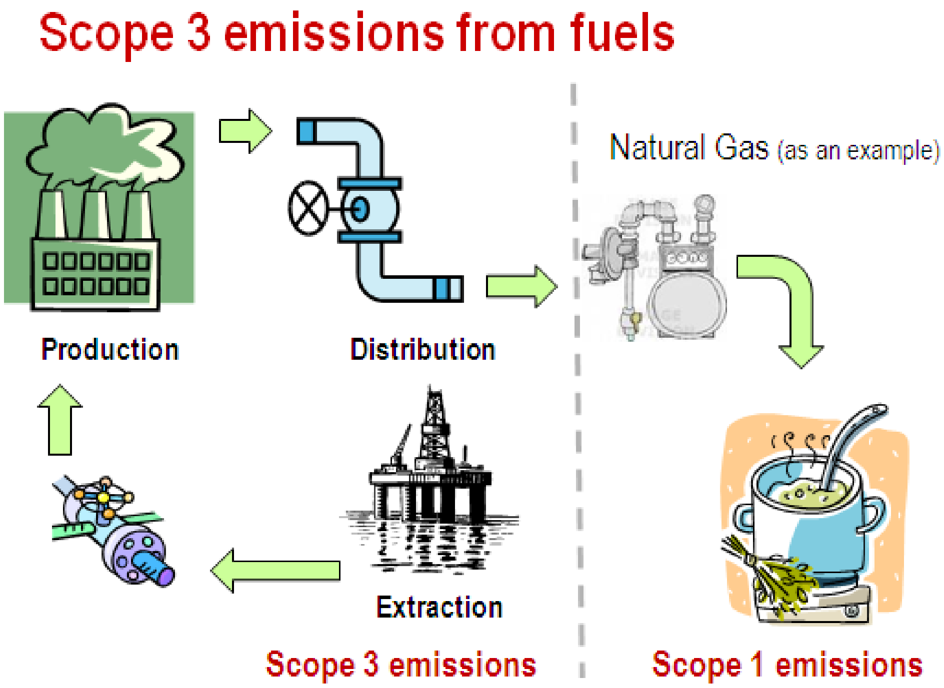


Figure 5. Scope 3 (Fuel) Emissions Factors

Using emissions factors

Before we can use an emissions factor, we have to be aware of the units of the factor and the units of the activity data. Before conducting emissions calculations, we must ensure that the units of both elements are compatible. If they are not, then we must convert the units of the activity data into the units used by the emissions factor.

Units in the equation

The formula for calculating GHG emissions:

GHG Emissions (CO_2-e) = Activity X Emissions Factor

Emissions factors often deal with various units of mass and activity.

For example:

*Electricity (Victoria) – **1.08 kg CO_2-e/kWh**;*

***1.08** is the mass of emissions in kilograms*

***CO_2-e** is summary of the emissions in carbon dioxide equivalent per*

***kWh** which is the unit of activity.*

With this understanding of an emissions factor, we can look at the formula and see that since the *emissions factor* includes units for the activity (in the case, kWh), then the *activity* data must be presented in THOSE same units in order to be compatible and complete the calculation.

***Example 1** (correct units & result):*

*Emissions (CO_2-e) = **Activity** X **Emissions Factor***

*Emissions (CO_2-e) = **10,000 kWh** X **1.08 kg CO_2-e/kWh***

*Emissions (CO_2-e) = **10,800 kg***

***Example 2** (incorrect units & result):*

*Emissions (CO_2-e) = **10 MWh** X **1.08 kg CO_2-e/kWh***

*Emissions (CO_2-e) = **10.8 kg***

In example 2, above, we used activity data in MWh (Megawatt hours) instead of the required kWh (kilowatt hours) and the result was incorrect by a factor of 1,000.

Changing or converting units

On the course we refer to the conversions as 'steps'. Each step represents one level of change or conversion.

One step – changing units:

These are examples of a simple conversion where we switch from one metric unit level to another – often by dividing or multiplying by 1,000. i.e. Mega- to kilo-.

- The electricity emissions factor for Victoria is 1.08 kg CO_2-e/**kWh**
- Activity data provided by the organisation is **10 MWh**
- We must convert **10 MWh to kWh**
  - 10 MWh x 1,000 = 10,000 kWh[42]
- We can now conduct the emissions calculation (10,000 x 1.08 = 10,800.00 kg CO_2-e)

One step – converting units:

This is an example of a conversion where we switch from one type of metric unit to another type, i.e. from volume to energy. Here we use an Energy Content Factor (ECF) provided by the NGA Factors workbook[43].

- The natural gas emissions factor is 51.53 kg CO_2-e/**GJ**
- The natural gas ECF is 0.0393 **GJ/m^3**
- Activity data provided by the organisation **150 m^3** (cubic meters of volume)
- We must convert 150 m^3 to GJ to prepare for the emissions calculation
  - 150 m^3 x 0.0393 GJ/m^3 = 5.895 GJ
- We can now conduct the emissions calculation (5.895 x 51.53 = 303.77 kg CO_2-e)

These examples illustrate one step each. Occasionally, activity data will require no unit conversions (steps). Often, they will require one conversion. Very often they will require multiple conversions, often as many as four.

[42] Info: Information on conversions of metric units is available on the internet and in Appendix 2 of the National Greenhouse Accounts (NGA) Factors. p.p. 61 of July 2017 edition.

[43] Info: The ECF is presented in the same table as the emissions factor for easy reference. See Table 2 in NGA Factors, July 2017, for example.

When two or more are required they usually combine unit changes and unit conversions i.e. a combination of the two examples above. When three or more steps are required it is usually a combination of multiple unit changes plus a unit conversion.

Two steps:

- The petrol emissions factor (for a post-2004 vehicle) is 67.62 kg CO_2-e/**GJ**
- The petrol ECF is 34.2 GJ/**kL**
- Activity data provided by the organisation is **1,250 L** (litres, volume)
- Step 1: We must convert L to kL to prepare for the ECF calculation
  - 1,250 L / 1,000 = 1.250 kL
- Step 2: We must convert kL to GJ to prepare for the emissions calculation
  - 1.250 kL x 34.2 GJ/kL = 42.75 GJ
- We can now conduct the emissions calculation (42.75 x 67.62 = 2,890.76 kg CO_2-e)

Three steps:

This example adds another layer of complication in the activity data provided by the organisation. Instead of giving the petrol consumption data in litres, they provide it as dollars spent over the period. They say that's all they have. The extra conversion here is to change the dollar amount to a volume (litres). That requires an additional conversion factor, but this factor is not likely to be provided as an authoritative number. It is one which will need some research and often some estimations and assumptions. Such data is sometimes available from the internet.[44] Only reliable and reputable internet sources should be sought.

- The petrol emissions factor (for a post-2004 vehicle) is 67.62 kg CO_2-e/**GJ**
- The petrol ECF is 34.2 GJ/**kL**
- The average cost of petrol is $1.40/**L** (an estimation for the period)
- Activity data provided by the organisation is **$1,475**
- Step 1: We must convert $ to L to prepare for the ECF conversion
  - $1,475 / 1.40 $/L = 1,053 L
- Step 2: We must convert L to kL to prepare for the ECF calculation
  - 1,053 L / 1,000 = 1.053 kL
- Step 3: We must convert kL to GJ to prepare for the emissions calculation
  - 1.053 kL x 34.2 GJ/kL = 36.01 GJ
- We can now conduct the emissions calculation (36.01 x 67.62 = 2,435.17 kg CO_2-e)

> ***It is possible to have more than three conversions. Here are two examples:***
>
> *Extending the petrol example. The organisation provides activity data in the form of 'km' (kilometres travelled during the period). We need to convert from kilometres to litres before starting the process. Converting from km to L requires data on the fuel efficiency of the vehicles i.e. how many litres of petrol are consumed per km travelled? Average car efficiencies are typically published online.*
>
> *Accounting for emissions due to taxi journeys also requires many conversions. The passenger pays a dollar amount to the driver and records that for company expenses. But we cannot simply convert cost into litres because the cab fare is a commercial arrangement which includes costs other than the fuel involved. Calculations require knowledge of fare tariffs, taxi fuel type and the taxi's fuel consumption. Again, this data may be available on the internet.*

[44] Info: For example, average fuel prices can be found on the RACV website: http://www.racv.com.au/wps/wcm/connect/racv/Internet/Primary/my+car/advice+_+information/fuel/

This requirement for conversions of data points to the fact that we should always seek the best form of data, closest to the format required by the emissions factor. This will save time and provide greater accuracy in the final result.

Final conversion step

Emissions in inventories are usually presented in **tonnes** (t) of CO_2-e. Emissions factors usually (but not always) result in emissions of **kilograms** (kg) of CO_2-e. In this case we usually need to divide the result by 1,000 to convert from kg to t. This is a final, additional and CRITICAL step applicable to most emissions calculations. It is essential that the units of emissions factors are recognised and handled appropriately.

Tip

When conducting these conversions in your spreadsheet, it is a good idea to separate each one into its own cell. If done this way, the overall calculation of emissions for a given source is broken down into steps and it is easy to identify errors and update the spreadsheet/inventory in future.

Summary

Think of steps/conversions and the preparation of your activity data for use in the emissions calculation.

They must be completed before conducting the emissions calculation for any emissions source/activity.

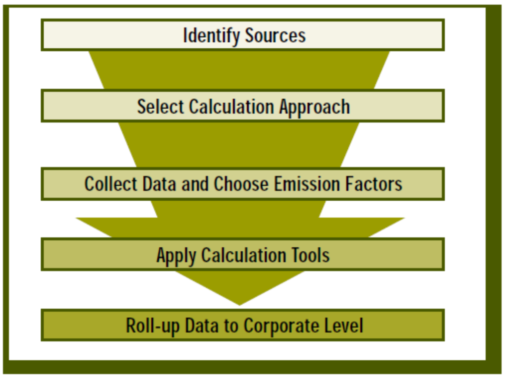
There are different types of conversions:

- *Changes of unit measure i.e. MWh to kWh;*
- *Changes of unit type i.e. m^3 (volume) to Joules (energy);*
- *Changes from other forms of data i.e. $ to volume.*

Calculating emissions

The GHG Protocol diagram 'Steps in identifying and calculating GHG emissions'[45] (right) outlines the process we follow. The exception being that the steps 2 and 5 are not always required and are excluded for the purposes of the course.

Steps in identifying and calculating GHG emissions



Once the inventory boundaries have been set and we have identified and categorised our emissions sources, we next need to calculate the emissions. This is done by considering the nature of each emissions source and the amount of activity (usually consumption) associated with that source.

This is usually achieved using the following formula:

Emissions (CO_2-e) = Activity X Emissions Factor

Emissions in an inventory are usually expressed in tonnes of CO_2-e. They may be expressed in kilograms (kg) where an inventory is limited to small amounts of emissions which do not scale well in tonnes. The units of Activity and the Emissions Factor will depend upon the source in question.

When applying NGER/NGA emissions factors to calculate an emissions inventory for a given financial year, organisations should use the factors developed for that financial year. For example, for the emissions inventory for the 2016-17 period, Council should use the NGER Measurement Determination and NGA Factors

[45] Source: The GHG Protocol: http://www.ghgprotocol.org/files/ghgp/public/ghg-protocol-revised.pdf , p. 41

dated July 2016. If the inventory was covering the 2017-18 period, then Council should use the NGER Measurement Determination and NGA Factors dated July 2017.

> ***Examples of emissions calculations***
>
> ***Electricity (Victoria):***
>
> *Emissions = 10,000 kWh x 1.08 kg/CO_2-e/kWh = 10.80 tonnes CO_2-e*
>
> ***Natural Gas:***
>
> *Emissions = 200 GJ x 51.53 kg/CO_2-e/GJ = 10.306 tonnes CO_2-e*

Deep dive 1: Calculating emissions for facility electricity use

The GHG Protocol Scope 2 Guidance (World Resources Institute, 2015) provides more detail about how electricity use is quantified in an emissions inventory.

For sites with on-site electricity generation (i.e. solar PV or a cogeneration/trigeneration system), emissions from electricity use should be calculated using the gross electricity consumption at the site i.e. total electricity used.

Net electricity use (calculated as the gross electricity generation from all fuels, plus electricity imports from the grid, minus exports to the grid, minus transmission and distribution losses) can be reported for full transparency but cannot be used to reduce or offset gross electricity use.

As a single emissions source in a GHG inventory, electricity captures the use of energy in numerous devices within the workplace, such as:

- Heating, ventilation, and air conditioning (HVAC) – typically accounts for ~40% of total electricity use[46]
- Lighting – ~25% of electricity use
- Equipment: computers, printers, fridges, servers, dishwashers, etc - ~20% of electricity use
- Other: lifts, domestic hot water – ~15% of electricity use.

Note that the percentage of electricity consumed by each source type is highly variable and a site-specific investigation is required to correlate emissions with any one source within a building. This may be achieved through an energy audit.

Local governments typically obtain information on electricity use across all of their facilities in one of two ways:

1. Organising their energy retailer to provide total electricity use by nominated account and National Meter Identifier (NMI) number; alternatively, Councils might have access to an account on the retailer's website where they can extract reports for the relevant reporting period; or
2. Reading electricity use from invoices and summing all invoices across a full year.

The first method is preferred for saving time since all information is compiled by the electricity retailer. The second method is more resource-intensive, as it requires summarising bills across all facilities within the inventory. However, the first method requires planning and preparation, and Council must provide the electricity retailer with a complete list of electricity accounts and NMIs across all of the buildings it owns, manages and leases. Council may also wish to include buildings it hires from another party on this list, although permission may be needed from the building owner to access this information from the retailer.

[46] Basics of HVAC energy efficiency –Department of the Environment (2013)

Incomplete or missing data:

Local governments may come across the following difficulties when compiling facility electricity-use inventories:

- ***Uncertainty around whether to include buildings that Council has leased out in the greenhouse gas inventory***. In this case, Council should first apply the Operational Control test (refer back to Unit 1, Module 2) to determine if the facility is within its organisational boundary. If a facility is not under operational control of Council, then Council should apply the Relevance Test (refer back to Unit 1, Module 2) to determine whether to include the facility as a Scope 3 source.
- ***Incomplete or missing data over a reporting period (one year)***. If Council obtains a facility's electricity use from the energy retailer invoices, and some months are missing, Council can estimate the electricity use for missing months using one of the following two approaches:
    - If any use is not seasonal (for example, an office building has roughly the same number of FTEs all year round), pro-rata the total electricity use over the known period to a full year. For example, an office building has used 80 MWh over 10 months. Extrapolating this information to 12 months: 80 x 12/10 = 96 MWh.
    - If electricity use is highly seasonal (for example, an outdoor swimming pool that only operates over summer), estimate electricity use by reading an old invoice from the same month from a previous year, or a similar month of that year.

Deep dive 2: Calculating emissions from street lights

Public (street) lighting is wholly dependent on purchased electricity. Although street lights are generally owned and maintained by power companies, local governments typically pay the bills associated with public lighting since they are responsible for meeting a standard level of illumination in public areas. For street lights owned and maintained by power companies, the purchased electricity by Council is considered a Scope 3 source (as described above). Example 1 steps through the process of calculating emissions from street lights using the method described below.

If Council does not own the street lights and only pay a percentage of the electricity bill, then Council should default back to the 'operational control' test and then the 'relevance test' to determine whether to include emissions associated with these street lights. Example two below steps through a common case study relating to this.

The process for gathering data to estimate emissions from street lights is described below:

Street lights owned and operated by energy provider

1. Find your primary source of data to inform the street light inventory

<u>Option 1a: Obtain street light information directly from invoices</u>

Local governments will typically be invoiced monthly for street lights owned and operated by energy providers. Costs are applied based on a flat rate ($ per annum) per light in the municipality, which covers:

- Operating costs (cost of electricity);
- Maintenance costs (such as pole inspection, bulk lamp replacement, defect remediation); and
- Replacement (if the light breaks).

Invoices will typically contain information on the lamp type (see below), flat rate per lamp, and Council's share of the total invoice to pay (if applicable).

<u>Option 1b: Obtain data by requesting this information from the energy provider</u>

Local governments can also request an inventory of street lights from the energy provider. This data can be easier to read than invoices, which may have numerous street lighting accounts.

You will come across the following types of street lights:

- Mercury vapour lights – Typically found on residential roads (and infrequently on main roads), these lights have low efficacy and are of concern due to the environmental toxicity of the mercury gas. MV lights have a high deterioration of light quality over their life.
- Compact fluorescent lights – Typically installed for street lighting applications after ~2008, these lights have a medium to high efficacy.
- High Pressure Sodium lights – These lights are the dominant lighting type on main roads and are characterised by a high efficacy and a yellow light.
- Metal halide lights – These lights have reasonable efficacy and excellent colour rendering, emitting a white light. Generally used in areas with high pedestrian traffic.
- LED lights – The latest technology in street lights, these lights are the most efficient lights and have a life expectancy of 15-20 years.

Each street light type will have a wattage associated with the description e.g. 42W compact fluorescent light. This enables electricity use per light to be calculated for the reporting year.

2. Build an inventory of total numbers of different street light types

Once you have compiled a count of street light types, you are ready to estimate emissions.

The previous inputs gathered are multiplied to estimate total electricity use from street lights:

$$Total\ electricity\ use\ \left(\frac{kWh}{year}\right) = (hours\ per\ day) * (days\ per\ year) * (number\ of\ lights) * (watts\ per\ light)/1000$$

Example 1

Council A was able to read the following information from its monthly invoices:

OM&R charges	Quantity	Rate
80W Mercury Vapour lights	540	$60 p.a.
Twin 14W Fluorescent lights	316	$35 p.a.
250 W Sodium high pressure lights	46	$70 p.a.

Council also consulted with the energy provider to obtain the following assumptions to use for calculations:

- Each light is turned on for an average of 11.5 hours per day, across the whole year

To estimate electricity consumption from the street lights, Council made the following calculations:

- Mercury vapour lights:
  Electricity use (MV80) = (11.5 hours/day) x (365 days/yr) x (540 lights) x (80 W) /(1000W per kW) = 181,332 kWh
- Fluorescent lights:
  Electricity use (Twin 14W) = (11.5 hours/day) x (365 days/yr) x (316 lights) x (2*14 W) /(1000W/kW) = 37,139 kWh
- Sodium high pressure:
  Electricity use (250W HPS) = (11.5 hours/day) x (365 days/yr) x (46 lights) x (250 W) /(1000W/kW) = 48,271 kWh
- Total electricity use, all lights = 181,332 + 37,139 + 48,271 = 266,742 kWh
- Total carbon emissions from street lights:
  Emission factor (NGA Factors 2016/17) for Victoria = 1.09 kgCO_2-e/kWh (Scope 2 emissions only)
  Emissions = 266,742 kWh x 1.09 kgCO_2-e/kWh = 290,749 kgCO_2-e/year

Example 2:

Council A is unsure if they need to include high pressure sodium (HPS) street lights that they jointly pay for with VicRoads in their greenhouse gas inventory. Council notes the following characteristics of the street lights:

- They do not own nor maintain the street lights – this is done by the energy utility
- They pay for 40% of the fixed per annum costs of each HPS street light, while VicRoads pays the remaining 60% (since the lights are on major roads)
- Under an existing agreement with VicRoads, Council must gain the written approval of VicRoads to upgrade the lights from HPS 250 W lights to LED 125 W lights. Similarly, VicRoads must obtain Council's approval to upgrade the lights. Council must provide 40 % of the total funding for light upgrades (HPS to LED) and will continue to pay for 40 % of the costs of the lights.

Council A would apply the following two tests:

1. Operation control test

Since Council does not own or maintain the street lights, and cannot upgrade the lights independently, Council determines the street lights are not under its operational control. Therefore, the emissions from these street lights are not Scope 1 or 2 (in-boundary) emissions, but potentially relevant Scope 3 emissions.

2. The Relevance Test

To assess whether the emissions sourced from street lights are relevant to Council A, the 5 criteria from the relevance test were applied, and 4 criteria (i to iv) were met:

i. These emissions are likely to be large relative to the precinct's Scope 1 and 2 emissions.
ii. The emissions from a particular source contribute to the organisation's GHG risk exposure, since street lights consume a high percent of total electricity used by Council.
iii. Council consults with a community working group, who believe street lights are a relevant emissions source, and Council should report on it.
iv. The responsible entity has the potential to influence the reduction of Scope 3 emissions from the source.
v. The Scope 3 emissions are **not** from outsourced activities that were previously undertaken with the organisation's boundary or from outsourced activities typically undertaken within the boundary for comparable organisations

Given two or more relevance criteria were met, emissions from street lights were deemed a relevant Scope 3 emissions source, and therefore included in the Council's inventory.

Deep dive 3: Calculating emissions from waste and landfills

A local government should read through the three different cases provided below to determine which case is applicable to their operations. The three cases are:

- Council operates a landfill within its Local Government Area (LGA)
- Council outsources the operation of a landfill within its LGA
- Council does not operate or outsource operating a landfill in its LGA, but will still include its corporate waste emissions.

Case 1: Council operates a landfill within its Local Government Area

Fugitive emissions from landfill are regarded as Scope 1 (direct) emissions. This includes both operating landfills and closed landfills. In most cases, limited or no information will be available on closed landfills, making it unfeasible to estimate emissions. In this case, the data gap should be documented, but no further action is required.

Although emissions are Scope 1, local governments (and any other operators) have limited control over landfill gas emissions. Landfills can install and operate landfill gas capture systems which enable landfill gas to be flared or converted into energy (by using its combustion to power a turbine) to reduce fugitive emissions. At present, landfill gas capture is estimated to capture 60 to 90 % of methane emissions[47]. Newer landfills are also designed with much stricter design guidelines and criteria, to limit fugitive emissions (along with other adverse environmental impacts from the landfill).

Case 2: Council outsources the operation of a landfill within its LGA to a waste-management company

When Council outsources one of its operations (such as waste collection and disposal), this automatically triggers 1 of the 5 criteria applied under the Relevance Test (refer back to Unit 1, Module 2). Since landfill gas emissions are also likely to be a significant source of total Scope 1 and 2 emissions, one other criteria under the Relevance Test is met. With two criteria ticked off, the landfill qualifies as a relevant Scope 3 emissions source in Council's greenhouse gas inventory.

For both Case 1 and Case 2, corporate waste emissions (see below for a detailed description) should be excluded from the inventory, to avoid double-counting. Council can estimate emissions using one of two methods:

- The National Greenhouse Accounts emission factors for total waste disposed to landfill (Table 44):
  - Requires knowing the total quantities of municipal solid waste (MSW), commercial and industrial waste (C&I) and construction and demolition waste (C&D) disposed of at the landfill per year
  - Captured or flared landfill gas can be accounted for by assuming a percentage capture of the total landfill emissions.
- The NGER Solid Waste Calculator (which has the First Order Decay Method built into the tool):
  - Requires more detailed inputs, including historical records of waste disposal since the landfill opened
  - Also enables waste composition to be recorded.
- For simplicity, we recommend using the NGA factors published each year. Note that these factors account for the total emissions from waste over 100 years.
- If a landfill is large, it may be worthwhile using the Solid Waste Calculator (provided for the purposes of reporting under the National Greenhouse and Energy Reporting Act) to better understand total emissions from the landfill. Details on how to use the calculator are provided later in this section.

Calculating emissions from corporate waste

Case 3: Waste from Council and the community is sent to a landfill outside of the Local Government Area, and thus Council will only account for the waste it generates from its own operations ('corporate waste').

If a landfill is outside the LGA, emissions from landfill are typically excluded but corporate waste emissions are included in the inventory as a Scope 3 source, if deemed relevant. Corporate waste emissions are calculated by quantifying the yearly mass (weight) of waste generated from each Council facility. Emission factors per unit of waste generated (MSW, C&I and C&D) are found in the National Greenhouse Accounts (Table 44) and have a unit of tonnes CO_2-e per tonne waste.

The process for including corporate waste emissions in your inventory is detailed below:

1. Identify the facilities most likely to generate large quantities of waste from your facility list. This is likely to include large office spaces and facilities with high occupancy.
2. For these large facilities (generally 2-5 as a starting point), either:
   a. Review invoices from the waste contractor to gauge yearly waste collection volumes from each facility
   b. Commission a waste audit to be undertaken at major sites to accurately estimate the quantity and mix of waste generated (an audit can also inform emission reduction opportunities).
3. Estimate likely waste generated from smaller facilities, using an assumption of 500-1,000 kg of waste generated per small building (child care centres, town halls, small offices, etc).
4. Sum the total waste quantity at all facilities.
5. Multiply by the correct emissions factors to estimate total emissions.

[47] Ref: https://www.epa.gov/lmop/benefits-landfill-gas-energy-projects

6. Compare total corporate waste emissions to your Scope 1 and 2 emissions inventory:
    a. If corporate waste emissions are less than 5%, no further work is required.
    b. If emissions are greater than 5%, consider a more detailed calculation approach using site-specific data.

How to calculate landfill emissions

Sourcing your data:

Quantity of waste

If your landfill serves a population of at least 5,000 people it will operate under a license from EPA Victoria and it will be required to submit an Annual Levy Statement to EPA Victoria each financial year. The Annual Levy Statement summarises the quantity of municipal solid waste (MSW), commercial and industrial waste (C&I) and construction and demolition waste (C&D) received by the landfill over the reporting year.

Alternatively, weighbridge data recording truck deliveries can be aggregated to determine the quantity of the three waste streams (MSW, C&I and C&D) delivered over the reporting year.

For each year, sum the total quantity of all three waste streams (in tonnes of waste), and calculate the percentage of MSW, C&I, and C&D waste. These calculations will be used to estimate emissions using the NGA factors or using the Solid Waste Calculator.

Incorporating flaring and landfill gas capture

When using the NGA factors to estimate emissions, Council can assume a proportion of capture between 60 and 90%. One study used a landfill gas collection average of 70% (Picken 2010 – LCA of Wollert Landfill).

For a more detailed calculation of landfill gas collection for input to the solid waste calculator, data may be available in several formats:

- Meters on site may record total volume of landfill gas, and composition of the gas
- For energy generation – the landfill may have records of how much electricity has been generated on site (in kWh). From this data, you can back-calculate methane flared using the following equation:
    - $M_{sent,h} = (Q_{EG,h} * 3.6)/(Eff_h * EC_{LFG})$

    Where $Q_{EG,h}$ is the electricity produced

    Eff_h is the electrical efficiency of the internal combustion device, specified by the manufacturer

    EC_{LFG} is the energy content factor for LFG set out in Part 2 of Schedule 1 of the NGER Measurement Determination: 37.7 x 10^{-3} for 2017/18.

Waste mix types

If you are using the NGER Solid Waste Calculator and the waste mix percentages of different waste types is known, the default factors in the Solid Waste Calculator can be overwritten. Waste mix percentages are generally only known through a specific study.

Default factors are used in the Solid Waste Calculator for waste mix types. However, Councils may be able to source information on the mix of waste from landfill records.

Using the NGER Solid Waste Calculator

The following steps are needed to calculate the emissions from landfills that accepted waste on or after 1 July 2012.

Getting started with the online tool

Before you start:

- Download the NGER Solid Waste Calculator 2016-2017. Note, always check the Clean Energy Regulator webpage to see if there is a more recent version.

- Save a version on your corporate directory, that can be updated in future years.

Filling in the online tool

'Inputs and data checks' tab:

Input field	How to fill out
Technique used to estimate opening stock of degradable organic carbon	Enter **1** if EPA Annual Levy Statements are used, or **3** if weighbridge records are used.
Enter the number of sub facility zones in the landfill	Only relevant if the landfill records waste quantities sent to different zones of the landfill, in which case each zone is treated separately as its own landfill.
Enter the year the landfill first reported under NGER	This field is not relevant for our purposes.
Input State / Territory and Input Climate Zones	Select VIC from the dropdown menu.
Select the class of MSW received at the landfill	Refer to S1.8 NGER Measurement Determination to select which class is collected. Generally speaking: Class I MSW – organic waste is not collected in a dedicated bin. Class II MSW – garden waste is collected in a dedicated bin to residents in the municipality on a regular basis.

'Sub facility 1' tab:

Note that for all input parameters, Council can refer to the NGER Measurement Determination section listed under each parameter for a detailed explanation of how to fill out the calculator. We have compiled a simplified version below which assumes that only basic parameters are known and default parameters are left for calculations.

1. Enter the quantity of waste received at the landfill. This should be input for all years dating back to when the landfill opened (or as far as records go). If data for early years is unknown, leave it blank or estimate the quantity based on historical and recent trends.
2. Enter the percentages of MSW, C&I and C&D waste received at the landfill (columns M to O).
3. Enter the total volume of landfill gas captured (Q_{cap} (CH4 only) in m^3), flared (Q_{flared} (CH4 only) in m^3) and transported (Q_{tr} (CH4 only) in m^3).
4. Leave all other factors as default, unless values are known in which case they can be input according to the NGER Measurement Determination.
5. Transcribe the **Total emissions calculated** (column F) for the reporting year into your greenhouse gas inventory.
6. Save a copy of the filled out Solid Waste Calculator so that it can be updated in the next reporting year.

Note that the years listed in the 'Sub facility 1' tab are for financial year ending (i.e. 2017 is FY2016/17).

Deep dive 4: Calculating refrigerant loss

Most emissions are calculated using the methods outlined above. Calculating emissions due to refrigerant releases/losses follows a different method, outlined below.

Refrigerant is a coolant gas commonly used in refrigerators and air conditioners. These devices are present in many domestic and commercial situations. Air conditioners in vehicles should not be overlooked in this regard.

As noted in Table 1, modern refrigerants are forms of hydrofluorocarbons, which are Kyoto GHGs. Hence their release to the atmosphere is a source of GHG emissions and must be recorded in an inventory.

They can be released in a number of ways:

- during manufacture of the gases;
- during assembly/charging of the equipment;
- during equipment damage, maintenance or disposal;
- due to leakage.

It is leakage which is the most commonly accounted for in carbon inventories. This is known as a 'fugitive emission' because it is largely unknown and undetected. It occurs when the pressurised gas slowly escapes from the pipes and joints in the device. Leakage rates depend on the particular installation and vary from 9% to 23%. The rates can be found in the National Greenhouse Accounting Factors and in the NGER Measurement Determination (Chapter 4, Part 4.5).

Calculating emissions due to refrigerant loss

1. Identify your source of refrigerant losses. In this example, it is a domestic fridge in the kitchen/canteen of an office.
2. Check the data label (sometimes a silver plate/sticker) on the fridge. It is often inside the door. If not, then it is on the back of the fridge, often attached to the motor at the bottom. The label will provide information about the model, but also the type and charge (amount) of the refrigerant contained within. Our fridge has a data label which tells us it has:
   - **Refrigerant** is 'HFC-134a'. This has a **GWP of 1,300**.
   - **Charge** is **0.175kg** (175g).
3. The annual **leakage rate** for domestic fridges is 3% (**0.03**).
4. Plugging these numbers into our formula:

   Annual CO_2e emissions =

   0.175 x 0.03 x 1,300

   = 6.825 kg

As mentioned in the section on 'Global warming potential', emissions due to refrigerant loss are calculated using global warming potentials. The formula in this case is adapted specifically for refrigerant devices as:

> ***GHG emissions from refrigerants (kg CO_2-e) =***
>
> *Recharge capacity (kg) X Global Warming Potential X Annual leakage rate (%)*

However, gathering the data (especially the refrigerant type and charge) can often be difficult due to limited access to the manufacturer's nameplate or no nameplate present (as for vehicles). This requires research into manuals, the internet, maintenance teams or manufacturers.

GWPs for common refrigerants can be found in the NGA Factors workbook[48]. Some leakage rates can also be found in the NGA Factors workbook[49]. Other common refrigerant GWPs and leakage rates can be sourced from the IPCC Fifth Assessment Report, 2014 (AR5)[50].

[48] Info: NGA Factors July 2017: https://www.environment.gov.au/system/files/resources/5a169bfb-f417-4b00-9b70-6ba328ea8671/files/national-greenhouse-accounts-factors-july-2017.pdf, table 27.

[49] Info: NGA Factors July 2017: https://www.environment.gov.au/system/files/resources/5a169bfb-f417-4b00-9b70-6ba328ea8671/files/national-greenhouse-accounts-factors-july-2017.pdf, table 25.

[50] Info: https://ghgprotocol.org/sites/default/files/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf

Optional background reading and reference materials.

- The GHG Protocol. Chapter 6: Identifying and Calculating GHG Emissions http://www.ghgprotocol.org/standards/corporate-standard

Learning activity – Calculating emissions

Council A provides you with the following information for the development of their emissions inventory. Using the NGA Factors emissions factors provided:

i. Calculate the amounts of greenhouse gases in the spaces below.
ii. State the units used to measure carbon emissions.
iii. Indicate any problems you had in conducting any of the calculations.

Emissions Source	Activity	Emissions (tonnes CO_2-e)
Natural Gas	538.7 GJ	
Electricity	361,606 kWh	
Food Waste	36,430 kg	
Petrol	$23,765	

Does any of this Activity data present problems?

Develop the inventory

In its most basic form, a carbon inventory is a list of emissions sources, the related activity data and the resulting calculated emissions. The individual emissions will be added to provide a total. Conventionally this information is presented in a table format. Because it includes numeric data and calculations, it is usually developed in a spreadsheet software.

GHG Protocol and ISO 14064 based inventories are required to present the emissions in written form as 'tonnes of CO_2-e' (tCO_2e) or 'tonnes of carbon dioxide equivalent'. They may exceptionally be presented in kilograms of CO_2-e where emissions are of small amounts.

Designing and constructing the inventory

The 'public face' of the inventory is the 'Summary' which only displays the data most relevant to the intended audience. The content and layout of the summary is somewhat prescribed by the standards. An example of an inventory summary for NCOS certification purposes is illustrated in Figure 7, which reflects Yarra City Council's emissions inventory for the 2015-16 period.

Behind the figures revealed in the summary is the mass of data supporting them. These data include the activity data and emissions factors used in the calculations.

If one considers this arrangement in terms of a spreadsheet with various tabs (or worksheets) then it could look like Figure 6.

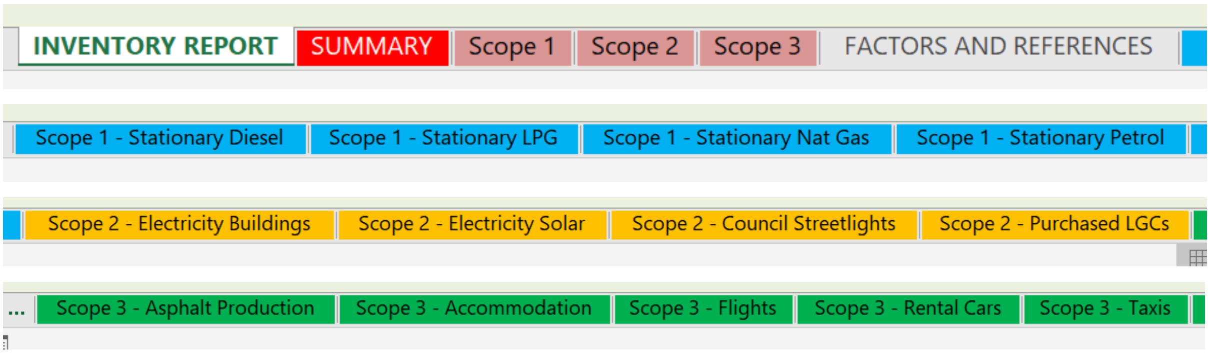


Figure 6. Example of an inventory spreadsheet's tabs

In Figure 6, we see how a spreadsheet might be constructed with multiple sheets (or tabs) supporting the summary. The following describes the function of each of the tabs:

- Inventory report – in this tab, organisations can summarise the data in the format required or desired for reporting purposes, for example as shown in Figure 7.
- Summary – main page for display Scope 1, 2 and 3 emissions totals.
- Scope tabs – in each of these tabs, the organisation could summarise Scope 1, 2 or 3 emissions per emissions source.
- Factors and references – the place to record the emissions factors used and cite their origin/source (where you found them).
- Data tabs – one tab for each emissions source identified within the inventory boundaries, e.g. natural gas, transport diesel, transport petrol, refrigerants, electricity, waste, flights, etc.

The titles can be anything which is helpful. They can be specific (petrol) or general (staff travel). For example:

- an organisation's inventory may include more types of vehicle fuel than petrol. In that case the tab could be named 'Vehicle Fuels' and include petrol, diesel and LPG.
- Staff Travel may include emissions from taxis, hire cars, public transport, etc.

Each of these tabs contains the activity data in raw format, in tables which is then summarised and multiplied by the relevant emissions factor. The emissions total is then reflected in the summary.

After reviewing hundreds of inventories, this arrangement of summary plus tabs may be considered best practice. The methodology is as follows:

1. Gather the emissions factors (EFs) and activity data.
2. Prepare your spreadsheet with 'Summary' and 'Emission Factors' tabs, add the various data tabs customised to your needs.
3. Inventory report tab – design and build the table to present the final inventory data. Refer to Figure 7 for a suggested layout.
4. Factors and references tab – enter and arrange emissions factors in tables with their source/references and any relevant notes.
5. Data tabs - enter the raw activity data[51] into the various data tabs. Arranged in tables with any notes.
6. Data tabs – calculate the total for each emissions source/activity. Multiply that by the relevant emissions factor taken from the Factors tab. This will provide the CO_2-e total for that activity.
7. Summary tab – pull in the various pieces of data from the data sheets to display in the Summary and then in the Inventory report tab.

Some suggestions for working with spreadsheets (such as Microsoft Excel):

Use the features of the spreadsheet to conduct the calculations. Don't use a calculator to work out the sums and then type them in.

Use the spreadsheet's ability to reference and use data from different tabs. Do not copy and paste the same piece of data from one tab into another tab. For example:

In point 6 – use an Excel formula to multiply the activity data total with the relevant emissions factor which is already entered in the Factors tab.

In point 7 – use a formula in each cell of the Summary to display the data you have calculated in the data tabs.

In the Data sheets, where the emissions calculations are conducted, ensure that the calculations are broken down into stages and each stage is presented in its own cell. This is particularly useful for calculations with multiple conversion steps.

Provide citation/links to supporting documents or sources of EFs, especially if sourced outside of the NGA Accounts.

Following these suggestions will:

- improve the speed and accuracy in building an inventory, populating it with data and conducting the calculations;
- allow the inventory to be quickly and easily updated with new data or emissions factors as they become available;
- allow the inventory to be reused for future years with little modification.

The inventory summary

The summary represents the collected and calculated data to the intended recipients. It must also follow the requirements of the standards (e.g. NCOS). It should be designed to focus attention on the most relevant or important information without distracting the reader with too much detail. This is achieved by good design, layout and selection of included data.

Main features of a good inventory summary may include:

- Listed individual emissions sources, arranged by Scope and identified using accurate descriptive names.
- Each Scope section could be summarised to show total Scope 1, total Scope 2 and total Scope 3 emissions.

[51] Info: For example – monthly electricity consumption in kWh, copied from the bills into a table. The table displays each month in the inventory period with its relevant consumption. These are then added to arrive at a total for that activity for that period and ready for calculation with the EF.

- Within each Scope, the emissions sources can be placed (ranked) in order of the size of their emissions. The source with the largest emissions in each Scope sits at the top of that section. This helps readers to identify the big ticket items and visualise some order and priority. Having a percentage column showing the contribution of each emissions source to the total emissions in the inventory can also reinforce this message.
- All emissions data is presented as tonnes CO2-e.
- Emissions reductions can also be included in the inventory summary report, such as GreenPower, LGCs and offsets. This would allow an organisation to report on its gross emissions and its net emissions, i.e. gross emissions minus emissions reductions for the reporting period.

Table 2. Emissions Summary

Scope	Emission source	t CO_2-e
1	Transport (petrol)	585
1	Transport (Autogas – LPG)	65
1	Transport (Diesel)	167
1	Natural Gas	1,802
1	Fugitive Emissions	202
2	Electricity	4,170
3	Electricity transmission and distribution losses	383
3	vehicle fleet (petrol extraction & distribution losses)	31
3	vehicle fleet (Autogas -LPG extraction & distribution losses)	4
3	vehicle fleet (Diesel extraction & distribution losses)	8
3	Natural Gas Distribution	136
3	Electricity –Street Lighting	2,934
3	Contractor Fuel Use (transport) – Petrol	115
3	Contractor Fuel Use (transport) – Autogas/LPG	18
3	Contractor Fuel Use (transport) – Diesel	1,711
3	Waste	39
3	Paper	112
3	Business Travel of Employees	44
3	Water Use -Corporate	176
3	Asphalt	85
3	*NCOS certified carbon neutral paper, including Performer and Green Wrap from Fuji Xerox and various from other sources total 1,919kgs*	0
Total Gross Emissions		12,787
GreenPower or retired LGCs		
Total Net Emissions		12,787

Figure 7. Yarra City Council's emissions inventory summary for the 2015-16 period[52]

Councils can opt to develop their own inventory spreadsheet or use available templates. An example of an available template is the GHG Inventory Tool developed by Ironbark Sustainability for local governments as part of Sustainability Victoria's Local Government Energy Saver Program (LGES) Stream 1: *Establish Local Government Corporate Emissions Profile and Reduction Plan*[53].

[52] https://www.environment.gov.au/system/files/pages/9c2f7c2e-cf08-4fe4-be4c-41397e886aa1/files/yarra-pds-2015-16.pdf

[53] http://www.sustainability.vic.gov.au/About-Us/Grants-and-Funding/Local-Government-energy-saver-program

Data validation and internal controls

Not to be confused with the optional verification/audit conducted by third parties.

It is essential to check your data entry and results for accuracy. Checking data entry can be achieved by taking samples of data (such as emissions factors) from the spreadsheet and checking against the original source materials. Better still, have another person do this on your behalf.

It is also worth checking the spreadsheet for internal consistency by cross checking data throughout the various tabs of the spreadsheet. Ensure that formulas reference the correct cells.

Checking the accuracy of results can be achieved by:

- Conducting a sample of manual calculations from scratch (using a calculator), going back to the source data and factors.
- Asking another person to check your calculations.
- Checking against inventories for previous years.
- Checking against online calculators. These may not be accurate, but can give you a sense of 'being in the right ballpark'.
- Conducting a 'common sense check'. This is most readily done after some experience has been gained in carbon accounting. You can look at an inventory and discern where the numbers are in the right 'ballpark'. Glancing over the figures, it may be that your attention is an individual source, Scope or the overall total attracts your attention for some reason.

These checks are important because it is easy to miss a step in the unit conversions and calculations and end up with a result which is 1,000 times too large or too small.

Using the '**Some suggestions for working with spreadsheets**' (in a box, above) will help to avoid inaccuracies.

Optional background reading and reference materials.

- The GHG Protocol. Chapter 7: Managing Inventory Quality
  http://www.ghgprotocol.org/standards/corporate-standard

Improving procedures

Continuous improvement is an important component of a quality approach. Carbon accounting is a significant process which benefits from feedback in order to improve the outcomes of the next cycle. This requires us to review the reporting procedure and report on opportunities for improvement. This approach is often portrayed as 'Plan – Do – Check - Act' as seen in Figure 8.

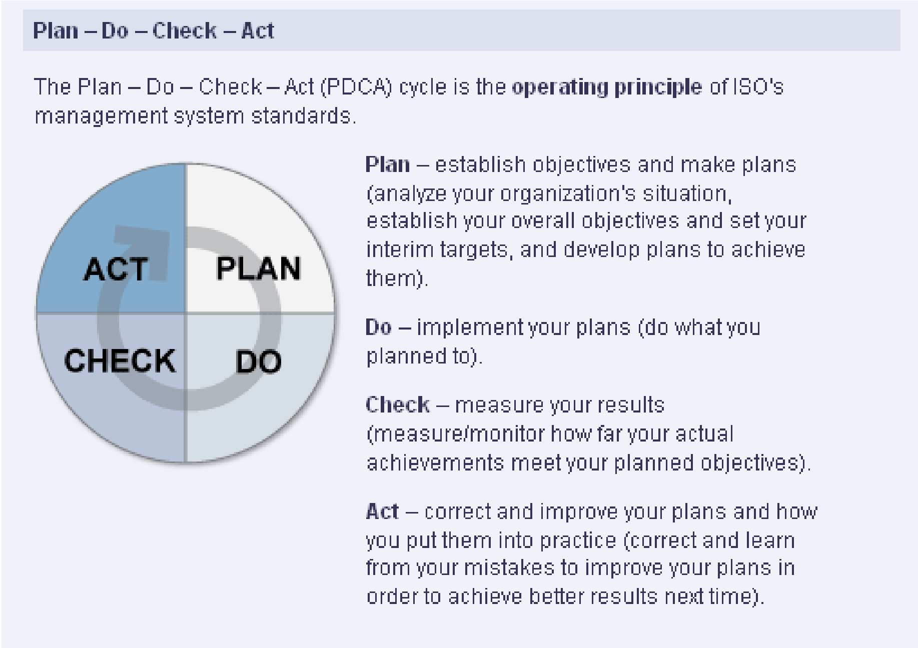


Figure 8. Continuous improvement cycle[54]

Improved outcomes may include:

- increased accuracy
- reductions in cost, time and other resources
- increased credibility
- increased satisfaction
- more effective emissions reductions initiatives.

With experience, it may be possible to determine the suitability of any existing reporting procedures at an early stage in the accounting process. In this case, improvements may be discussed with the organisation and incorporated as the process proceeds.

However, it is usually the case that the review can only take place towards the end of the process with reflection and hindsight. Processes can be reviewed with regards to the:

- overall approach taken by the organisation – was it reasonable?
- standard employed – was it suitable, how closely was it adhered to?
- interactions with the organisation's personnel for data gathering purposes – how efficient/effective were they?

In this case, recommendations for improvements should be linked to corporate planning processes and included in the carbon report. Linkage to corporate planning is important in order to increase the likelihood of the changes being successfully implemented. Identifying corporate planning processes is achieved through gaining an understanding of the organisation, its processes and key personnel. Recommendations should then be pitched in a manner which can be readily integrated into the organisation's existing operations.

Aligning the inventory with organisational needs

Close alignment of the inventory with the organisation's needs will result in better outcomes. These may include increased levels of communication, knowledge, awareness, understanding, ownership and action.

The broader organisational needs regarding the carbon inventory are likely to be reflected in the drivers (the reasons, motivations or intent) behind the development of the inventory. There may be a single driver or multiple drivers.

[54] Ref: http://www.iso.org/iso/iso_catalogue/management_standards/understand_the_basics.htm

They may have been explicitly recognised and stated by the organisation or some of its members. Or they may be implicit, unstated or poorly understood. Where they are explicit, it is possible to more easily define organisational needs and ensure the inventory is developed appropriately to meet them and satisfy the client. Where they are implicit, the reverse is true.

A generic inventory is one which may meet the basic requirements of the standard employed but has boundaries and emissions sources defined without great involvement of the organisation. It is possible that some items of Scope 1 may be missing, that data is difficult to gather and Scope 3 inclusions are limited.

For example:

- An organisation which is required to report under legislations such as NGER will have very clear goals and timelines and will be highly motivated to meet them.
- An organisation wishing to develop an inventory to better understand and reduce its carbon footprint will have a good idea of what it wants to achieve in broad terms but be unclear about how to achieve them. There will be more flexibility in the outcomes compared with the regulatory example.
- Alignment with organisational need can also impact on certain other details within the inventory. For example, the accuracy of the presentation of the calculated emissions figures. It is generally suitable to present emissions in the inventory, rounded to two decimal places, i.e. 11,564.67 tonnes CO2-e.

Optional background reading and reference materials.

- The GHG Protocol. Chapter 2: Business Goals and Inventory Design
  http://www.ghgprotocol.org/standards/corporate-standard

Quizzes and assessments. Log into your OpenLearning account here to access Unit 1 Module 3 quiz and Unit 1 final assessment.

UNIT 2: REPORTING AND PLANNING

Unit description

This unit describes the skills and knowledge required to document the outcomes of the emissions inventory developed in Unit 1 by applying standard approaches for reporting on the inventory. Participants will also explore how carbon inventories can be used to set (and track progress against) emissions reduction targets, and inform strategic investment in emissions reduction measures.

Modules

Module	Objectives
1. Documenting carbon inventory results	• Document the carbon inventory results in a way that is easily replicated and maintained, and that enables local governments to maintain their emissions inventories and track their progress year-on-year.
2. Target setting	• Understand the approaches and options for setting targets, using inventories as a basis for visualising level of effort and ambition.
3. Strategic planning and investment	• Understand how carbon inventories can be used to inform strategic planning and investment in emissions reduction opportunities.

Module 1. Documenting the carbon inventory results

The carbon report

The carbon report is a document designed to communicate data and analysis on the organisation's greenhouse gas emissions. To be effective, the report should be highly contextualised. That is, adapted to suit the specific needs of the organisation for which it is being developed. It should also be transparent about the process, methodology used, assumptions made etc.

Some of the needs to be considered include:

- The drivers (or intent) behind the carbon accounting initiative. As discussed in Unit 1.
- The intended audience for the report, such as internal, public, general staff, management.
- The internal reporting requirements and styles of the organisation.
- The external reporting requirements of any regulations, verification or other standards which the report is required to meet.

A generic carbon report might have the following structure:

1. Executive summary
2. Introduction
3. Carbon accounting and reporting framework (i.e. standards, methodologies and sources of emissions factors used)
4. Results (the inventory Summary table, charts and graphs)
5. Analysis (using carbon management and other tools)
6. Next steps (e.g. emissions reduction targets and plans)
7. Conclusions

Carbon reporting standards

A carbon inventory may be communicated by means of external publication. It may be delivered as a simple inventory (a table) or as part of a carbon report. The report is a document which includes the inventory in its content but adds significant commentary and information to support the inventory.

As with the development of the inventory in Unit 1, there are various standards which may be applied to carbon reports.

The two widely recognised and accepted standards are:

- The Greenhouse Gas Protocol – A corporate accounting and reporting standard.
- ISO 14064-1[55] – Specification with guidance at the organisation level for quantification and reporting of greenhouse gas emissions and removals.[56]

We might also add NCOS to this list, noting that NCOS is not a reporting standard per se. It is based on the GHG Protocol or ISO 14064, and includes reporting requirements specific to organisations claiming or self-declaring themselves as carbon neutral. It is specifically designed to address issues such as consumer confidence, so by following its specific approach, it could potentially help to avoid problems with the ACCC.

ISO 14064 has been 'harmonised' with the GHG Protocol and essentially both standards are thus closely related. On this course we align with the GHG Protocol, in part because it is free and the ISO standards are licensed and must be paid for. We do however recommend the ISO approach to the layout and contents of the report. To this end we circulate examples of such a report for reference by participants.

Five principles underpin both standards. Regardless of any carbon report customisation of content and style, these must be adhered to throughout:

[55] Note: Not to be confused with sister publications 14064-2 which covers specification at the PROJECT level or 14064-3 which deals with the verification of carbon accounting and reporting.

[56] Note: Often referred to in Australia as the identical AS ISO 14064-1 which is available from https://infostore.saiglobal.com/store/Details.aspx?ProductID=342525.

- Relevance – fit for purpose.
- Completeness – all emissions within the chosen inventory boundary.
- Consistency – apply the same methodology across processes and over time.
- Transparency – provide an audit trail, disclose assumptions.
- Accuracy – reduce uncertainties.

Additionally, voluntary reporting under schemes such as the Carbon Disclosure Project (CDP), NCOS, the Global Reporting Initiative (GRI) or the SBTi may specify formats for the preparation and presentation of carbon reports.

Voluntary reporting

Within voluntary reporting there are two approaches which may be described as formal reporting and informal reporting. Formal reporting includes schemes which prescribe various aspects of the procedures used and the format of the report. This may carry greater credibility and be suitable for larger organisations. Informal reporting is less prescribed and may be as simple as an organisation publishing its carbon inventory and report on its website.

We discuss these approaches using examples below.

1. Formal reporting:

1.1. Carbon Disclosure Project (CDP)[57]

The Carbon Disclosure Project launched in 2000 to collect and distribute high quality information that motivates investors, corporations and governments to take action to prevent dangerous climate change.

Companies, cities, states and regions from over 90 countries now measure and disclose their greenhouse gas emissions and climate change strategies through CDP. This data is made available for use by a wide audience including institutional investors, corporations, policymakers and their advisors, public sector organizations, government bodies, academics and the public.

CDP acts on behalf of 650 institutional investors, holding US$87 trillion in assets under management and 99 supply chain members representing a combined purchasing power of over $3 trillion[58]. Over 100 of the world's states and regions and over 500 cities now measure their environmental impacts through CDP.

The CDP links with GRI (see below) to increase reporting efficiency for organisations subscribing to both programs.[59]

1.2. Global Reporting Initiative (GRI)[60]

The GRI is a sustainability reporting framework widely employed and recognised around the world. It offers a number of environmental, social and economic indicators against which organisations may report. A number of these indicators are related to carbon emissions. Organisations may thus publicly report GHG emissions as part of broader sustainability disclosures.

1.3. National Carbon Offset Standard (NCOS)[61]

NCOS is a voluntary standard to manage greenhouse gas emissions and to achieve carbon neutrality. It provides best-practice guidance on how to measure, reduce, offset, report and audit emissions for organisations, products & services, events, precincts and buildings.

[57] Info: https://www.cdp.net

[58] Info: https://www.cdp.net/en/info/about-us#6d54357de16dae873aca455b2a0757b4

[59] Info: https://www.cdproject.net/en-US/WhatWeDo/CDPNewsArticlePages/linking-up-GRI-and-CDP.aspx

[60] Info: https://www.globalreporting.org

[61] Info: http://www.climatechange.gov.au/government/initiatives/national-carbon-offset-standard.aspx

The NCOS can be used in a number of ways. Organisations can use the standard to better understand and manage their carbon emissions, to credibly claim carbon neutrality and to seek carbon neutral certification[62].

NCOS sets out the following, it:

- provides guidance on what constitutes a genuine, additional voluntary carbon offset;
- sets out minimum requirements for the verification and retirement of voluntary carbon credits;
- provides voluntary standards for calculating the carbon footprint of an organisation or product for the purposes of achieving carbon neutrality.
- issues a trademark to provide consumers with confidence that organisations and products bearing the logo are committed to carbon neutrality in a way that achieves genuine emissions reductions.

NCOS is based on Australian and international standards, many of which should by now be familiar:

- ISO 14064 – GHG accounting
- ISO 14040 – Life cycle analysis
- ISO 14064 – GHG accounting validation and verification
- The GHG Protocol
- NGER.

One can use the NCOS standard as a reference by which to conduct carbon accounting/reporting, regardless of whether the organisation wishes to become carbon neutral. Doing so does align the report with NCOS and could provide some recognition (albeit without the use of the logo) and credibility. It also provides a recognised way forward towards carbon neutrality.

The pathway to organisational/product carbon neutrality is through a basic form of carbon management, namely to:

1. **measure** its carbon footprint;
2. **reduce** emissions;
3. **offset** residual emissions.

There are recently published guidelines available detailing the process.[63] These will be very useful to you as a carbon accountant – being able to use them as a credible reference for your own processes. The Australian Government's Carbon Neutral Program[64], managed by the Department of Environment and Energy, certifies organisations products and services, events and precincts against the NCOS.

The logo may not be used unless an independent audit of the footprint has been completed and an emissions management plan has been developed. Audits should be conducted by a 'suitably qualified auditor'.

1.4. Science-based targets

A science based target (SBT) is an emissions reduction target that is aligned to the level of decarbonisation required to keep global temperature increase below 2°C of pre-industrial levels. To set a science-based target, an organisation must select the most relevant method, and then calculate an emission reduction target according to the method. SBTs do not have to be approved as such, but they can be submitted for review so that they are recognised as a committed company on the SBTi website (which is likely to incur a fee).

Many other schemes exist, some being country specific. The GHG Protocol lists more in its Appendix C.[65]

[62] Info: http://www.environment.gov.au/climate-change/government/carbon-neutral/ncos

[63] http://www.environment.gov.au/climate-change/government/carbon-neutral/publications/ncos-organisations

[64] http://www.environment.gov.au/climate-change/government/carbon-neutral/certification/carbon-neutral-program

[65] The GHG Protocol: Appendix C: p. 90.

2. Informal reporting

Formal reporting may bring increased recognition, but it is not a requirement. In reporting on carbon for the first time, the organisation may decide that it is of primary importance to report to its internal and external stakeholders. This will provide the opportunity to work closely with its internal stakeholders to further develop and refine the reporting process. The benefits include reducing costs and gaining staff support and credibility.

Publication may be by any means, but commonly occurs via organisational websites or in printed annual reports. Annual reports often include sections on both financial and environmental/sustainability/CSR (corporate social responsibility).

The inventory and report may be developed in-house by staff or externally by consultants. Regardless of which approach is taken, these reports are often verified/audited by a third party. This verification ensures that the report satisfies reasonable criteria and fairly represents the organisations position. This is a similar approach to having an external audit conducted on financial accounts. Carbon report auditing is not a legal requirement, but it does provide the organisation and the public with assurances about its accuracy. This affords the organisation some protection against criticisms of 'greenwash'.

Verifications may be conducted against the requirements of GHG Protocol or ISO14064-1. When selecting a verifier, it is important to ensure they have relevant experience and an appropriate reputation. The resulting verification will be a reflection of these and other values. The verifier will usually publish a statement to accompany the carbon report.

'Documenting the carbon inventory results' webinar. Log into your OpenLearning account here to access the recorded webinar on Module 1 Documenting the carbon inventory results.

Optional background reading and reference materials.

- NCOS: http://www.environment.gov.au/climate-change/government/carbon-neutral/ncos
- The GHG Protocol. Chapter 2: Business Goals and Inventory Design: http://www.ghgprotocol.org/standards/corporate-standard

Quizzes and assessments. Log into your OpenLearning account here to access Unit 1 Module 1 quiz.

Independent verification

Independent verification is a process by which a third party reviews the carbon inventory and the processes used to develop that inventory. It then forms an opinion on whether the inventory has applied the appropriate standards and methodologies and whether it is a fair and accurate account of the organisation's emissions. Verification is not required for all inventories but is often sought to provide assurance to the organisation, its stakeholders and the public. The GHG Protocol provides guidance for verification.[66]

Optional background reading and reference materials.

- Carbon neutrality claims: http://www.environment.gov.au/climate-change/government/carbon-neutral/certification
- The GHG Protocol. Chapter 10: Verification of GHG Emissions: http://www.ghgprotocol.org/standards/corporate-standard

[66] Info: The GHG Protocol, Ch 10.

Best practices in carbon reporting

Aside from the text components, the carbon report will contain tables and charts and other forms of graphical information. This presents data in alternative formats which help readers to assimilate the information.

Tables

A carbon report MUST include a summary of the carbon inventory. This is usually in the form of the complete Summary table prepared in the spreadsheet. This is one reason why we construct the spreadsheet as recommended under 'Develop the Inventory'.

Where the Summary table is too large or complex to include in the document in a single page, it may be broken down into smaller, logical parts such as:

- Scope 1
- Scope 2
- Scope 3
- Emissions reductions and offsets

Tables are also recommended for displaying 'inclusions and exclusions' as applied in setting operational boundaries.

Charts and graphs

Charts and graphs are an ideal alternative format for presenting complex data sets. They display relationships and allow readers to readily visualise the data. In this way, the processes of communication, interpretation, analysis and conclusions are enhanced.

Pie charts are recommended for 'point in time' data – a single data set. An example would be to use pie chart data from a single inventory emissions summary covering the period of a year. These are very typically used in carbon reports to illustrate emissions by source and emissions by Scope. Examples are Figure 9 and Figure 10.

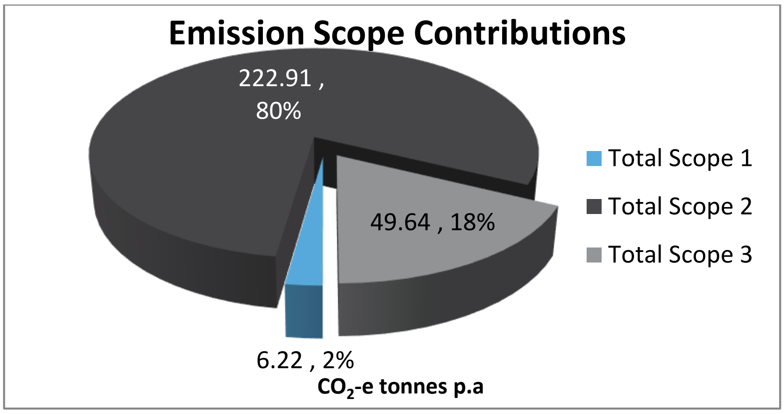


Figure 9. Example of pie chart showing emissions by Scope

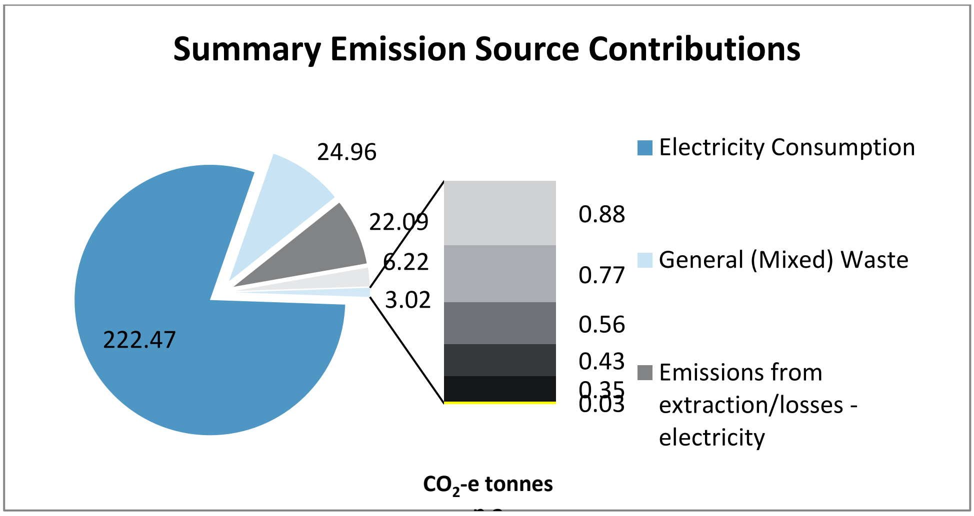


Figure 10. Example of pie chart showing emissions by source

Line graphs are recommended for time series data – a series of data sets over time. An example would be to line graph data from various inventories over a number of years, showing the trends. Figure 11 shows an example.

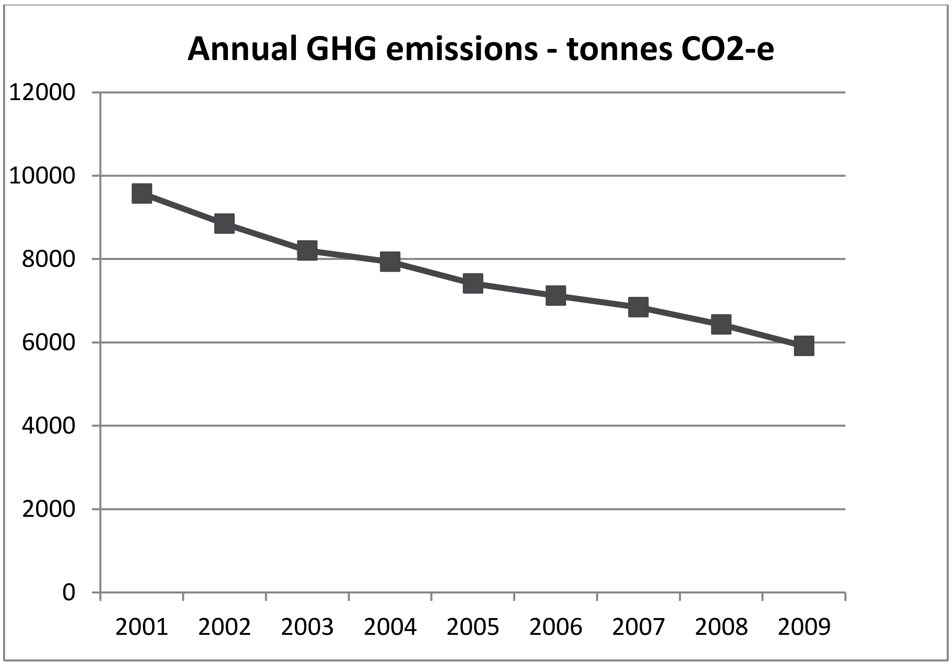


Figure 11. Example of line chart showing emissions by year

Design and style

There are several existing examples available of report design and style that an organisation's report can be based on. In addition, the organisation may have already developed financial reports or environmental reports from which data or information can be extracted.

Indicators

Two principal aspects of GHG performance are of interest to management and stakeholders. One concerns the overall GHG impacts of an organisation. That is, the absolute quantity of GHG emissions released to the atmosphere. This is often referred to as *the carbon footprint*. The other concerns the organisation's GHG emissions normalised by some organisational metric that results in a ratio indicator.[67]

Ratio indicators provide information on performance relative to an organisations type and can facilitate:

- comparisons of performance over time and through organisational changes
- comparisons between similar products, processes, services or organisations
- comparability between different sized organisations
- establishing relationships between the value of a product and its environmental or social impact
- a quick analysis of the inventory.
- It is necessary to know the organisation context before designing an appropriate indicator.

There are three types of indicator specified in the GHG Protocol:

- **Productivity/Efficiency ratios**
  These ratios express the amount of activity or value (created by the organisation) per unit of GHG emitted. In other words, the financial value or amount of output delivered for each tonne of CO_2-e released.

  > ***For example:***
  >
  > *$800 in brick sales per tonne of emissions ($800 sales/tonne CO_2-e).*
  >
  > *1,200 bricks produced per tonne of emissions (1,200 bricks/tonne CO_2-e).*

- **Intensity ratios**
  The inverse of productivity ratios, they express the amount of GHG emissions in terms of organisational output.

  > ***For example:***
  >
  > *1.25kg of emissions per $ of sales (1.25kg CO_2-e/$ sales).*
  >
  > *0.83kg of emissions per brick produced (0.83kg CO_2-e/brick).*

- **Percentages**
  A simple ratio between two amounts. Used in carbon inventories to express the emissions of an individual source as a percentage of the overall emissions total (or carbon footprint). When all lines in an inventory have percentage ratios, it is easy to compare the impact of each emissions source with all sources. It's also easy to identify high impact sources which require immediate attention.

'Documenting the carbon inventory results' webinar. Log into your OpenLearning account here to access the recorded webinar on Module 1 Documenting the carbon inventory results.

Optional background reading and reference materials.

- The GHG Protocol. Chapter 9: Reporting GHG Emissions, pages 65-67: http://www.ghgprotocol.org/standards/corporate-standard

Aligning the report with organisational requirements

In Victoria, the Climate Change Act (2017) commenced operation from 1 November 2017 and provides the legislative foundation to manage climate changes risks, maximise opportunities from decisive action, and drive Victoria's transition to net zero emissions.

[67] Info: The GHG Protocol, ch 9 p. 65.

The Act is consistent with the Framework of the Paris Climate Agreement and has a long-term target of net zero emissions by 2050. Interim targets will also be set, with targets for the 2021-2025 period to be released shortly.

For State Government departments, the State has set a reduction target of 30% below 2015 levels by 2030. While no targets exist yet for local governments, this may change in future.

Councils currently report under the Local Government Performance Reporting Framework. This Framework does not include any carbon reporting component. As such, local governments report GHG emissions on a voluntary basis and no standardised procedures or templates exist. We have a suggested a template in Module 3.

If a formal report is being produced (as is often the case for external reporting of emissions) then procedures advised by the scheme or legislation should be followed.

Examples are:

NGER Guidelines: *http://www.cleanenergyregulator.gov.au/NGER*

GRI: *https://www.globalreporting.org/resourcelibrary/G3.1-Guidelines-Incl-Technical-Protocol.pdf*

'Documenting the carbon inventory results' webinar. Log into your OpenLearning account here to access the recorded webinar on Module 1 Documenting the carbon inventory results.

Quizzes and assessments. Log into your OpenLearning account here to access Unit 2 Module 1 quiz.

Module 2. Target setting

Emissions reduction targets can be derived using several methodologies. These could include:

- one or more of the seven methods endorsed by the Science-Based Target initiative
- a more traditional approach based on the actual emissions reductions that could be achieved by the organisation within the proposed capital works budget
- a target based on the public commitments made by peers of the organisation.
- This course focuses on science-based target setting methodologies. While not perfect, these methods are the most credible and defensible that are currently available to organisations.

Science-based emissions reduction targets

Without additional efforts, anthropogenic GHG emissions are expected to increase to over 100 $GtCO_2e$ by 2100, resulting in an increase in global temperatures of 3.7°C to 4.8°C (IPCC, 2014). To avoid this temperature increase, the world must stay within a certain cumulative carbon emissions budget. To achieve this, global GHG emissions must be cut by between 49 and 72% from 2010 levels by 2050 (IPCC, 2014b). In the long term (beyond 2050), net zero emissions to the atmosphere must occur to avoid exceeding the budgeted CO_2 amount that would lead to warming higher than 2°C (Science Based Targets Initiative, 2015).

Science-based targets (SBTs) are emissions reduction targets that are based on what is **needed** to limit global warming to well below 2°C with an aspirational goal of limiting temperature increase to 1.5°C. Following the Paris Agreement, the UNGC, CDP, WWF and WRI joined forces to start the Science-Based Targets Initiative (SBTi), to guide and support companies on aligning their GHG emissions reduction targets with climate science and creating a common business practice to set SBTs. In this time, science-based targets for companies have become prevalent, with over 100 companies having targets validated by the SBTi at this time.

The key components of an SBT method are the carbon budget, the emissions scenario and the allocation approach, as shown in Figure 12.

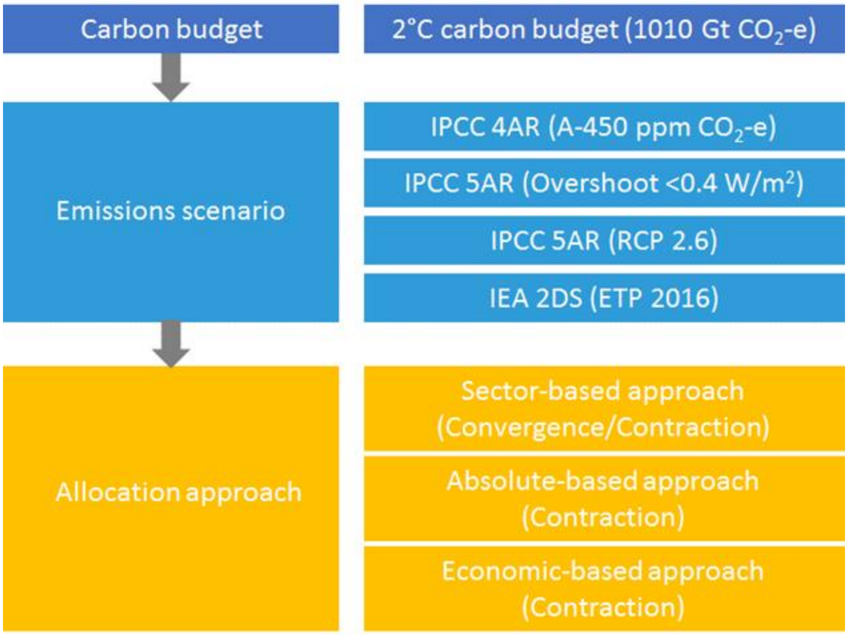


Figure 12. Main elements of an SBT setting method (SBTi, 2017)

Over time, the expectation of what constitutes an SBT may change to reflect advances in economic modelling, climate science, and global emissions reduction efforts.

Methods available

The SBTi recognises six different methods to set targets:

1. One method uses convergence of emissions intensity to create physical intensity target: *Sectoral Decarbonization Approach* (SDA). See the Sectoral decarbonisation Approach manual for more information on setting targets using this method.
2. One method uses contraction of absolute emissions to create absolute targets: *Absolute Emissions Contraction*.
3. Four methods use contraction of economic intensity to create economic intensity targets: Corporate Finance Approach to Climate-stabilizing Targets (C-FACT), Climate Stabilization Intensity Targets (CSI), Context-based Carbon Metric (CSO), and Greenhouse Gas Emissions per Value Added (GEVA).

The Science Based Targets initiative recommends companies use either the SDA or the Absolute Emissions Contraction Method to set their Scope 1 and 2 targets as these methods ensure that global emissions are reduced in absolute terms in the long term. In addition, the Science-based Target setting manual provides more information on setting targets.

Setting targets

- Emissions inventory boundary should align with recommendations in the GHG protocol corporate standard and Scope 3 guidance
- Based on SBT requirements, Scopes 1 and 2 must use science-based target setting methods such as SDA. Scope 3 targets do not have to be science-based but should be ambitious and measurable. If an organisation operates in more than one sector, it should identify the top sectors that cover the majority of its operations.
- Companies can calculate targets as a percentage reduction in absolute emissions (*absolute*), emissions intensity per unit economic output, or emissions intensity per amount of physical product (*intensity-based*). Because intensity and absolute targets each have advantages and disadvantages, the SBTi recommends expressing targets in both absolute and intensity terms.
- The company should develop an aggregated target that applies across its entire structure for external reporting and communication, although separate internal targets may be developed by sector, facility, or emissions category for ease of tracking and execution.
- Companies should set a target that covers a minimum of 5 years and a maximum of 15 years from the date the target is submitted for validation to the SBTi.

Optional background reading and reference materials.

- Science-based Target Setting Manual: http://sciencebasedtargets.org/wp-content/uploads/2017/04/SBT-Manual-Draft.pdf
- Sectoral decarbonisation Approach Manual: http://sciencebasedtargets.org/wp-content/uploads/2015/05/Sectoral-Decarbonization-Approach-Report.pdf

Quizzes and assessments. Log into your OpenLearning account here to access Unit 2 Module 2 quiz.

Module 3. Strategic planning and investment

Implications of the inventory

The carbon inventory also has implications in local government planning and carbon management. These are discussed in the following sections. The approach taken towards carbon management may initially depend on Council's business plan.

Local government planning

Numerous aspects of the existing Council plan will have implications for how a local government should manage its greenhouse gas emissions into the future. Local governments are required to provide a wide variety of services to their municipalities and enforce various federal, state and local laws for their communities. Services such as community health, safety, and emergency management are all impacted by how a local government uses energy and maintains its facilities. Local governments must also consider the ongoing operational costs of facilities and services, forecast population growth in the municipality, and the rates and fees it charges its residents when constructing a holistic greenhouse gas management plan.

If no specific plans have been made, local governments could consider broader implications such as:

1. Carbon cost

Carbon emissions have a cost to society in the form of climate change impacts. While Australia abolished the carbon price in 2014, Carbon is also priced in Australia in carbon-offset markets. In terms of accessing carbon offsets, the carbon markets classify them into two main types, being voluntary offsets and compliance offsets. In Australia (and under NCOS), most businesses and organisations have typically used voluntary offsets in the past to offset their emissions, however due to supply and demand factors (including local content requirements here in Australia), sometimes compliance offsets are also used for voluntary purposes. At present, Australian (made) carbon offsets ranges from around $15.00-$20.00. This price (point) can be decreased if blended with international offsets, potentially achieving price points around $5.00 - $10.00 depending on the mix of offsets used.

With regards to price, there are several local and international factors that may influence the supply and demand (i.e. price) of offsets here in Australia going forward.

<u>Local Factors</u>

- The number of registered projects under the Emissions Reduction Fund, including the total number of units that are not currently contracted (i.e. available supply)
- The baselines targets that are set under the safeguard mechanism which will also affect (available) supply in the secondary market.
- The average auction price paid per tonne under the ERF (currently at $11.90)
- New local and international methodologies to create offsets;
- Organisational preferences for projects type of offset (i.e. renewables, indigenous) from a particular country (i.e. Australia)
- Future policy decisions here in Australia around carbon pricing and emissions trading schemes

<u>International Factors</u>

- Developments in international trade agreements, including bi-lateral agreements
- The new rules that are currently being negotiated under the Paris Agreement including:
  - International carbon trading rules under Article 6
  - The level of ambition set by individual countries with regards to offsetting/INDCs
- The ability to import or export actual carbon offsets under both international trade agreements and the Paris Agreement
- The reliance on other Countries to purchase offsets to meet their own emissions reduction targets.
- The uptake and inclusiveness of emission trading schemes and carbon taxes globally

Markets and governments around the world have also set a cost of carbon. For example:

- Singapore has set a carbon price of $5 per tonne from 2019 to 2023, with an increase in price expected after this date;
- The European Union carbon market typically has a carbon price from $8-14 per tonne.

The cost of carbon is highly uncertain, with some estimates of future prices around $25-$50 per tonne. Given these prices and an overall carbon emissions footprint, it is possible to calculate the organisation's exposure.

> ***For example: for an organisation with annual emissions of 2,350 tonnes CO_2-e, cost =***
>
> *$10 x 2,350 = **$23,500** or;*
> *$23 x 2,350 = **$58,750** or;*
> *$50 x 2,350 = **$117,500**.*

These calculations should be considered as indicative only as they are based on several assumptions, namely that 100% of the costs of carbon permits will be passed on to the end user/ consumer. However, they can provide a useful ballpark figure for the potential carbon cost vulnerabilities of the organisation, as the future cost of carbon is a risk factor for any organisation. Knowledge of this risk allows the organisation to build suitable strategies and plans for its mitigation before the Clean Energy Legislative Package commences.

2. Energy cost

In addition to the carbon cost, other factors increase the cost of energy (electricity, gas, liquid fuels etc) over time. There are numerous reasons for these increases, aside from inflation, such as increased taxes, demand and additional environmental factors.
Examples of environmental factor could include the cost of crude oil based products due to increased legislation around air quality impacts

3. Others

To a large extent, the drivers for the development of the carbon inventory and report will determine how one analyses the results. For example:

- A Council decides it wants to reduce its carbon emissions to reflect best practice in its sector. On benchmarking the results of its inventory with peers, it discovers it is already performing well. It may decide it is satisfied with that position or to set itself targets to become the best in the sector.
- A Council decides to become carbon neutral. Looking at its overall carbon footprint (total emissions) it finds that the cost of buying offsets would be prohibitive in the current economic climate. Analysing the various emissions sources, Council finds that electricity is its largest source within the inventory. It embarks on a program to reduce its electricity consumption before proceeding with its neutrality initiative.

Optional background reading and reference materials.

- Climate Change Risks to Local Government: https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0023/73049/Climate-Change-Risks-to-Local-Government_FINAL.pdf

Carbon management

Carbon management is the measurement and control of carbon emissions. This is usually referred to within a specified boundary, such as a company or other organisation. This definition would include both carbon accounting and carbon reporting processes.

Carbon management for local governments in Victoria is voluntary at present. The reductions targets and other aims are entirely up to the Councillors, Executive Management Team and Council staff, whom are accountable to the broader local community.

Carbon management principles

As a new and potentially complex topic, the practice of carbon management benefits from a structured approach. Such a structure may be as simple as a few steps (consider waste management's "reduce, reuse, recycle" hierarchy) or as comprehensive as a management framework.

A framework for carbon management that borrows from EPA Victoria's Carbon Management Principles is outlined below. This framework consists of a comprehensive series of steps assembled into a continuous improvement cycle, and helps prioritise actions to optimise environmental and community-orientated outcomes. A diagram of the principles can be found at Figure 13.

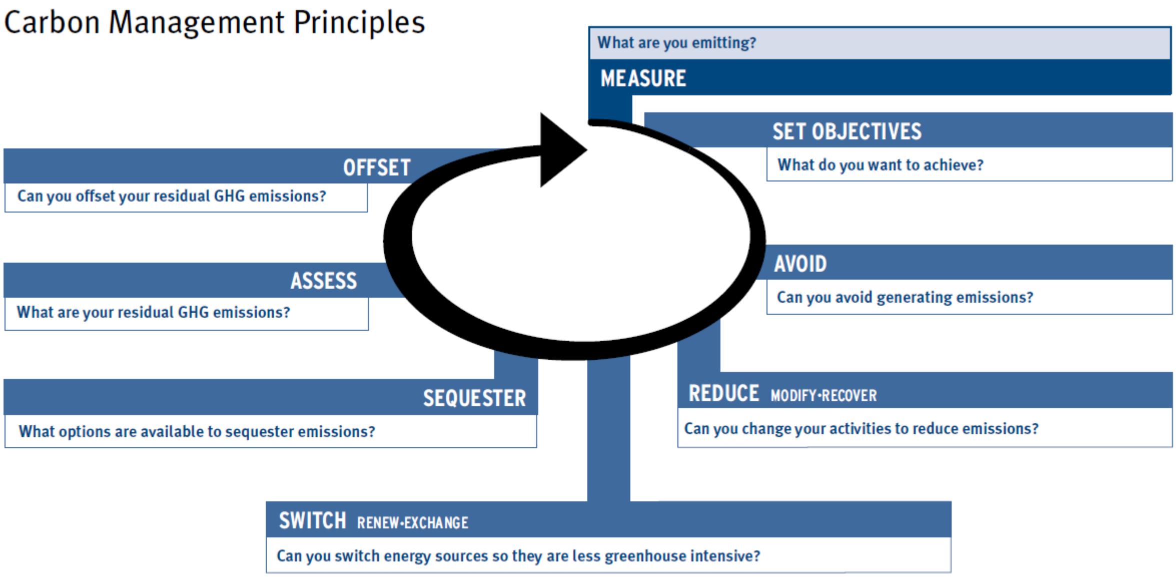


Figure 13. EPA Victoria's Carbon Management Principles[68]

The outline of the framework is as follows:

1. Measure	What is the organisation emitting?
2. Set objectives	What does the organisation want to achieve?
3. Avoid	Can the organisation avoid generating emissions?
4. Reduce	Can the organisation change its activities to reduce its emissions?
5. Switch	Can the organisation switch its energy sources to less greenhouse intensive sources?
6. Sequester	What are the options available to sequester carbon?
7. Assess	What are the organisation's residual emissions?
8. Offset	Can the organisation offset its residual emissions?

[68] Source: http://epanote2.epa.vic.gov.au/EPA/publications.nsf/2f1c2625731746aa4a256ce90001cbb5/30c54a4fad83e70bca25721400071e2c/$FILE/1154.pdf

1. *Measure*

You can't manage what you don't measure. On this principle, it's necessary to prepare a carbon inventory to use as data for informing the other seven steps. Preparation of a carbon inventory aligned with the Greenhouse Gas Protocol is covered in Unit 1 of this course.

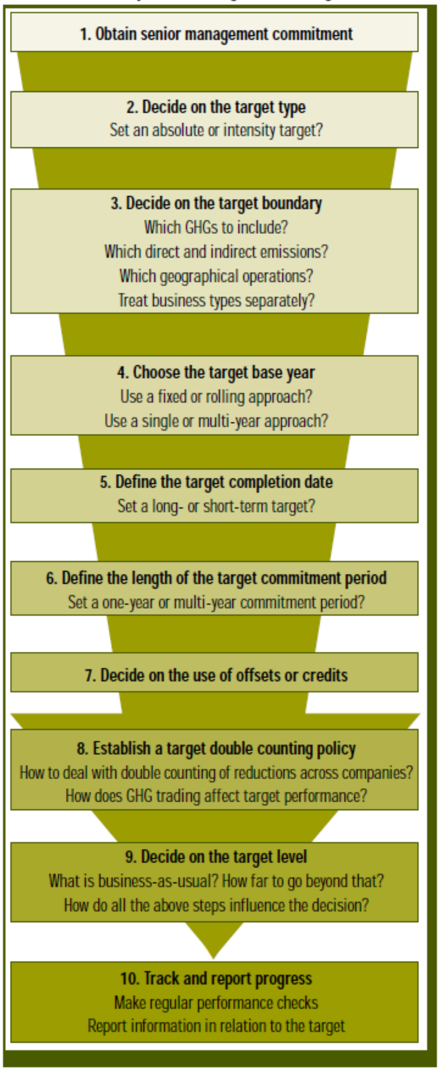
There are other approaches to the preparation of a carbon inventory. Depending on how robust an inventory you require this may be as simple as looking at your energy bills or as comprehensive as measuring each:

- stationary combustion source (e.g., boilers, power generation);
- transportation source (e.g., cars, boats, planes);
- process emission source (e.g., refrigeration, landfill methane).

At a minimum your emissions profile should include GHG emissions directly produced on site (such as fuels for boilers and vehicles) and indirect emissions from purchased electricity, heat or steam. The inclusion of other indirect emissions, such as from commercial air travel and emissions associated with purchased materials should be evaluated on a case-by-case basis.

Once measured, it is important to monitor emissions and track progress against objectives.

Steps in setting a GHG target



2. *Set objectives*

As with any corporate strategy, it is important to set clear objectives.

When setting carbon management objectives, it is worth considering short and long-term goals. If the overall goal is to go carbon neutral, then intermediate GHG reduction targets will keep you on track and ensure that early reductions are achieved.

Deciding on appropriate objectives will depend on a number of factors. For example, if a local government has reduced emissions in the past, fewer opportunities may be available compared to another local government that has never had an energy or carbon management strategy. If your local government is unsure about what is achievable, it may help to contact other Councils or Sustainability Victoria to see what others are achieving or to undertake an opportunities assessment (audit) to assist in the decision.

Setting objectives may also mean establishing criteria for determining whether to implement identified actions. For example, are you going to implement everything with a specific financial rate of return? Are you going to set aside a specific budget to reduce your GHG emissions? Will the preferred strategy optimise value against your established criteria (e.g., environmental, financial, market, reputation)?

The GHG Protocol diagram 'Steps in Setting a GHG Target'[69] outlines a comprehensive target setting process.

[69] Source: The GHG Protocol: http://www.ghgprotocol.org/files/ghgp/public/ghg-protocol-revised.pdf, p. 75.

3. *Avoid*

The best way to reduce your carbon impact is by avoiding direct GHG emissions and energy related indirect emissions. In addition to downsizing your carbon footprint, avoidance leads corporate sustainability through minimising other environmental impacts, reducing energy and other resource costs, and minimising exposure to a potential carbon price.

Avoiding energy use, for example, reduces the need for energy production, whether from greenhouse intensive fossil-fuel sources or renewable sources. Avoiding fossil fuel energy sources has the benefit of reducing direct GHG emissions, indirect emissions from fuel transport and impacts associated with extraction of natural resources.

The specific avoidance activities that you can undertake will depend on the type and magnitude of emissions sources in your inventory. Some avoidance opportunities won't require capital outlay at all, and will often be about changing behaviour.

Avoid and Reduce – what is the difference?

Avoid *describes activities through which* ***emissions can be completely stopped****, for example, not having a light on in a vacant room.*

Reduce *describes measures that* ***decrease the emissions*** *intensity of essential activities, for example, making lighting more efficient.*

Avoidance examples:

- ensuring appliances and equipment are not idling or on stand-by;

- ensuring energy is not being consumed when rooms or buildings are vacant;

- walking or riding a bike instead of driving.

Other opportunities may involve some capital outlay, but in the long term, will more than likely result in cost savings; for example:

- purchasing materials that are sourced locally to avoid emissions associated with transportation;
- meeting via telephone or videoconferencing instead of travelling to meet in person.

4. *Reduce*

Once you have identified all the ways in which you can avoid GHG emissions, the next best option is to reduce emissions from essential activities. The preferred approach to emissions reduction will depend on your circumstances. For simplicity, reduction activities have been divided into two categories — modify and recover.

a. Modify

This approach is highly applicable to most organisations.

Options to modify essential activities vary in terms of the required level of effort and cost. Options range from the 'low-hanging fruit' of changing standard light bulbs to LEDs, through to undertaking complete building retrofits. Some key measures include:

- Ensuring appliances and equipment are running efficiently; if buying new equipment, ensure it has a high efficiency rating;
- ensuring smart building design for new buildings and retrofitting old buildings. Considerations include better orientation, materials, insulation and shading;
- Considering fuel efficiency when buying a new vehicle — see http://www.greenvehicleguide.gov.au.

Behaviour change can also provide cost effective emissions reductions. For example:

- take public transport where possible;
- if you are using your car, ensure it is being driven in the most fuel efficient way.

Reducing the use of other resources will also often have a significant impact on GHG emissions. For example, more efficient use of hot water can reduce GHG emissions, energy and water consumption.

b. Recover

This approach is generally only appropriate to very specific circumstances within existing industrial processes. Outlines are included here but details are available in EPA's 'Draft Carbon Management Principles – EPA Discussion Paper'[70].

- **Cogeneration** – the production of two forms of energy from a single process. An example of this is electricity generation. The heat from the process is often removed by cooling towers and lost to the atmosphere. If that heat can be collected, it can be used to heat local premises such as public buildings or hot houses.
- **Waste gas to energy** – capturing waste gas and putting it to use as an energy source. An example being the capture of methane from landfill and burning it to produce heat or generate electricity. Note that the burning of methane releases carbon dioxide to the atmosphere, but this has a much reduced warming potential compared with methane (refer to Module 1 above).
- **Waste to energy** – This option involves extracting the energy embedded within waste as a way of producing energy. Energy can be in the form of heat and steam, liquid fuel or fuel gas. A common application is the use of waste as a supplementary fuel in cement kilns, for example, using waste tyres as an energy source.

5. Switch

As well as opportunities to reduce your net energy end use, there are also opportunities to ensure that the primary energy source you are using is being delivered in the most GHG-efficient way. This can be delivered through renewable sources, or by exchanging fuel sources to minimise GHG intensity.

a. Renew

Renewable resources are not destroyed or are readily replenished when energy is harvested. On-site installation or purchase of renewable forms of energy such as solar, wind, hydro and biomass reduces dependence on fossil fuels and significantly reduces GHG emissions.

Using renewable energy does not always have the immediate financial benefits that avoiding, modifying or recovering action items can have. The payback periods for investments in on-site renewable energy are usually medium term (4—10 years). Purchasing renewable energy is now cost-competitive with energy derived from fossil fuels, and renewable technologies will improve over time.

i. Direct renewable

Installing solar panels, wind turbines or other forms of renewable energy at your home, office or industrial facility reduces reliance on fossil fuel based electricity. These systems can either be stand alone, providing energy for just your premises, or connected back to the electricity grid. They have the added benefit of reducing distribution losses inherent in centralised power generation.

ii. Purchased renewable

Electricity from renewable energy sources can be purchased from accredited electricity retailers through the GreenPower scheme. Through this scheme, accredited renewable energy such as solar, wind, hydro, biomass or wave is purchased on your behalf. Every unit of accredited GreenPower energy purchased will ensure equivalent renewable energy is supplied to the grid reducing the energy supplied from other sources. It comes

[70] Info: http://epanote2.epa.vic.gov.au/EPA/publications.nsf/2f1c2625731746aa4a256ce90001cbb5/30c54a4fad83e70bca25721400071e2c/$FILE/1154.pdf

at a small additional cost to your regular electricity bill, but ensures that your power has very low greenhouse impact. Electricity providers can offer you different levels of GreenPower based on your budget and technology preference. For more information go to www.greenpower.gov.au.

Biofuels are made from renewable sources and can be blended with traditional fuels to lower greenhouse intensity or used as the sole fuel source. A full life-cycle assessment should be undertaken to examine the full greenhouse and other environmental impacts and benefits of this fuel source.

b. Exchange

If you can't avoid using fossil fuels, you can still choose fossil fuels with lower greenhouse intensity. For example, electricity generation from natural gas has lower greenhouse intensity than coal-fired electricity. Using LPG to power your vehicle has a lower greenhouse impact than petrol. When considering these options, it is important to take into account the efficiency of energy sources. If the efficiency of delivery is low this can have a negative impact on the net greenhouse outcome.

6. Sequester

The action items prior to Sequester have focused on decreasing the sources of GHG emissions to the maximum extent achievable. Another key component of carbon management can be to reduce atmospheric GHG concentrations through natural or artificial GHG (usually carbon) sequestration. The Emission Reduction Fund (ERF) supports methodologies to quantify carbon reductions to create Australian Carbon Credit Units, which can be sold or retired to offset emissions.

This option is limited by the available methodologies under the ERF. In Victoria, the majority of ERF projects involve revegetation, landfill and waste, agriculture, and energy efficiency.

7. Assess

Now that you have gone through the process of reducing your on-site GHG concentrations you should look back on your original objectives.

If you are not meeting the objectives you set for energy use or greenhouse gas emissions reduction, are there reduction opportunities you have not considered? Do you need to change the decision criteria for which opportunities you implement?

8. Offset

A carbon offset is any project that indirectly reduces GHG emissions at one source by investing in GHG emissions reductions elsewhere. Offset products most typically involve projects that invest in renewable energy, energy efficiency and reforestation. Including offsets in a carbon management strategy generally involves purchasing GHG reduction credits from an offset scheme provider.

Carbon offsets are commonly considered a legitimate means of reducing the net impact of energy use and GHG emissions, provided that they form part of a broader greenhouse management strategy and are derived from verified projects that create actual emissions reductions.

Offsets are the last in the order of carbon management action because of the importance of first considering 'at-source' options for reducing energy use and GHG emissions. For those wanting to become carbon neutral in their operations, offsetting will, in most cases, form a necessary component in an integrated carbon management strategy.

The Federal Department of the Environment and Energy supported the Carbon Market Institute to develop Australia's Carbon Marketplace. It is important that anyone planning to purchase carbon offsets conducts appropriate research to ensure that products have been appropriately verified to deliver the net environmental outcomes claimed. For further guidance on purchasing offsets go to:

- http://www.environment.gov.au/climate-change/government/carbon-neutral/ncos-eligible-offsets
- https://www.epa.vic.gov.au/about-us/environmental-performance/greenhouse-gas-inventory/offsets-and-reduction-measures
- https://carbonneutral.com.au/carbon-offsets/

9. Review

Not shown in the Carbon Management Principles diagram. Carbon management is not a static process. Regular review is essential to ensure you make the most of new practices and technologies as they emerge over time. Energy and other costs (including the cost of offsets) will change over time, necessitating regular review and optimisation of the carbon management strategy.

As the implementation of avoidance and reduction actions increases, the need to sequester or offset your emissions should decrease, increasing environmental and operational benefits over time.

This principle represents the 'continuous improvement' aspect of the framework.

Optional background reading and reference materials.

- The GHG Protocol. Chapter 2: Business Goals and Inventory Design: http://www.ghgprotocol.org/standards/corporate-standard

Learning activity – Carbon management: Your own organisation

1. List some emission AVOIDANCE opportunities for your Council

2. List some emission REDUCTION opportunities for your Council

Identifying carbon management options

So far, we have covered the theory of carbon management using EPA Victoria's principles as an example. To be useful, the theory must be applied to the organisation's situation. The following is based on an assumption that a carbon inventory has been developed and a carbon report is being prepared for a local government.

A carbon inventory is useful as a tool for communicating information on various aspects of an organisation's emissions. It may be used to discern focus, direction and set targets regarding emissions. The targets will generally be to reduce emissions (otherwise known as 'carbon minimisation').

Once targets have been set, activities must be scheduled in order to achieve them. The question is what are those activities? This is where the carbon management framework is useful. When the framework is applied to the inventory, it is possible to identify and prioritise opportunities, thus optimising environmental and organisational outcomes.

This type of analysis will assist local governments in their forward planning processes.

Optional background reading and reference materials.

- The GHG Protocol. Chapter 11: Setting a GHG Target: http://www.ghgprotocol.org/standards/corporate-standard

Quizzes and assessments. Log into your OpenLearning account here to access Unit 2 Module 3 quiz and Unit 2 final assessment.