Accounting for and Reporting of Greenhouse Gas (GHG) Emissions

Dr Maria Balatbat

School of Accountingand the Centre for Energy for Energy and Environmental Markets (CEEM)

Learning Objectives:

1. Introduction to GHG accounting
2. Understand the key elements in establishing a GHG inventory using the Greenhouse Gas Protocol;
3. Learn to calculate of GHG Emissions and how these are reported by organisations
4. Awareness of other frameworks and guidance
5. Limitations of accounting for GHG

Pre-Reading/References

World Business Council for Sustainable Development and World Research Institute, 2004, *The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard*, WBCSD and WRI, Geneva and Washington.

PricewaterhouseCoopers, 2009. *Typico plc, Greenhouse Gas Emissions Report: An illustration for business climate change and greenhouse gas emissions reporting*, Dublin.

DIICCSRT, 2013, National Greenhouse Accounts (NGA) Factors, July 2013, read pp 5-9; 11-20.

Useful websites:

www.ghgprotocol.org

www.wbcsd.org

http://www.climatechange.gov.au/climate-change/greenhouse-gas-measurement

Fundamentals of Accounting for Greenhouse Gas (GHG)

- What is GHG Accounting?

  ...a way to account for the emissions and reductions of greenhouse gases in the atmosphere
- Why account for GHG gases?

  ... you can not manage what you do not measure
- Standards and protocols used (GHG protocol, ISO 14064)
- Sources of GHGs (6 GHGs covered by Kyoto Protocol)
- Global warming potential (GWP)
- Distinction between carbon and CO_2
- Setting boundaries
- Setting reduction targets

Features of the GHG Protocol

Purpose: Provide standards and guidance for companies to prepare their GHG inventory

Mission: develop internationally accepted GHG accounting and reporting standards for business and to promote their broad adoption

Covers so called Kyoto Protocol gases - (i.e. **carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O),** hydrofluorocarbons (HFCs), **perfluorocarbons** (PFCs), and sulphur hexafluoride (SF_6)

Program and policy neutral

Comprise of two separate but linked standards

- Corporate Accounting and Reporting Standard (guide to quantifying GHG emissions)
- Project Quantification Standard (focus on quantification of GHG reductions)

Expected users

- Businesses developing its GHG inventory
- Policy makers and architects of GHG programs

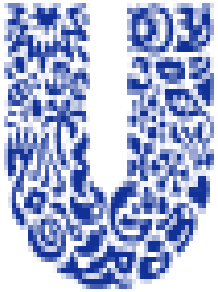
Why there is a need for a GHG inventory?

Common Business Goals for developing GHG Inventory include:

- Comply with the reporting of mandatory programs (e.g. NGER Act, Kyoto Protocol, EU ETS etc.)
- Manage GHG risks and identify reduction opportunities
- Increasing regulations make emissions a risk to businesses
- Public reporting and participation in voluntary GHG programs
- Increasing stakeholders' interest on corporate disclosure (consumers, employees, socially responsible investors)
- Participation in Greenhouse Friendly and other accredited programs
- Participation in the carbon markets (voluntary or mandatory)
- Recognition of early voluntary action

  (Note: Early voluntary action that are not documented may not be recognised by future regulation)

Examples of Companies that Measure and Report GHG Emissions



Step-by-step guide to accounting and reporting GHG inventory

1. Set temporal, organisational and operational boundaries
2. Track emissions over time
3. Identify and calculate GHG emissions
4. Manage inventory quality
5. Account for GHG reductions
6. Report GHG emissions
7. Verify GHG emissions
8. Set GHG targets

1. Setting Operational Boundaries (emissions boundary)

Define the GHG emission sources from within the organisational boundary (note that operational is different from organisational boundaries)

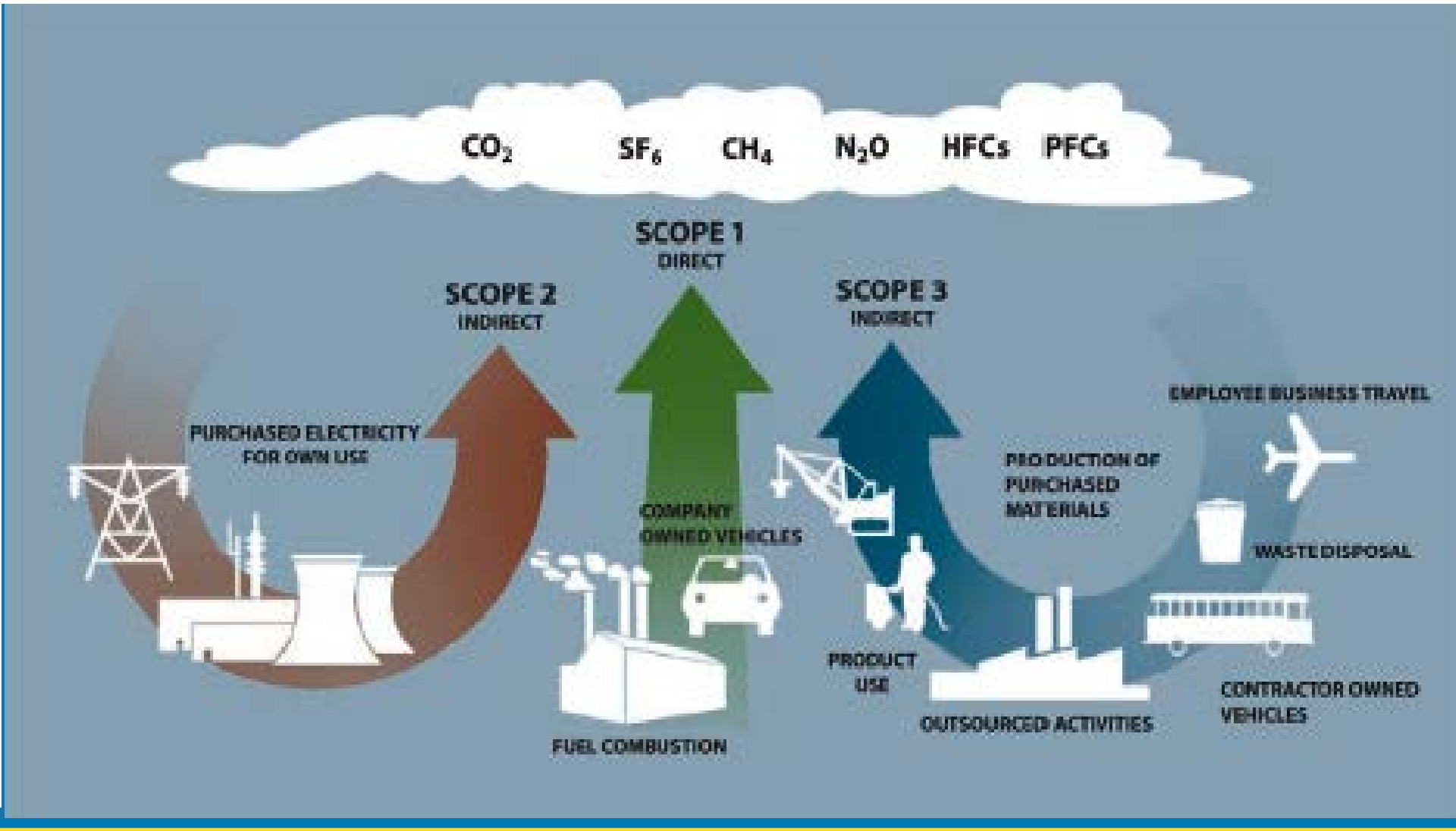
For example: Electricity use, transportation, air travel, use of boilers and furnaces and other energy consumption

Effective and innovative GHG management requires a comprehensive coverage of its direct (scope 1) and indirect (scope 2) emissions

- Direct emissions – those emitted from **sources owned or controlled by the entity/company** (e.g. generation of electricity, heat or steam – boilers, furnaces, turbines)
- Indirect emissions – **emissions from purchased electricity** consumed by the company in its owned and controlled equipment or operations

Scope 3: Other indirect emissions – those emitted as a consequence of the activities of the company but **occur at sources owned by another company**

Breakdown of Emission Sources



Source: New Zealand Business Council for Sustainable Development

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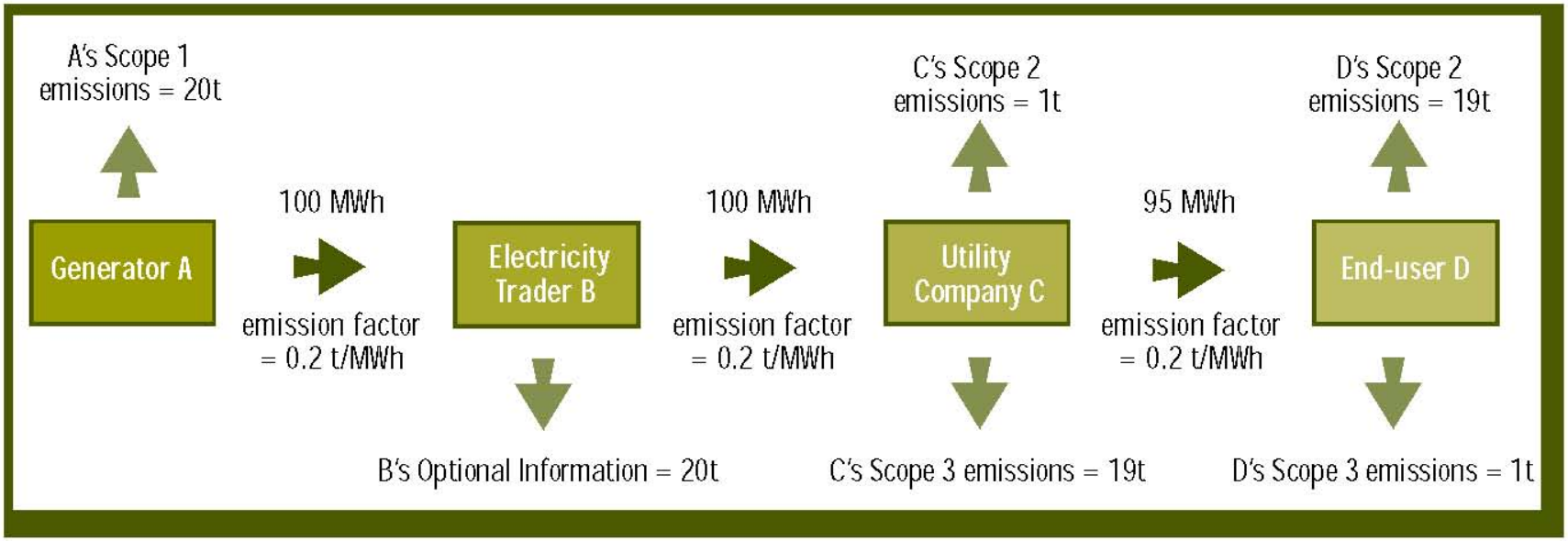
The distinction between sources of emissions is necessary to avoid double counting of the same emission sources by various organisations by assigning responsibility for emission sources based on ownership or control. What is considered to be direct and indirect may depend on how the company consolidates it emissions inventory (i.e. equity share or control)

FIGURE 4. **GHG accounting from the sale and purchase of electricity**



(Source: GHG Protocol: A Corporate and Reporting Standard, page 29)

2. Track emissions over time

Choose and report base year

- Choose a base year for which verifiable emissions data must be available and explain reasons for doing so
- Base year could be a single year or an average over certain consecutive year
- E.g. 1990 is Kyoto base year; average during 1998-2001 emissions is the base year for Chicago Climate Exchange

Develop a policy for recalculation of base year emissions if a significant change occurs:

- structural changes in the reporting organisation (merger, acquisition, divestment);
- changes in calculation methodology or improvements in in the accuracy of emission factors used or activity data that will result in a significant impact to base year emissions data; or
- discovery of significant errors.

3. Identify sources and calculate GHG emissions

Identify sources of emission (Scope 1, Scope 2 and Scope 3 emissions)

Select a calculation approach

- Direct measurement (through the use of continuous emissions measurement technology)
- Calculation-based (activity data is converted to GHG emissions by way of emission factors)
- Estimation
- Note that some standards or registry require ranking of the quantification methods used by levels of accuracy

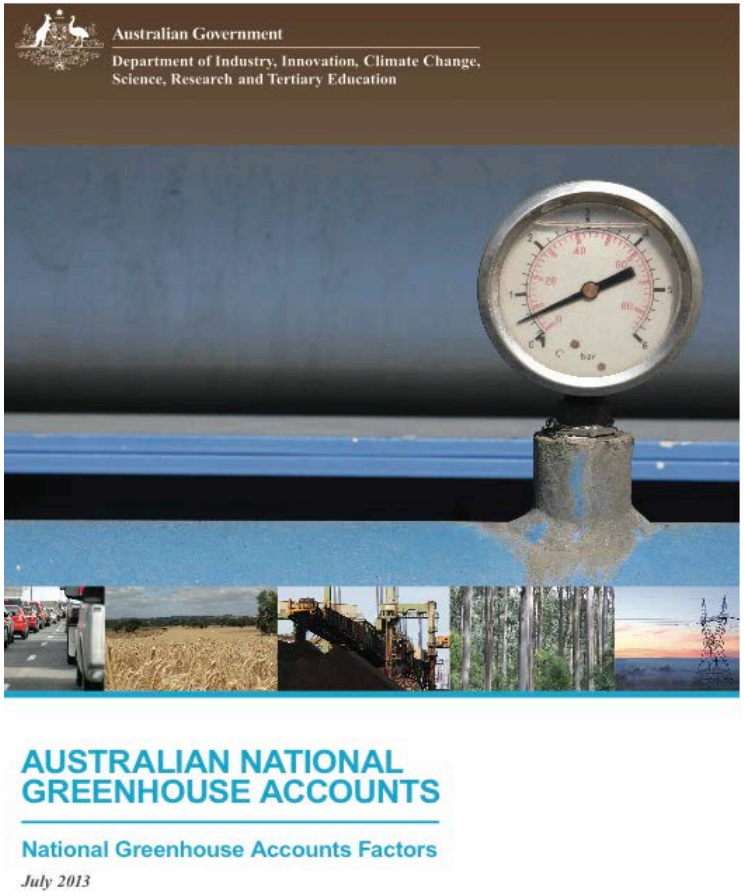
Collect data and choose emission factors

Apply calculation tools

Roll-up data to corporate level

- Centralised (sites report activity data and GHG emissions are calculated at head office)
- Decentralised (sites report GHG emissions)

References – Calculation of GHG Emissions



- National Greenhouse Accounts
- National Greenhouse and Energy Reporting (Measurement) Determination.

Available at:

http://www.climatechange.gov.au/climate-change/greenhouse-gas-measurement

Measurement Methods for Scope 1

Method 1: the National Greenhouse Accounts (default method based on national average estimates)

Method 2: generally a facility-specific method using industry sampling and Australian or international standards listed in the Determination or equivalent for analysis of fuels and raw materials to provide more accurate estimates of emissions at facility level.

Method 3: generally a facility-specific method using Australian or international standards listed in the Determination or equivalent standards for both sampling and analysis of fuels and raw materials (additional reporting required over Method 2)

Method 4: direct monitoring of emission systems, either on a continuous or periodic basis.

Source: DIICCSRT, National Greenhouse and Energy Reporting (Measurement) Determination, July 2013

Common Unit Conversions

Starting Unit	Target Unit	Multiplier
kWh	MWH	.001
Lb.	Kg	.45359237
Lb.	Metric tons	.00045359237
Kg	Metric tons	.001

Refer to DIICCSRT, National Greenhouse and Energy Reporting (Measurement) Determination for more unit conversions

Other points to consider when calculating GHG emissions

- Several GHGs are emitted to the atmosphere when fossil fuels are burnt; for example combustion of liquid fuels emits carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O)
- Different GHGs have different global warming potential (GWP) – i.e. rate that it traps heat in the atmosphere; See National Greenhouse and Energy Reporting (Measurement) Determination for GWP for most pollutants
- GHG emissions from all gases are aggregated using CO_2 as the benchmark and converted to CO_2-e using GWP as conversion (where $CO_2 = 1$)
- Emission factors provided have considered the GWP

Culprits
(Source: UNEP/GRID-Arendal - http://maps.grida.no/go/graphic/main_greenhouse_gases1

Gas (regulated by Kyoto Protocol)	1998 Level (Pre-industrial level) (in ppm)	Lifetime (in Years)	Main Human Activity source	Global Warming Potential (GWP)
Carbon dioxide (CO_2)	365 (280)	50-200	Fossil fuel, cement production and land use change	1
Methane (CH_4)	1.75 (0.70)	12	Fossil fuel, rice paddocks, waste dumps, livestock	21
Nitrous Oxide (N_2O)	0.31 (0.27)	114	Fertilizers, combustion and industrial processes	310
Chlorofluorocarbon (CFCs)	1.4×10^{-5} (0.0)	100	Refrigerants	Various
HCFC	7.5×10^{-7} (0.0)	13	Industrial processes	1,500
Sulfur hexafluoride (S_6)	4.2×10^{-6} (0.0)	3,200	Industrial processes	22,200

(See also Australia's National Greenhouse Gas (NGA) Factors for GWP of other gases)

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Example of GHG Calculation – Fuel used for transport energy

Example: calculation of emissions from transport fuels consumed

A freight company consumes 10000 kL of automotive diesel for transport purposes.

Emissions of greenhouse gases (carbon dioxide, methane and nitrous oxide) in tonnes of CO_2-e are estimated as follows: :

Emissions of carbon dioxide:

= (10,000 x 38.6 x 69.2)/1,000

Where do we start?

Example 1:

Ask questions such as:

Type of activity? Delivery of goods to customers

Source of emission? Freight trucks owned by the organisation

Type of emission: Scope 1

Data required: Type of fuel consumed by freight trucks (and volume/quantity of fuel used

Source of data: bills, invoices or meter readings

Other information required: Emission Factors for this type of activity See pages 11 to 20 of National Greenhouse Accounts (NGA) Factors

Example of GHG Calculation – Fuel used for transport energy

Table 4: Fuel combustion emission factors -fuels used for transport energy purposes

Transport equipment type	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
General transport					
	Gasoline (other than for use as fuel in an aircraft)	34.2	66.7	0.6	2.3
	Diesel oil	38.6	69.2	0.2	0.5
	Gasoline for use as fuel in an aircraft	33.1	68.3	0.04	0.7
	Kerosene for use as fuel in an aircraft	36.8	68.9	0.01	0.7
	Fuel oil	39.7	72.9	0.06	0.6
	Liquefied petroleum gas	26.2	59.6	0.6	0.6
	Biodiesel	34.6	0.0	1.2	2.2
	Ethanol for use as fuel in an internal combustion engine	23.4	0.0	1.2	2.2

Example of a Formula to estimate GHG emissions for Scope 1

$$E_{ij} = \frac{Q_i \times EC_i \times EF_{ijoxec}}{1\,000}$$

where:

E_{ij} is the emissions of gas type (j), (carbon dioxide, methane or nitrous oxide), from fuel type (i) (CO_2-e tonnes).

Q_i is the quantity of fuel type (i) (tonnes).

EC_i is the energy content factor of the fuel (gigajoules per tonne) according to each fuel in Table 1.

If Q_i is measured in gigajoules, then EC_i is 1.

EF_{ijoxec} is the emission factor for each gas type (j) (which includes the effect of an oxidation factor) for fuel type (i) (kilograms of CO_2-e per gigajoule) according to each fuel in Table 1.

Example of GHG Calculation – Fuel used for transport energy

= 26,711 t CO_2-e

Emissions of methane:

= (10,000 x 38.6 x 0.2)/1,000

= 77 t CO_2-e

Emissions of nitrous oxide:

= (10,000 x 38.6 x 0.5)/1,000

= 193 t CO_2-e

Total scope 1 GHG emissions = 26711 + 77 + 193

= 26,981 t CO_2-e

This is the level of emission for this activity for a period of time

Examples of GHG calculation

For other Scope 1 Examples, See pages 11 to 20 of National Greenhouse Accounts (NGA) Factors

For other emission factors: See Australian GHG Factors and methods workbook for reference available at: (http://www.climatechange.gov.au/)

There are other websites that may provide some guidance in the calculation of GHG emissions in Europe for example

- http://www.decc.gov.uk/
- http://www.defra.gov.uk/

Example 2

Type of activity: Consumption of electricity

Type of emission: Always Scope 2

Sources of data: bills, invoices or meter readings

Other information required: Emission Factors for this type of activity See pages 11 to 20 of National Greenhouse Accounts (NGA) Factors

Scope 2 Example- Purchased Electricity

Table 5: Indirect (scope 2) emission factors for consumption of purchased electricity from the grid

State, Territory or grid description	Emission factor kg CO_2-e/kWh
New South Wales and Australian Capital Territory	0.87
Victoria	1.17
Queensland	0.82
South Australia	0.62
South West Interconnected System in Western Australia	0.78
Tasmania	0.20
Northern Territory	0.69

Sources: National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Schedule 1)

Example: calculation of emissions from electricity consumption

A company in New South Wales consumes 100,000 kWh of purchased electricity from the grid.

Emissions of greenhouse gases (scope 2) in tonnes of CO_2-e are estimated as follows:

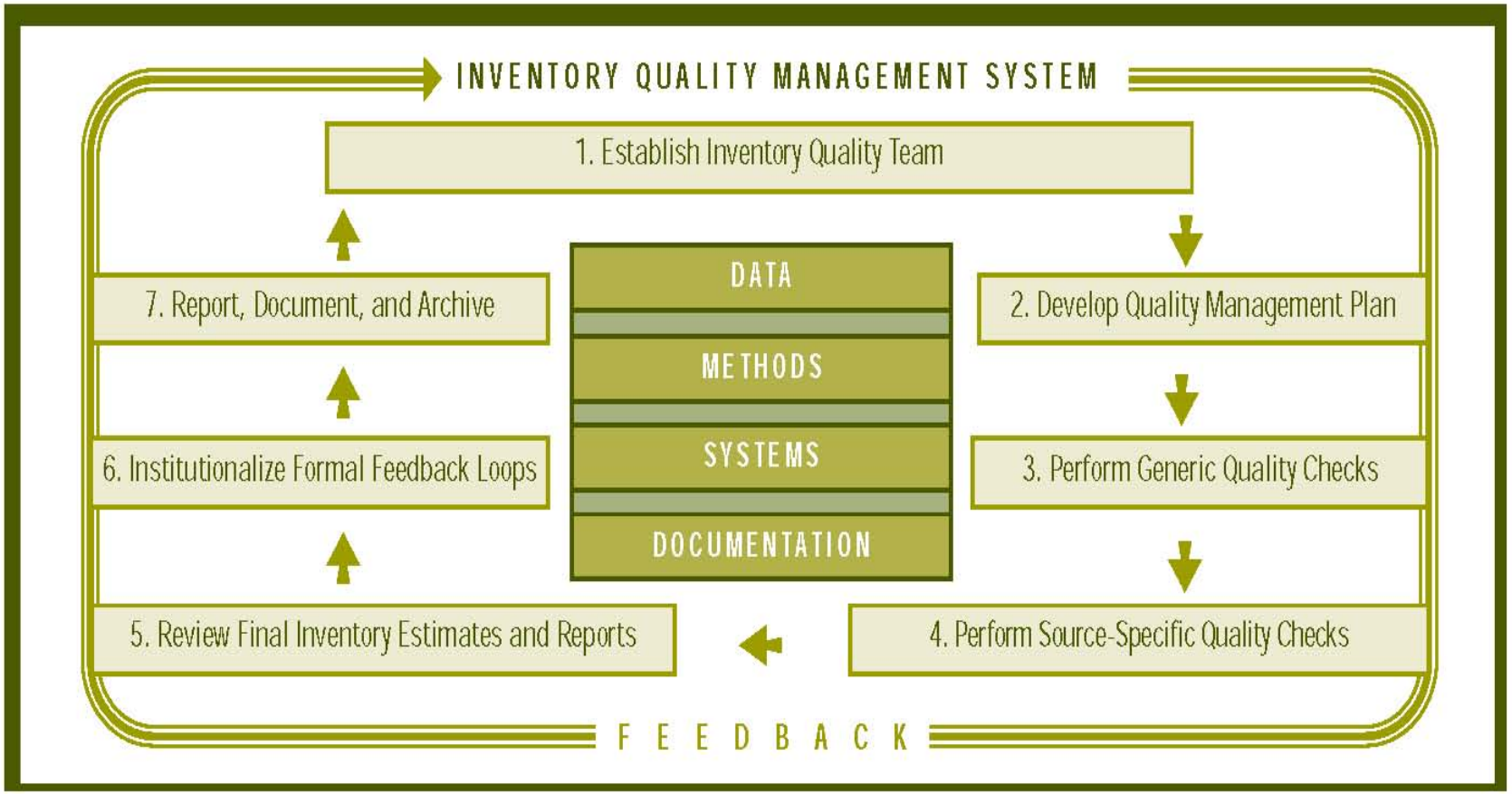
= 100,000 x (0.87 /1000)

= 87 tonnes.

Total scope 2 GHG emissions = 87 tonnes CO_2-e

3. Managing Inventory Quality

FIGURE 11: **Inventory quality management system**



(Source: GHG Protocol: A Corporate and Reporting Standard, page 51)

5. Accounting for GHG Reductions

Corporate GHG reductions

- Reductions in indirect emissions (not always a real reduction in emissions)

Project based reductions and offsets and credits

- Select baseline scenarios (Business as Usual)
- Demonstrate additionality
- Identification and quantification of relevant secondary effects
- Consideration of reversibility
- Avoidance of double counting

6.Reporting for GHG emissions

Summary of GHG emissions for the year ended 31 December 2009

CO_2e emissions ('000 tonnes)	Note	Performance		Adjusted Baseline	Target	Percentage Change	
		2009 Assured*	2008	2006	2012	2008 /2009	2006 /2009
Scope 1	2,3,4	432	521	645	364	-17%	-33%
Scope 2	2,3,4	1,293	1,386	1,494	1,038	-7%	-13%
Total gross controlled emissions	2,3,4	**1,725**	**1,907**	**2,139**	**1,402**	**-10%**	**-19%**
Scope 3	2,3,4	7,245	7,320	8,001	6,101	-1%	-9%
Total gross emissions	2,3,4	8,970	9,227	10,140	7,503	-3%	-12%
Renewable electricity purchased in the UK	1.9	(12)	(89)	-	-		
Renewable electricity sold to grid		(946)	(500)	-	(1,038)		
Voluntary carbon offsets		(1,725)	(1,907)	-	(1,402)		
Net emissions		6,287	6,731	10,140	5,063	-7%	-38%

Greenhouse gas emission intensity

CO_2e '000 tonnes / £m turnover	Industry benchmark#	2009	2008	Baseline 2006	Target 2012
Scope 1	0.150	0.100	0.157	0.229	0.057
Scope 2	0.400	0.299	0.418	0.531	0.162
Scope 3	1.500	1.675	2.208	2.841	0.953
Total	2.050	2.074	2.783	3.601	1.172

[Description of industry benchmark used]

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Contrast between a Carbon Footprint and Ecological Footprint

Carbon footprint is the amount of carbon (usually in tonnes) being emitted by an activity or organization.

Ecological Footprint takes a slightly differing approach, translating the amount of carbon dioxide into the amount of productive land and sea area required to sequester carbon dioxide emissions. This tells us the demand on the planet that results from burning fossil fuels.

This is usually measured in number of planets, where one planet is equal to the earth's biocapacity in a given period.

In 2005 humanity's ecological footprint was 2.5 times that of 1961 and exceeded the earth's biocapacity by a third

7. Verification of GHG emissions

Verification is an objective assessment of the accuracy and completeness of reported GHG information and the conformity of this information to pre-established GHG accounting and reporting principles.

Relevant to companies who are developing GHG inventories and have planned for, or are considering, obtaining an independent verification of their results and systems

Verification involves an assessment of the risks of material discrepancies in reported data.

Prioritization of effort by the verifier towards the data and associated systems that have the greatest impact on overall data quality

8. (Why) Set GHG Targets

- Minimise and manage GHG risks
- Achieve cost savings and stimulate innovation
- Prepare for future regulation
- Demonstrate leadership and corporate responsibility
- Participate in voluntary programs (Greenhouse Friendly, Energy Efficiency Program, NSW)

Consider: What are the pros and cons of reporting emission levels (absolute) versus intensity ratios in setting GHG targets

Steps in setting GHG Targets

a) Obtain senior management commitment
b) Decide on target type
c) Decide on target boundary
d) Choose target base year
e) Define target completion date
f) Define the length of the target commitment period
g) Decide on the use of offsets and credits
h) Establish a target double counting policy
i) Decide on target level (BAU, How far back do you go?
j) Track and report progress

Standards and Protocols used to account for GHGs

Jurisdiction	Guidance or Standard	Scope 1	Scope 2	Scope 3
International	GHG Protocol: Accounting and Reporting Standard (2004)	Yes	Yes	Optional
International	ISO 14064-1, 2 & 3: GHG Accounting & Verification (2006)	Yes	Yes	Optional
Australia	National Greenhouse And Energy Reporting Streamlining Protocol (2009)	Yes	Yes	Optional
North America	The Climate Registry (TCR): General Reporting Protocol (2008)	Yes	Yes	Optional
International	BSI PAS 2050: Specification for the Assessment of Life Cycle GHG Emissions of Goods & Services	Yes	Yes	Yes
International	BSI PAS 2060: Specification for the Demonstration of Carbon Neutrality	Yes	Yes	Yes
UK	DEFRA Guidance: How to Measure and Report Your GHG Emissions	Yes	Yes	Optional
International	GHG Protocol: Product Life Cycle and Supply Chain Standards	Yes	Yes	Yes
International	ISO 14067-1 & 2: Carbon Footprint of Products	Yes	Yes	Yes
International	Climate Disclosure Standards Board (CDSB)	Yes	Yes	Optional

Regulatory Report: NGER Report

UNCLASSIFIED: FOR OFFICIAL USE ONLY

Australian Government
Clean Energy Regulator

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NATIONAL GREENHOUSE AND ENERGY REPORTING
SECTION 19 - ENERGY AND EMISSIONS REPORT

FOR THE REPORTING YEAR 2013 – 2014

Report under Section 19 of the National Greenhouse and Energy Reporting Act 2007

Corporations registered under Division 3 of Part 2 of the *National Greenhouse and Energy Reporting Act 2007* (the NGER Act) are required to provide a report to the Clean Energy Regulator (the Regulator) by 31 October each year in respect of the previous financial year relating to:

- greenhouse gas emissions; and
- energy production; and
- energy consumption;

from the operation of facilities under the operational control of the corporation and entities that are members of the corporation's group, during that financial year.

A report under section 19 of the NGER Act must be given in a manner and form approved by the Regulator and set out the information specified in the *National Greenhouse and Energy Reporting Regulations 2008* (the NGER Regulations). The report must also be based on the methods, or methods which meet criteria, set out in the *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (the Measurement Determination).

This report is an approved form in which a report under section 19 of the NGER Act may be given to the Regulator.

Giving false or misleading information is a serious offence.

Submitting the Report

The approved manner for submission of the section 19 report is completion and submission of the report in the Emissions and Energy Reporting System.

Your report must be submitted to the Regulator by 31 October 2014.

If a copy of this report is printed in hardcopy form for any purpose it does not represent, nor can it be treated as, an official version of the report submitted to the Regulator.

Example NGER Report

GHG emissions	Energy Consumption	Energy Production
2,500,000 tCO2-e	3,000,000 GJ	500,000 GJ

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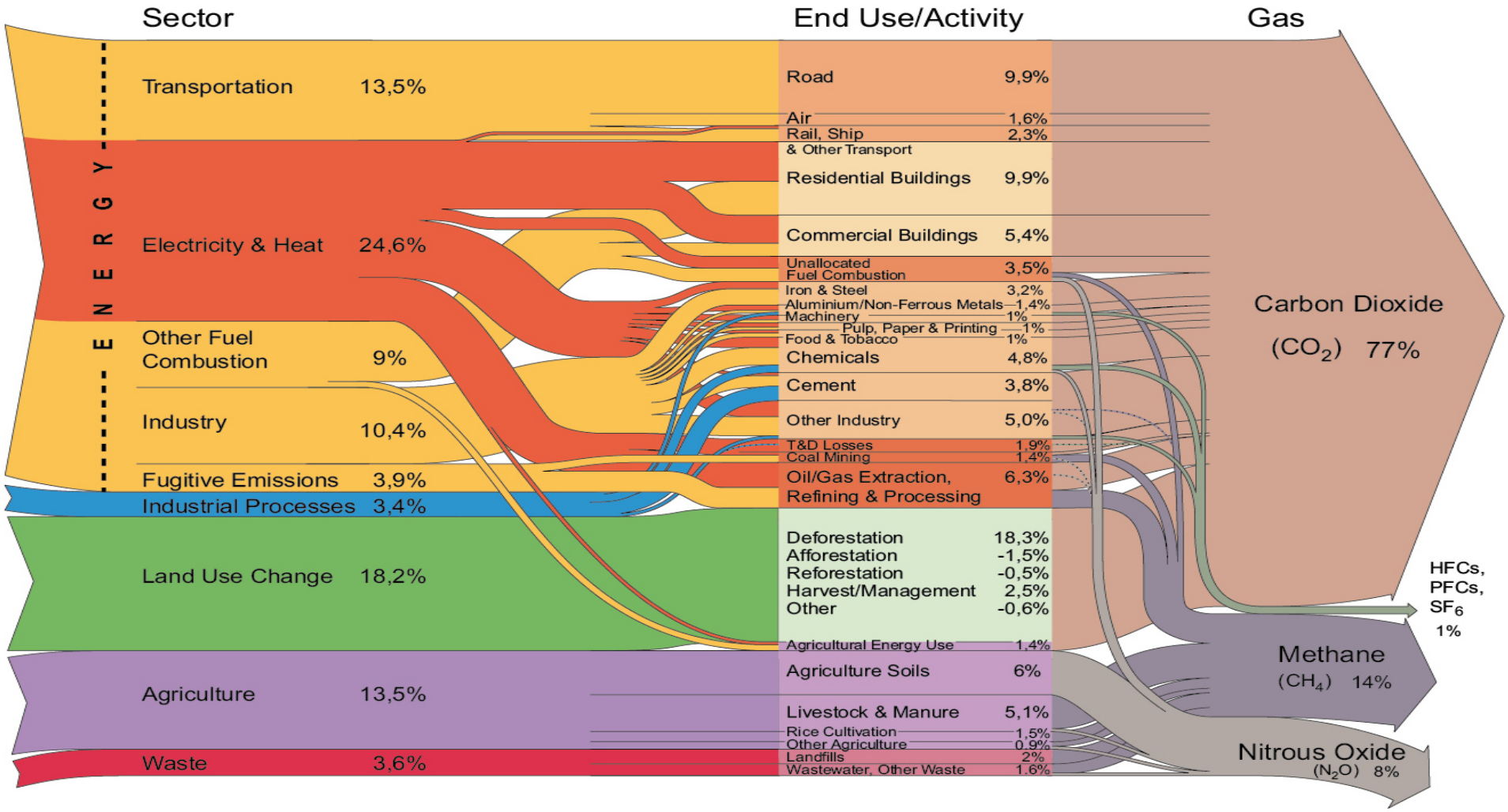
World Greenhouse gas emissions by sector



All data is for 2000. All calculations are based on CO_2 equivalents, using 100-year global warming potentials from the IPCC (1996), based on a total global estimate of 41 755 MtCO_2 equivalent. Land use change includes both emissions and absorptions. Dotted lines represent flows of less than 0.1% percent of total GHG emissions.

Source: World Resources Institute, Climate Analysis Indicator Tool (CAIT), Navigating the Numbers: Greenhouse Gas Data and International Climate Policy, December 2005; Intergovernmental Panel on Climate Change, 1996 (data for 2000).