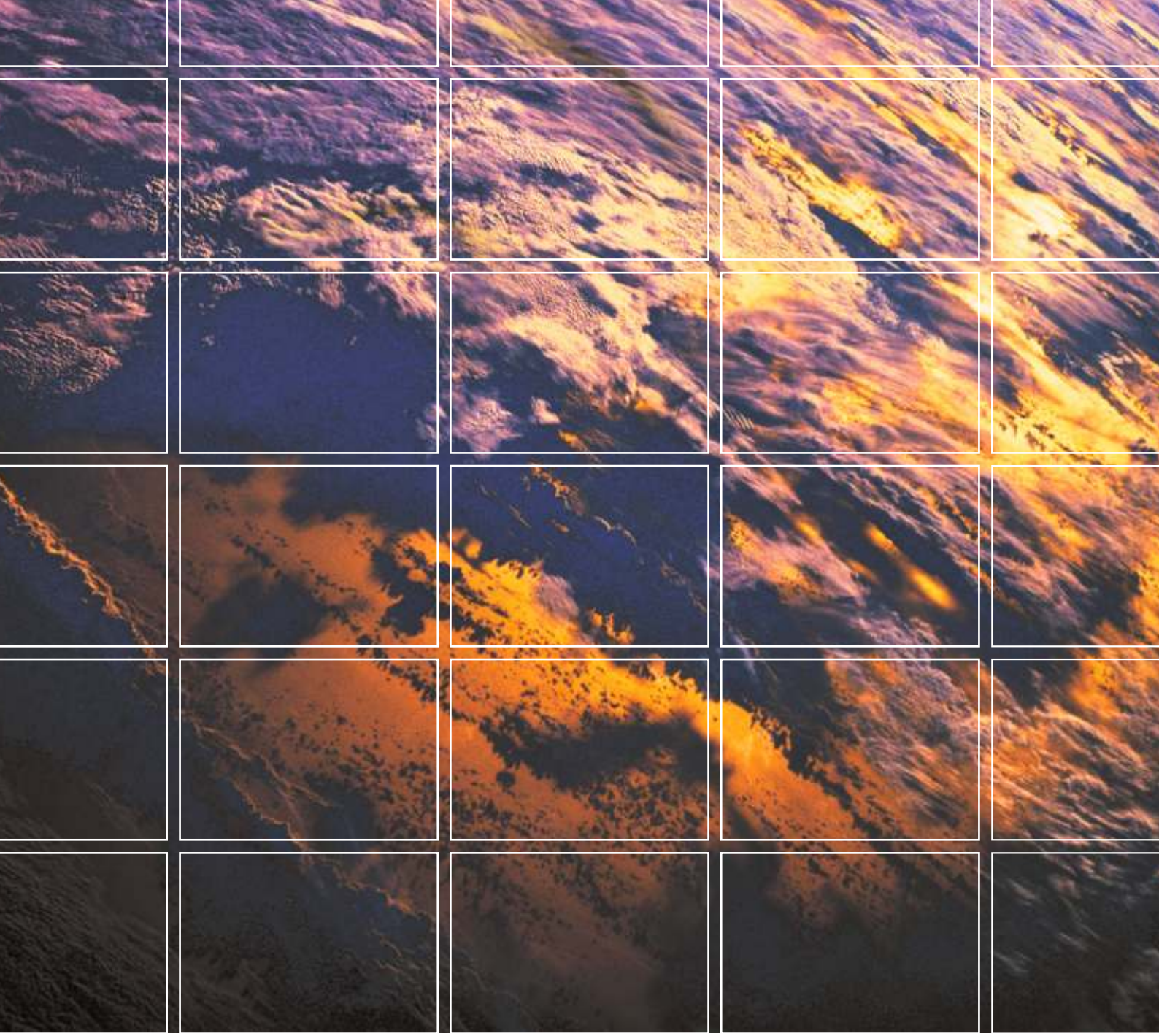


Greenhouse Gas Footprinting for New Zealand Seafood: Overview and User Guide for GHG Tool

Ministry of Fisheries

Final Report

July 2009

www.erm.com

Delivering sustainable solutions in a more competitive world

ERM

FINAL REPORT

Greenhouse Gas Footprinting for New Zealand Seafood:

Overview and User Guide for GHG Tool

July 2009

Environmental Resources Management
Commerce House, Level 2, 13 Commerce Street
PO Box 106234, Auckland City 1143
New Zealand
Telephone +64 9 303 4664
Facsimile +64 9 303 3254
www.erm.com

FINAL REPORT

Prepared for Ministry of Fisheries

Greenhouse Gas Footprinting for New Zealand Seafood

Overview and User Guide for GHG Tool

July 2009

Reference: 0094959

For and on behalf of
ERM New Zealand Limited

Prepared by: Peter Garrett

Signed:
Position: Senior Consultant

Date: 8th July 2009

Approved by: Matthew Klein

Signed:

Position: Managing Partner

Date: 8th July 2009

CONTENTS

CONTENTS

1 INTRODUCTION

Environmental Resources Management (ERM) in collaboration with JTK Risk Solutions was commissioned by the Ministry of Fisheries (MFish) in partnership with the Ministry of Economic Development (MED), New Zealand Seafood Industry Council (SeaFIC), and Aquaculture New Zealand (AQNZ) to undertake a study of the greenhouse gas (GHG) emissions footprint of New Zealand seafood and to develop a tool measure the product carbon footprint for the following seafood catch methods:

1. Aquaculture:
    a. Intertidal shell fish culture;
    b. Sub-tidal long line shellfish; and
    c. Sub-tidal sea cage fish culture.
2. Wild Capture – Processed at sea:
    d. Trawling; and
    e. Long lining.
3. Wild Capture—Fresh landed product
    f. Diving/ hand gathering;
    g. Dragging methods: Trawl/ dredge/ troll;
    h. Pot/ trap;
    i. Seining; and
    j. Long lining.

The tool is intended for use by individual seafood businesses to voluntarily assess their own products and associated operations and supply chains.

This method has been developed to be consistent with the requirements of PAS2050 which is recognised internationally as best-practice for measuring a product's carbon footprint. It provides a basis for potential product GHG labelling, and is consistent with other sector studies in New Zealand.

This report provides an *overview and simple user guide* for the Excel-based GHG calculation tool for measuring the GHG emissions footprint of different seafood products.

1.1 BACKGROUND

Concerns regarding the environmental impacts of food production and the potential effects of climate change have grown in focus globally over several years. The trend to demonstrate the environmental performance of products and services, initiated by major United Kingdom supermarket chains, became

of critical interest when New Zealand products were used as an example of 'food miles' based on assumptions that long distance transport generates a relatively large GHG footprint. This in-turn led to 'buy local' campaigns from domestic competitors.

In response, the New Zealand Government has initiated a series of projects to support the export sectors by ensuring they are able to meet customer demands and that these export sectors are in a good position to utilise emerging GHG footprinting standards, such as PAS 2050.

Many land-based primary sectors, such as lamb, dairy and kiwifruit, have already partnered with Government on sector-specific projects to measure and manage their GHG footprints as an industry as a whole.

1.2 AIM THE FOR THE SEAFOOD SECTOR

As part of the same overall strategy, the MFish in partnership with the MED, SeaFIC and AQNZ, has developed a GHG method and tool to measure the GHG emissions for New Zealand seafood.

The goal of this work was to develop an internationally credible and practical footprinting method which can be independently verified and is convenient for use by individual businesses.

The method provides a platform for seafood businesses to voluntarily manage and to reduce the GHG footprint of their products.

1.3 BUSINESS BENEFITS

The method, tools and guidance will provide valuable insights to help measure and reduce emissions, including:

- a baseline against which to measure reductions;
- identification of the main drivers or 'hot spots' for GHG emissions in the life cycle – and therefore direction for effort to most effectively seek opportunities to reduce emissions;
- identification of the scale of opportunities for GHG reduction and therefore offer a process to identify the best value for money (ie GHG benefit per dollar spend and payback analysis) of potential reduction opportunities; and
- a basis to provide consumer information and for product GHG labelling.

The reduction of GHG emissions usually provides direct reductions in business financial costs due to the savings that are made on fuel and energy bills and reduced use of materials and equipment.

The method and tools were developed with support of several case study companies which participated in using the Excel tool. This has helped to provide a robust method and guidance.

1.4 REDUCTIONS OPPORTUNITIES

It may be useful to classify opportunities according to who has control over each driver or 'hot spot' (eg industry-wide, market/customers, supply chain, internal, etc). Actions to implement reductions, along with their cost (both GHG and financial) and feasibility, can then be identified and measured to match the specific business situation.

At a general level, the following is a list of common emission reduction opportunities:

For energy use:

- increase proportion of energy from renewable sources.

For production processes:

- decrease waste volumes;
- increase scale;
- decrease amount of processing; and
- change manufacturing practices and improve efficiency.

For transport and distribution:

- decrease heating/cooling in storage and transport; and
- decrease distances travelled.

For business management decisions:

- include energy/carbon criteria in purchasing/supplier choices;
- include energy/carbon criteria in design decisions;
- change product design/configuration/materials (eg use recycled rather than virgin materials);
- change technology choice (eg upgrading equipment to be more energy efficient); and
- improve inventory management.

1.5 LIMITATIONS OF THE GHG TOOL

The tool is requires further development in the following areas:

- *Emission factor data*: The tool only contains emission factors from publicly available sources. These factors do not cover a significant proportion of the equipment that is specific to the seafood sector. The tool contains 'blank data' for these items. Consequently, the tool cannot calculate GHG emission for these items. Further development is needed in this area.

- *Allocation rules*: The tool does not include the functionality to calculate the allocation rules for on-vessel processing, fishing equipment and reusable packaging which need to be calculated manually.

2 GHG CALCULATION TOOL

A 'carbon footprint' is a term used to describe the quantity of greenhouse gas emissions that result from a particular activity and provides a way for organisations to assess their contribution to climate change.

For a product or service the carbon footprint is a measure of the GHG emissions throughout the supply chain of the product or service, from raw material extraction, through to product manufacture, use and disposal.

Historically, many companies that measure their global warming impacts have focused on their own business emissions, but now there is increasing demand and concern with emissions across their entire supply chain.

Accompanying this report for the *Overview and User Guide for GHG Tool* is the report titled *Greenhouse Gas Footprinting for New Zealand Seafood: Method Report* which provides further definition and discussion for the seafood sector.

2.1 MEASURING GHG PERFORMANCE

For seafood, GHG emissions are measured on the basis of the "*unit weight of seafood product at the point of stabilisation*".

For example, one tonne of blue cod landed on-shore fresh on ice. This is a clearly understood unit within the industry and one that provides a clear basis for comparison.

The term 'stabilised' has been defined as 'the first point, onshore, at which the seafood is considered to be stable, prior to further processing'.

The point of stabilisation varies depending on the seafood sub-sector, species and catchment method, as shown in *Table 2.1*. The amount on pre-processing required in order to produce a stabilised product will vary, both in terms of the activities undertaken and whether these occur on-vessel or on-shore.

The following two catchment methods are not significant in New Zealand, but have been shown in *Table 2.1* for the purposes of completeness.

1. Aquaculture:

    c. Sub-tidal sea cage fish culture.

3. Wild Capture—Fresh landed product:

    i. Seining - Danish seine.

Table 2.1 Seafood Catch Method

Seafood Sub-Sector	Method of Catchment	Sub-Method of Catchment	Species	Description of Output Product (ie at point of stabilisation)
1. Aquaculture	a. Intertidal shell fish culture	Rack and sticks	Pacific oysters	Shucked and half shell
	b. Sub-tidal long line shellfish	Drop line	Mussels	Shucked and half shell
	c. Sub-tidal sea cage fish culture	Cages	Salmon, kingfish	Landed fresh or live
			flat fish and butterfish	
		Barrels	Paua	Landed fresh or live
2. Wild Capture – Processed at sea	d. Trawling	Bottom water and mid-water	Multi species	Cartons of pre-processed fish as fillet, mince, block and meal
	e. Long lining	Bottom	Multi species	Whole - pre-processed frozen in freezer holds and bulk stored in cages
			Multi species	Pre-processed, frozen and packaged in cartons
			Multi species (eg tooth fish)	Whole - gilled, gutted and frozen
3. Wild Capture—Fresh landed product	f. Diving/ handgathering	-	Paua, rock lobster (Chatham Islands only)	Landed live (no ice)
	g. Dragging methods	Trawl	Multi-species	Fresh on ice
		Dredge	Bluff oysters and scallops	Shucked and some half shell
		Troll	Albacore tuna	Fresh whole on ice
	h. Pot/ trap		Rock lobster	Landed live (no ice)
			Blue cod and paddle crabs	Landed fresh on ice
	i. Seining	Purse seine	Jack mackerel, kahawai and skip jack tuna	Fresh, whole on ice
		Danish seine	Not applicable	Fresh, whole on ice
	j. Long lining	Dahn lining	Multi species	Fresh whole on ice
		Surface lining	Multi pelagic species (eg tuna, shark)	Headed, gutted and fresh on ice; or Whole fresh on ice
		Bottom lining	Multi species	Headed, gutted and fresh on ice; or Whole fresh on ice

2.2 *ASSESSMENT BOUNDARY*

For seafood, the boundary reflects a partial life cycle which is analogous to a business-to-business assessment[1].

The boundary only focuses on GHG emissions for the specific fishing catchment methods that are unique to the sector up to the point of fish stabilisation, as listed below and shown in *Table 2.1*.

1. Aquaculture:
    a. Intertidal shell fish culture;
    b. Sub-tidal long line shellfish; and
    c. Sub-tidal sea cage fish culture.
2. Wild Capture – Processed at sea:
    d. Trawling; and
    e. Long lining.
3. Wild Capture—Fresh landed product
    f. Diving/ hand gathering;
    g. Dragging methods: Trawl/ dredge/ troll;
    h. Pot/ trap;
    i. Seining; and
    j. Long lining.

The system boundary does not include downstream sources of GHG emissions, for example, relating to processing, canning, smoking, distribution, export, retail, consumption and disposal.

Nonetheless, a beneficial and significant future development for the study would be to assess the entire life cycle and to include all downstream activities in the entire supply chain. As such, the method developed herein aims to be compatible with future extension and inclusion of these down stream life cycle stages at a later stage.

[1] Some seafood businesses are vertically integrated which means that they control the supply chain from fishing through to distribution and retail. In these cases, the boundary would not be considered a business-to-business assessment under PAS 2050, but the boundary would need to be expanded to reflect the actual business activities to point where the product arrives at the new organisation.

2.3 SOURCES OF EMISSIONS

2.3.1 Emission Sources to be Included

In general terms, the primary contributors to the seafood sector GHG emissions include the following:

- fuel use for sea vessels (for transport and on-vessel processing);
- materials, electricity and packaging used for processing;
- refrigerant gas usage;
- replacement of fishing equipment and repairs; and
- transport between processing steps.

2.3.2 Emission Sources to be Excluded

The areas that are excluded from an assessment relate to the following list:

- emissions from downstream activities (eg processing, distribution, consumption and disposal) beyond the point of product stabilisation;
- purchased carbon credits are excluded and should be reported separately;
- human energy inputs;
- transport of employees to and from normal place of work (note, all business paid for travel is included);
- animals providing transport;
- production of capital goods;
- carbon uptake of living organisms, for example, indirect uptake to form shell and bone;
- seafood metabolism; and
- land use changes, including seabed damage.

3 DATA COLLECTION

3.1 PRIMARY DATA COLLECTION

Data shall be collected from those processes owned, operated or controlled by the organisation implementing the carbon footprint study. When assessing the complete life cycle, only implementing organisations that contribute 10% or more in the life cycle need to collect primary data.

This means that all seafood companies that use the tool will need to gather primary data of their operations. Examples include: fuel bills which indicate diesel usage; financial records of materials purchased and consumed; and using quota management system data to indicate the quantity of species caught. The data need to reflect the conditions normally encountered.

The tool has been developed to clearly identify the data required to populate the tool for each catchment method. In practice, this requires the business to input detailed data in relation to their business operations and detailed data relating to transport of materials and consumables used by the business.

The collection of primary data does not apply to downstream emission sources beyond the organisation or where physical measurement is needed.

3.2 SECONDARY DATA COLLECTION

Secondary data shall be used for inputs where primary activity data is not required. This applies to all data downstream of the business. Secondary data refers to published reports and generic data sources that are not specific to the business or supply chain.

Secondary data is often used to enable consistency and comparability across results and is preferable in these circumstances. This applies usually to use of emissions factors (eg mass of CO_2e emitted per 1kWh of NZ electricity supply) and global constants or conversion factors, including the following:

- global warming potential of greenhouse gases;
- electricity emissions (in kg CO_2e per kWh) from various energy sources;
- commodity chemical/material production emissions per kg;
- fuel emissions per litre;
- transport emissions per km per vehicle type; and
- waste emissions per kg.

These relevant factors are contained within the tool, although, the limitation in terms of missing emission factors should be noted.

4 CALCULATING GHG FOOTPRINT

4.1 QUANTIFYING GHG EMISSIONS

Quantifying GHG carbon footprint involves aggregating the sum of all materials, energy and waste across all activities (within the assessment boundary) multiplied by their emission factors. The calculation itself involves multiplying the activity data by the appropriate emission factors, as shown below:

Carbon footprint of a given activity =

Activity data (mass/volume/kWh/km) × Emission factor (CO2e per unit)

4.2 QUANTIFICATION PROCESS

The following general process is used to calculate the GHG emissions:

1. Primary activity data and secondary data shall be converted to GHG emissions by multiplying the activity data by the emission factor for the activity.
2. GHG emissions data shall be converted into CO_2e emissions by multiplying the individual GHG emissions figures by the relevant GWP.
3. The impact of carbon storage associated with the product shall be expressed as CO_2e and deducted from the total calculated at step 2 above.
4. The results shall be added together to obtain GHG emissions in terms of CO_2e emissions per unit.
5. The GHG emissions shall then be scaled to account for any minor exclusions.

When conducting steps 1 to 3 above, the method laid out for seafood should be adhered to, for example, relating to exclusions, allocation rules, carbon storage, etc which are described below.

5 DETAILED CALCULATION PROCEDURES

Section 5 provides some detailed guidance on the specific calculation procedures required to calculate a carbon footprint. These procedures relate to specific areas of consideration when conducting a footprint study, including the following:

- materiality thresholds;
- mass balance;
- species caught;
- transport;
- on-vessel fuel and material use;
- fishing equipment;
- packaging;
- re-assessment;
- uncertainty; and
- verification.

5.1 MATERIALITY AND THRESHOLDS

All emissions within the system boundary that have potential to make a material contribution shall be included in the assessment.

For GHG emissions arising from the life cycle of a product, except those from the use phase, this shall include:

- at least 95% of the total anticipated emissions; and
- if a single source of emissions accounts for more than 50% of the emissions, the 95% threshold rule shall apply to the remaining GHG emissions.

The above thresholds also apply separately to the use-phase (if this phase were to be included in the boundary).

Where less than 100% of the anticipated emissions have been determined, the emissions shall be scaled up to represent 100%.

The following estimation for the contribution of different activities as a percentage of total global warming impacts up to point of stabilisation is as follows:

- Offices:
    - *administration activities: estimated as under 1%*

- Pre-trip:
    - *consumables*: estimated as under 1%
    - *packaging*: estimated as under 2%
    - *refrigeration*: estimated as 5% - 40%
    - *vessel maintenance and repair*: estimated as under 2%
    - *fishing equipment*: estimated as under 2%
    - *business travel*: estimated as under 2%
- Fishing vessels:
    - *fuel use*: estimated as 20% - 90%
- Discharge:
    - *fuel and energy use*: estimated as under 1%
- Materials transport:
    - *fuel use*: estimated as under 5%

As outlined above, up to 5% of emissions can be excluded from the total footprint. Where exclusions occur, the emissions will need to be scaled back up to represent 100%. The tool will not automatically calculate any underestimation, which requires manual calculation.

5.2 MASS BALANCE CHECK

In addition the above general procedure, any assessments should also conduct a mass balance check, as described below:

- *Mass balance*: Calculating the carbon footprint normally requires a 'mass balance' to be conducted which ensures that all materials have been fully accounted for and no streams are missing. The fundamental concept is that the total mass flowing into a process must equal the total mass flowing out. Therefore ensuring that all input, output and waste streams are accounted for.

5.3 SPECIFIC CALCULATION PROCEDURES

There are circumstances where specific calculation procedures are required to determine the seafood activities. Some processes may yield more than one product (ie a co-product) and they may also recycle intermediate products or raw materials. When this occurs, the study is required to allocate the GHG emissions to the different products.

The general approach to allocation is for it to be avoided altogether where possible by either dividing the process into sub-processes or expanding the assessment boundary.

Where allocation is necessary, this shall occur between the co-products in proportion to the economic value.

The following rules apply for seafood in the specific cases listed below:

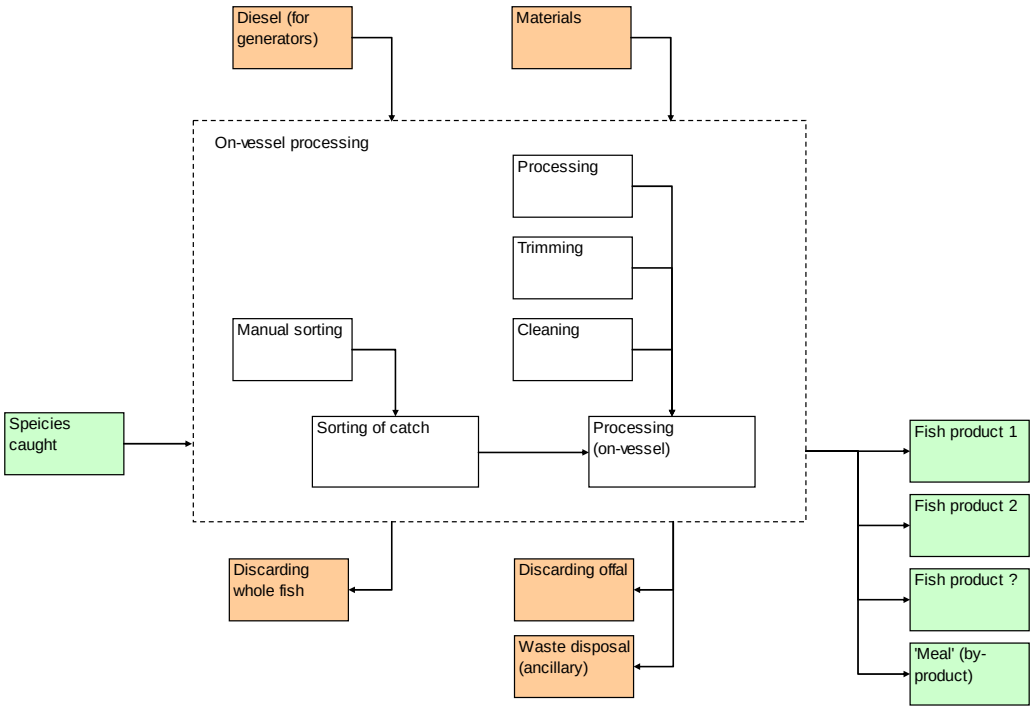
- *Species caught*. The most significant implication of this allocation rule occurs for seafood where multi species are caught by a single catchment method. In order to allocate the GHG emissions associated with catchment to an individual species this will need to occur based on the economic value of the total of each species caught. Under the quota management system data are recorded for mass of species caught by individual holders of quota. The tool allows for data to be input for mass and economic value, and allocation will be calculated automatically. It should be noted that prices vary over the fishing season and a weighted average over the year for the business conducting the assessment needs to be determined.

- *Transport*. Where more than one product is being transported (eg by truck, ship, aircraft, train) the emissions from transport system shall be shared amongst the products on the basis of mass or volume, whichever is the limiting factor. Emissions associated with the return journey must also be included. The seafood tool has accounted for these allocation rules by requesting appropriate data from the user.

- *On-vessel fuel and material use*: For the *Wild Capture – Processed at Sea* catchment methods, a variety of on-vessel processing may occur depending on the species and the output product. All operations are either conducted manually (ie not requiring additional activities which in involve GHG emissions) or are powered by the on-vessel generation system (eg diesel powered). Operations include, for example, refrigeration, freezing, sorting, cutting, trimming, drying, grading and packing, etc. Depending on the output fish product from on-vessel processing, the level of processing may vary, for example where some species require more handling/processing operations than others. Additionally, offal (ie the by product of processing) and unwanted fish maybe sent to a *meal plant* (where these operations exist) which minces and dries the product to a powder called *meal*. Meal is used as feed for fish and other animals. Meal represents a co-product which also needs to be accounted for. Boats that have *on-vessel processing* represent a multi-output process and allocation of inputs is required based on the level of processing received. As mentioned, all on-vessel operations are powered by the engines (which operate generators). An allocation is needed for inputs of diesel and materials (including refrigerant use) based on economic throughput of fish for particular operations, as well as for waste outputs. *Figure 5.1* illustrates the process requiring allocation. For fuel

use, a weighting factor may be estimated based on energy consumption of individual processing equipment employed, as a proportion of energy consumption for all equipment, multiplied by a factor for economic throughput, and aggregated.

Figure 5.1 On-vessel Fuel and Material Use



- *Fishing equipment*: Where fishing equipment is used (for example, nets, buoys, lines, etc) which have a longer lifetime than the 12-month assessment period, then allocation is required in order to apportion the equipment used to the assessment time period. Allocation may be based on component lifetime in years. For example, if a buoy weighs six kilograms and is used for three years, then the allocated weight of the buoy over the twelve month period will be six kilograms divided by three years, which equates to two kilograms. The weighting factor for each material is as follows:

$$\textit{Weighting factor} = \frac{\textit{Assessment period (years)}}{\textit{Equipment lifetime (years)}} \times \textit{Material weight (kg)}$$

- *Packaging:* Where packaging items are used more than once (eg for wooden pallets) then the environmental impact associated with the items production needs to allocated according to a single use per unit mass (ie 1kg) of fish product. In this case, the following data are required: packaging materials and weights, packaging capacity (eg mass load or volume load, whichever the limiting factor), number of reuses. The mass of each packaging material therefore allocated as follows:

$$\textit{Weighting factor} = \frac{\textit{Fish weight (kg)}}{\textit{Packaging capacity (weight) x Number of uses}}$$

Other additional rules may be necessary relating to those items listed below, although currently these activities are not known to be occurring for seafood and are not explained further here.

- waste;
- combined heat and power (CHP) plants;
- recycled materials;
- remanufacture; and
- delayed emissions.

5.4 REASSESSMENT OF GHG EMISSIONS

Any carbon footprint results shall be valid for a maximum period of two years, at which point a reassessment should occur, except in the following cases:

- where an unplanned change to the life cycle results in an increase of more than 10% of GHG emissions (for a period of more than three months) a reassessment shall be carried out; and
- for a planned change, the above rule applies for an increase of 5%.

5.5 UNCERTAINTY

There are no requirements to quantify or to record uncertainty.

5.6 VERIFICATION PROTOCOLS

In accordance with the requirements of PAS2050, any claims of conformance shall be made in the principal documentation or on the packaging provided for the product for which the claim is being made, in accordance with BS EN ISO/IEC 17050-1 (BSI, 2004) and in the form relevant to that particular claim.

The claim shall identify the type of conformity assessment undertaken as one of the following three levels:

1. independent third party certification;
2. other party verification; or
3. self verification.

6 EXCEL CALCULATION TOOL

6.1 EXCEL CALCULATION TOOL FOR SEAFOOD GHG EMISSIONS

There are four separate MS Excel calculation tools which cover the catchment methods shown in *Table 6.1*.

Table 6.1 Excel Calculation Tool

Seafood Sub-Sector	Method of Catchment	Tool Name
1. Aquaculture	a. Intertidal shell fish culture	1. NZ Seafood - Aquaculture.xls
	b. Sub-tidal long line shellfish	1. NZ Seafood - Aquaculture.xls
	c. Sub-tidal sea cage fish culture	1. NZ Seafood - Aquaculture.xls
2. Wild Capture – Processed at sea	d. Trawling	4 NZ Seafood - Trawl_Longline_Seine.xls
	e. Long lining	4 NZ Seafood - Trawl_Longline_Seine.xls
3. Wild Capture—Fresh landed product	f. Diving/ handgathering	3. NZ Seafood - Dive&Handgathering.xls
	g. Dragging methods	4 NZ Seafood - Trawl_Longline_Seine.xls
	h. Pot/ trap	2. NZ Seafood - Pot&Trap.xls
	i. Seining	4 NZ Seafood - Trawl_Longline_Seine.xls
	j. Long lining	4 NZ Seafood - Trawl_Longline_Seine.xls

The tool has been developed with the aim to be as simple as possible to use and to introduce commonality and consistency across the four tools wherever possible.

6.1.1 Tool Development Process

The tool has been developed through an iterative process, where initially a draft calculation tool was developed and provided to seafood companies in New Zealand to use, test and to comment on for each of the different catchment methods.

6.1.2 Tool Structure

The Excel tool has been organised in a logical and structured manner. Separate Excel Worksheets are provided for the following:

- *Summary worksheet* – presents overall GHG emission results;
- *Flow diagram worksheet* – provides a diagram of the system boundary;
- *User input worksheets* – an individual worksheet is provided for each main phase in the catchment method which details the inputs for each activity or process (including, quantity, unit, reference, general comments and uncertainty);

- *Calculation worksheet*s – detailed calculation worksheets are provided for each main phase in the catchment method; and

- *Emission factor worksheet* – detailed emission factor worksheet is provided detailing all activities within the tool.

The tool automatically calculates the carbon footprint for each seafood catchment method based on the data input by the user. The results are automatically aggregated and presented in the *Summary* worksheet.

6.1.3 System Boundary

The tool covers the system boundary up to stabilisation as previously described for all seafood catchment methods.

6.1.4 Tool Data

The tool contains all data as described in this method report relating to the following:

- emission factors from publicly available sources[2]; and

- units and conversion factors.

6.1.5 Tool Limitations

The following limitations of the tool exist:

- *Allocation procedures*: The tool does not include the functionality to calculate the following allocation rules that are described in *Section 5.3* , which need to be calculated manually:

    - on-vessel processing;

    - fishing equipment; and

    - reusable packaging.

However, the tool does include the functionality to calculate the allocation of multi-species catch by economic value (or mass) and for road transport (assuming default values for outbound and return journeys.

[2] It should be noted that a limited set of emission factors are available and the tool will not calculate a comprehensive carbon footprint that meets PAS2050 requirements.

- *Material contribution and threshold*: The tool does not have the functionality to estimate or to calculate the material contribution thresholds. The user of the tool will need to ensure that all thresholds are met and if the footprint results needs to be scaled to reach 100%then this must be determined manually.

- *Transport*: The tool assumes that all transport of input materials relates to road transport only within New Zealand. The emission factors contained within the tool are assumed to reflect all transport steps up to the point of import into New Zealand.

- *Emission factor data*: The tool only contains emission factors from publicly available sources. These factors do not cover a significant proportion of the equipment that is specific to the seafood sector. The tool contains 'blank data' for these items. Consequently, the tool cannot calculate GHG emission for these items. Further development is needed in this area.

7 USER GUIDE FOR AQUACULTURE

7.1 USER GUIDE FOR AQUACULTURE

The carbon footprint tool has been developed for the New Zealand seafood sector to allow for individual companies to calculate their carbon footprint.

This user guide explains how the user should input data into the carbon footprint tool that is developed in MS Excel.

The following *Sections* describe each Worksheet in the tool, as follows:

- *Summary* worksheet – shows footprint results;
- *Information and Flow Diagram* worksheet – shows flow diagram;
- *User inputs* - data sheets for user to input data:
    - *General Information* worksheet;
    - *Species* worksheet;
    - *Offices* worksheet;
    - *Seed brood stock* worksheet;
    - *Fish farming* worksheet;
    - *Sourcing* worksheet;
    - *Harvesting* worksheet;
    - *Discharge* worksheet;
    - *Pre-processing* worksheet; and
    - *Transport Stages* worksheet.

The aquaculture tool applies to the three types of aquaculture assessed in the scope of this report. The Excel tool has been designed with three columns where data are input by the user, which relates to each type of aquaculture, as follows:

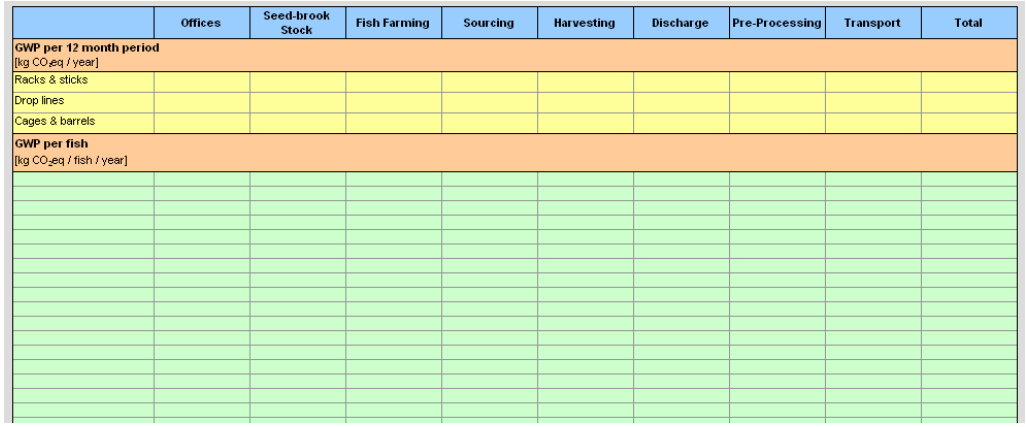
1. intertidal shell fish culture;
2. sub-tidal long line shellfish; and
3. sub-tidal sea cage fish culture.

7.2 WORKSHEET: SUMMARY

The *Summary* worksheet provides an outline of the overall carbon footprint for the twelve month period, providing a total per section of the life cycle (eg pre-trip, vessels, transport, etc) and per fish species. Results are presented in kilograms of CO_2 equivalents over the twelve month period.

The results are based on the data input by the user and the results rely on correct population with data of the user input worksheets. Once the user data has been entered into the input worksheets, the carbon footprint results will be displayed and calculated automatically, as shown in *Figure 7.1*.

Figure 7.1 Summary Worksheet



	Offices	Seed-brook Stock	Fish Farming	Sourcing	Harvesting	Discharge	Pre-Processing	Transport	Total
GWP per 12 month period [kg CO_2eq / year]									
Racks & sticks									
Drop lines									
Cages & barrels									
GWP per fish [kg CO_2eq / fish / year]									

7.3 *WORKSHEET: INFORMATION AND FLOW DIAGRAM*

The flow diagram presented in this worksheet shows exactly which parts of seafood life cycle are being included in the study. This is a useful reference when further understanding the data input required.

7.4 *WORKSHEET: USER INPUTS*

The *User Inputs* worksheet indicates that all sheets following this one are where the user is required to input data into the tool.

Generally, that are yellow indicate where the user should input data into the model. Further details of each Worksheet are given below.

Some specific items should be noted:

- All required inputs refer to data covering a twelve month period (the exact dates are specific by the user). Therefore, if a material or item lasts longer than a twelve month period then this should be allocated accordingly. For example, if a plastic buoy is used for 10 years and weighs 5 kilograms, the user should allocated the weight of the buoy evenly over the time it is used and so would input one tenth of the 5kg weight, which equates to 0.5kg for the 12 month period being considered.

- The columns titled *Data Source*, *Reference* and *Comments* refer to the following:
  - *Data Source*: where the data has been sourced from;
  - *Reference*: any assumptions or calculations required to reach the input value; and
  - *Comments*: any additional comments regarding the data included.

- Also included in each *Worksheet* is a section for data uncertainty and representativeness. This is not used directly for the calculation of the carbon footprint and may be left blank. Instead it is used for external data verification and, if necessary, for the purposes of meeting the requirements for carbon labelling of the UK Carbon Trust standard.

7.5 WORKSHEET: GENERAL INFORMATION

The *General Information* Worksheet requires the user to input their company, contact details, the name of the user entering the data and the twelve month period over which the input data refers.

Although this Worksheet is not required to calculate the carbon footprint results directly, the information entered here is a crucial reference to allow for sufficient traceability of the input data to be undertaken should the models require verification.

Figure 7.2 ***General Information Worksheet***

General information	
Company name	
Contact person	
Address	
Fax	
Telephone	
Mobile	
Email	

Period over which data is collected	
What 12 month period is the data collected over?	Eg from 1 January 2008 to 31 December 2008

7.6 WORKSHEET: SPECIES

The *Species* Worksheet is used to reference the different types of fish caught over the twelve month period. Up to 45 different species can be listed in this Worksheet. If more than 45 species are caught over the period, please enter the 44 most significant species caught and enter 'Other Species' in the 45th position.

The *Method of catchment* column should be completed to indicate trawling, long line or seining. Please note, however, this is not used for the calculation of results.

The *Total Caught in 12-months* should be entered as tonnes of each species. This data is used to calculate the global warming impart (GWP) for each of the specific fish species caught for that year.

The value of fish sold per year refers to the sales price that the company receives for each tonne of specific fish in New Zealand dollars. If this column is left blank the tool will still automatically calculate the results.

Figure 7.3 Species Worksheet

Species	Method of Catchment	Total harvested in 12 months [tonne/year]	Value per tonne [$NZ / tonne]	Value of catch [$NZ / year]

Total	
Racks & sticks	*0*
Drop lines	*0*
Cages & barrels	*0*

7.7 WORKSHEET: OFFICES

Data entry in the *Offices* Worksheet refers to the energy, fuel and material consumption of the companies' administrative buildings.

Electricity, gas and water consumption data can likely be sourced from company energy bills. Other inputs (eg diesel) over the twelve- month period may be available from accounts system or monitored separately.

If air conditioning is used within the buildings, it is likely that there is refrigerant leakage from these. It may be possible to estimate the leakage rate based upon air-conditioner servicing and maintenance data which shows the quantities and type of refrigerant that is recharged.

Figure 7.4 Offices Worksheet

Description	Racks & sticks	Drop lines	Cages & barrels	Total	Unit	Output measure	Data source	Reference	Comments
Energy and Fuels									
Electricity				0	kWh	over 12-month period			
Diesel				0	litres	over 12-month period			
Gas				0	kWh	over 12-month period			
Materials									
Water				0	kg	over 12-month period			
Paper				0	kg	over 12-month period			
Refrigerants (general)				0	kg	over 12-month period			Refrigerant loss from air-conditioners

7.8 WORKSHEET: SEED BROOD STOCK

The data entry required in the *Seed Brood Stock* Worksheet refers to the materials and fishing equipment required to operate the fishing vessels over the twelve month period.

Inputs should be provided based upon the particular catchment method such as racks & sticks, drop lines or cage & barrels.

If items listed are not used by the company then the *Value* column should be left blank and a note added in the *Comments* column to indicate that this item is irrelevant.

Also please note the following:

- If an item's lifetime is longer than twelve months, such as a plastic buoy, then this should be allocated evenly over the time period of use. For example, if a buoy weighs 6 kilograms and is used for 3 years, then the allocated weight of the buoy over the 12 month period will be 6kg divided by 3 years, which equates to 2kg.

Figure 7.5 ***Seed Brood Stock Worksheet***

Description	Racks & sticks	Drop lines	Cages & barrels	Total	Unit	Output measure	Data source	Reference	Comments
Transport									
Fuel				0	kg	over 12-month period			Involves vessel transfers to and from; dedicated percentage use associated with
Rubber tyres				0	no. items	over 12-month period			
Oil				0	kg	over 12-month period			
Seawater (onshore tanks)									
Fuel oil				0	kg	over 12-month period			Transport of seawater to onshore tanks
Biofilters				0	kg	over 12-month period			Filter made of various substances including
Seawater electricity				0	kWh	over 12-month period			power to run pumps
Feed (onshore tanks)									
Pelletised fish feed				0	kg	over 12-month period			Tank reared salmon and other finfish species
Cultured algae				0	no. items	over 12-month period			For oyster spat reared in tank
Biofilter									
Biofilter materials				0	kg	over 12-month period			
Energy and fuels									
Electricity				0	kWh	over 12-month period			
Repairs and maintenance (onshore and offshore)									
Replacement sticks				0	no. items	over 12-month period			
Replacement nylon rope				0	kg	over 12-month period			
Plastic tank/ pipe replacement				0	kg	over 12-month period			
Stainless steel clips replacement				0	kg	over 12-month period			
Surface buoy replacement				0	no. items	over 12-month period			

7.9 *WORKSHEET: FISH FARMING*

The *Fish Farming* Worksheet includes the fuel, equipment and material use for to the rearing of fish and oysters in hatcheries and intertidal zones over the twelve month period.

The data are split into three sections for energy and fuel used for transferring stock from source to wharf, farm maintenance, and feed.

Material inputs used for longer than the 12 month period should be allocated accordingly as outlined above in the *Seed brook stock Section*.

Data should be included for each of the three specified catchment methods. If a data entry point is irrelevant to a catchment method, the cell should be left blank and a note made in the comments column.

Figure 7.6 ***Fish Farming Worksheet***

Description	Racks & sticks	Drop lines	Cages & barrels	Total	Unit	Output measure	Data source	Reference	Comments
Energy and fuels									
Fuel				0	kg	over 12-month period			Involves vessel transfers to and from; oyster
Oil				0	kg	over 12-month period			
Repair and maintenance									
Nylon ropes				0	kg	over 12-month period			Replacement - mussel farms
Plastic buoys				0	kg	over 12-month period			Replacement - mussel farms
Cotton stocking				0	kg	over 12-month period			Holds spat bearing seaweed onto ropes
Steel anchors/ steel chain				0	kg	over 12-month period			Anchors / chain to hold farms in place
Stainless snoods				0	kg	over 12-month period			Used to attach drop lines bearing mussels to
Timber				0	kg	over 12-month period			Timber oyster sticks and racks
Sea cage galvanised mesh				0	kg	over 12-month period			Repair to finfish sea cages.
Feed (at sea cages)									
Pelletised fish feed				0	kg	over 12-month period			Cage reared salmon and other finfish species

7.10 WORKSHEET: SOURCING

Sourcing data information refers to fuel consumed be a vessel that is used to periodically check the fish/oyster/mussel conditions on a farm to determine the time for harvesting.

The fuel and oil consumed should be entered for the individual catchment methods.

Note: All fuels and oils consumed should be entered in litres into the *Value* column.

Input Description	Racks & sticks	Drop lines	Cages & barrels	Total	Unit	Output measure	Data source	Reference	Comments
Fuels and Oils									
Fuel				0	kg	over 12-month period			Vessel used to check condition of mussels on
Oil				0	kg	over 12-month period			

Figure 7.7 Sourcing Worksheet

7.11 WORKSHEET: HARVESTING

Harvesting data includes the consumption of fuels used by barges and vessels retrieve, harvest and slaughter mussels, oysters and fish. Also included are materials and packaging used for farm reseeding.

Data should be included for each of the three specified catchment methods. If a data entry point is irrelevant to a catchment method, the cell should be left blank and a note made in the comments column.

Input Description	Racks & sticks	Drop lines	Cages & barrels	Total	Unit	Output measure	Data source	Reference	Comments
Barge/ Vessel									
Fuel				0	kg	over 12-month period			Harvesting barge or vessel used to strip
Oil				0	kg	over 12-month period			
Packaging									
Sacks				0	no. items	over 12-month period			Storing mussels removed from mussel lines
Plastic bins				0	no. items	over 12-month period			Storing finfish on ice
Reseeding Farm									
Seedweed laden spat				0	kg	over 12-month period			Seaweed wraped around mussel lines and held on
Sticks with oyster spat				0	no. items	over 12-month period			Seeded oyster sticks placed on empty cracks
Tanks with juvenile finfish				0	no. items	over 12-month period			
Cotton stocking				0	kg	over 12-month period			

Figure 7.8 Harvesting Worksheet

7.12 WORKSHEET: DISCHARGE

The *Discharge* Worksheet includes all fuels, electricity or materials consumed in the process of discharging (or offloading) the fish from the fishing vessels to

the wharf. Specifically included is the use of forklifts, cranes and pumps and packaging (used for distribution).

Although it is unlikely that these values have been measured exactly for each company, it may be possible to obtain approximations of fuel consumption, electricity and packaging based upon bills/invoices, or approximations made of the quantities consumed.

Data should be included for each of the three specified catchment methods. If a data entry point is irrelevant to a catchment method, the cell should be left blank and a note made in the comments column.

Note: All approximations or estimates of data should be indicated in the *Comments* column.

Figure 7.9 Discharge Worksheet

Input Description	Racks & sticks	Drop lines	Cages & barrels	Total	Unit	Output measure	Data source	Reference	Comments
Cranes									
crane fuel				0	kg	over 12-month period			
crane oil				0	kg	over 12-month period			
crane electricity				0	kWh	over 12-month period			
Transport to Pre-Processing									
Fuel				0	kg	over 12-month period			
Oil				0	kg	over 12-month period			

7.13 WORKSHEET: PRE-PROCESSING

Pre-processing includes the fuel and materials inputs used for chilling, sorting, cooking/smoking, shucking, trimming/filleting and packing.

Data should be included for each of the three specified catchment methods. If a data entry point is irrelevant to a catchment method, the cell should be left blank and a note made in the comments column.

Figure 7.10 Pre-Processing Worksheet

Input Description	Racks & sticks	Drop lines	Cages & barrels	Total	Unit	Output measure	Data source	Reference	Comments
Reception chilling									
Fuel				0	kg	over 12-month period			Motorised machines (fork lifts) used to unload
Oil				0	kg	over 12-month period			Motorised machines (fork lifts) used to unload
chilling electricity				0	kWh	over 12-month period			Chiller
Sorting and grading									
sorting electricity				0	kWh	over 12-month period			Lighting, heating etc.
Cooking/smoking									
Water				0	litres	over 12-month period			
cooking electricity				0	kWh	over 12-month period			
Timber for smoking fish				0	kg	over 12-month period			Variety of timbers used to smoke fish
Shucking									
shucking electricity				0	kWh	over 12-month period			
Trimming/debasing/fish filleting									
filleting electricity				0	kWh	over 12-month period			
Packing									
Cardboard				0	kg	over 12-month period			
Plastic lining				0	kg	over 12-month period			
packing electricity				0	kWh	over 12-month period			

7.14 WORKSHEET: TRANSPORT STAGES

The *Transport Stages* Worksheet requests information to input which describes the transport of all materials that are entered into previous Worksheets.

The following data should be entered:

- The location where the items are sourced from and their final destination should be included, as well as the distance (in km) between these two places.

- Four options are then available to assess whether the transport distance provided was *measured*, *calculated*, *estimated* or *assumed*. If this is not known, a best guess is sufficient if documented accordingly in these columns and also in the comments.

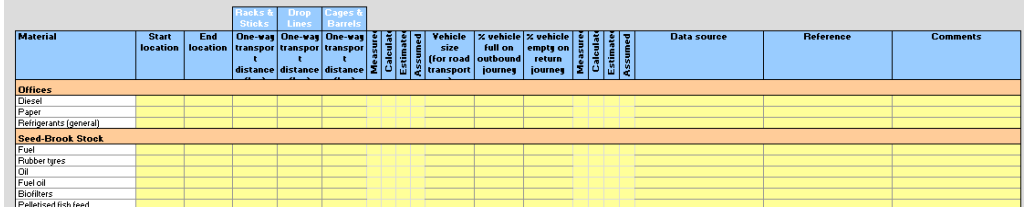
- A *vehicle type* is the required to be selected from the dropdown menu. Currently this can only be transport via road and a number of different truck and lorry types can be selected from a drop-down list.

- The '*% vehicle full on outbound journey*' is required to determine the amount of loading of the truck during the journey. The value in this field should be between 0% and 100%. The default value is 100% and this would normally be used. An input of 100% would mean the truck has a full load during the trip to the final destination and an input of 50% would mean the truck is transporting half of its possible total load. 0% would indicate that the truck was travelling without a load and therefore not transporting the products at all.

- The '*% vehicle empty on return journey*' refers to the percentage of the return trip back to its starting point. The value entered here can range between 0% and 100%. The default value is 100% and this would normally be used. A value of 100% indicates that the truck returns to its original destination full. A value of 0% indicates that the truck transports an empty load.

The *truck type*, *percentage full* and *percentage of return journey* should be described in the *Comments* column as to whether they are *measured*, *calculated*, *estimated* or *assumed*. It is likely that these values will not be known directly and assumptions included.

Figure 7.11 Transport Stages Worksheet



Material	Start location	End location	Trucks & Sticks: One-way transport distance	Drop Lines: One-way transport distance	Cages & Barrels: One-way transport distance	Measured	Calculated	Estimated	Assumed	Vehicle size (for road transport)	% vehicle full on outbound journey	% vehicle empty on return journey	Measured	Calculated	Estimated	Assumed	Data source	Reference	Comments
Offices																			
Diesel																			
Paper																			
Refrigerants (general)																			
Seed-Brook Stock																			
Fuel																			
Rubber tyres																			
Oil																			
Fuel oil																			
Biofilters																			
Pelletised fish feed																			

8 USER GUIDE FOR POT & TRAP / DIVE & HAND GATHERING / TRAWLING, LONG LINE & SEINING

8.1 USER GUIDE FOR POT & TRAP / DIVE & HAND GATHERING / TRAWLING, LONG LINE & SEINING

The carbon footprint tool has been developed for the New Zealand seafood sector to allow for individual companies to calculate their carbon footprint.

This user guide explains how the user should input data into the carbon footprint tool that is developed in MS Excel.

The following *Sections* describe each Worksheet in the tool, as follows:

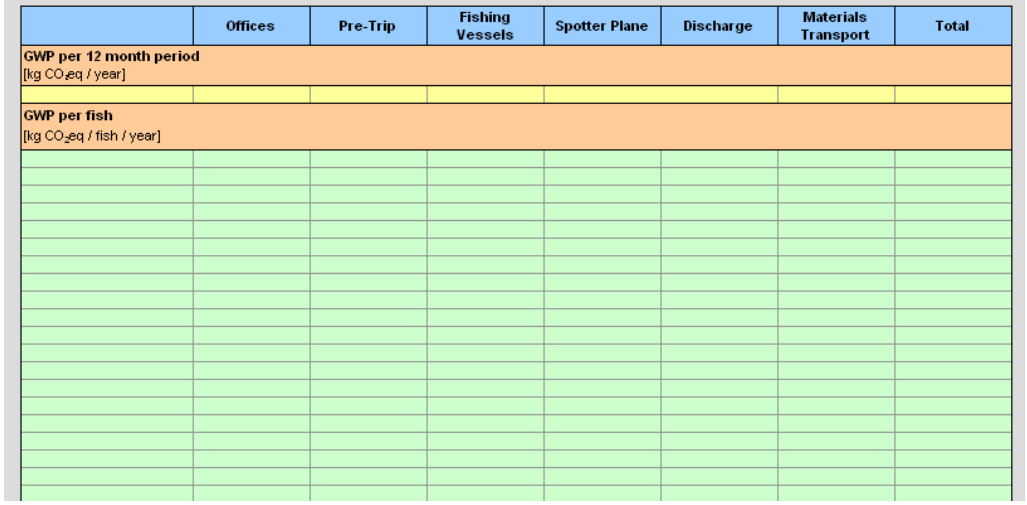
- *Summary* worksheet – shows footprint results;
- *Information and Flow Diagram* worksheet – shows flow diagram;
- *User inputs* - data sheets for user to input data:
    - *General Information* worksheet;
    - *Species* worksheet;
    - *Offices* worksheet;
    - *Pre-Trip* worksheet;
    - *Fishing Vessels* worksheet;
    - *Spotter Plane* worksheet (not relevant for dive & hand gathering);
    - *Transport to Pre-Processing* worksheet (dive & hand gathering only);
    - *Discharge* worksheet; and
    - *Transport Stages* worksheet.

8.2 WORKSHEET: SUMMARY

The *Summary* tab provides an outline of the overall carbon footprint for the twelve month period, providing a total per section of the life cycle (eg pre-trip, vessels, transport, etc) and per fish species. Results are presented in kilograms of CO_2 equivalents over the twelve month period.

The results are based on the data input by the user and the results rely on correct population with data of the user input worksheets. Once the user data has been entered into the input worksheets, the carbon footprint results will be displayed and calculated automatically, as shown in *Figure 8.1*.

Figure 8.1 Summary Worksheet



	Offices	Pre-Trip	Fishing Vessels	Spotter Plane	Discharge	Materials Transport	Total
GWP per 12 month period [kg CO_2eq / year]							
GWP per fish [kg CO_2eq / fish / year]							

8.3 WORKSHEET: INFORMATION AND FLOW DIAGRAM

The flow diagram presented in this worksheet shows exactly which parts of seafood life cycle are being included in the study. This is a useful reference when further understanding the data input required.

8.4 WORKSHEET: USER INPUTS

The *User Inputs* worksheet indicates that all sheets following this one are where the user is required to input data into the tool.

Generally, that are yellow indicate where the user should input data into the model. Further details of each Worksheet are given below.

Some specific items should be noted:

- All required inputs refer to data covering a twelve month period (the exact dates are specific by the user). Therefore, if a material or item lasts longer than a twelve month period then this should be allocated accordingly. For example, if a plastic buoy is used for 10 years and weighs 5 kilograms, the user should allocated the weight of the buoy evenly over the time it is used and so would input one tenth of the 5kg weight, which equates to 0.5kg for the 12 month period being considered.

- The columns titled *Data Source*, *Reference* and *Comments* refer to the following:
  - *Data Source*: where the data has been sourced from;
  - *Reference*: any assumptions or calculations required to reach the input value; and

- *Comments*: any additional comments regarding the data included.

- Also included in each *Worksheet* is a section for data uncertainty and representativeness. This is not used directly for the calculation of the carbon footprint and may be left blank. Instead it is used for external data verification and, if necessary, for the purposes of meeting the requirements for carbon labelling of the UK Carbon Trust standard.

8.5 WORKSHEET: GENERAL INFORMATION

The *General Information* Worksheet requires the user to input their company, contact details, the name of the user entering the data and the twelve month period over which the input data refers.

Although this Worksheet is not required to calculate the carbon footprint results directly, the information entered here is a crucial reference to allow for sufficient traceability of the input data to be undertaken should the models require verification.

Figure 8.2 General Information Worksheet

General information	
Company name	
Contact person	
Address	
Fax	
Telephone	
Mobile	
Email	

Period over which data is collected	
What 12 month period is the data collected over?	Eg from 1 January 2008 to 31 December 2008

8.6 WORKSHEET: SPECIES

The *Species* Worksheet is used to reference the different types of fish caught over the twelve month period. Up to 45 different species can be listed in this Worksheet. If more than 45 species are caught over the period, please enter the 44 most significant species caught and enter 'Other Species' in the 45th position.

The *Method of catchment* column should be completed to indicate the catmint method (ie pot or trap; hand gathering; trawling, long line or seining). Please note, however, this is not used for the calculation of results.

The *Total Caught in 12-months* should be entered as tonnes of each species. This data is used to calculate the global warming impart (GWP) for each of the specific fish species caught for that year.

The value of fish sold per year refers to the sales price that the company receives for each tonne of specific fish in New Zealand dollars. The default value is $1.00, which should be used of no other data are available. If this column is unchanged the tool will still automatically calculate the results. The tool cannot calculate results if the *total caught* and *value per tonne* are not both completed.

Figure 8.3 ***Species Worksheet***

Species	Method of Catchment	Total caught in 12 months [tonne/year]	Value per tonne [$NZ / tonne]	Value of catch [$NZ / year]
Total				

8.7 *WORKSHEET: OFFICES*

Data entry in the *Offices* Worksheet refers to the energy, fuel and material consumption of the companies' administrative buildings.

Electricity, gas and water consumption data can likely be sourced from company energy bills. Other inputs (eg diesel) over the twelve- month period may be available from accounts system or monitored separately.

If air conditioning is used within the buildings, it is likely that there is refrigerant leakage from these. It may be possible to estimate the leakage rate based upon air-conditioner servicing and maintenance data which shows the quantities and type of refrigerant that is recharged.

Figure 8.4 Offices Worksheet

Description	Value	Unit	Output measure	Data source	Reference	Comments
Energy and Fuels						
Electricity		kWh	over 12-month period			
Diesel		litres	over 12-month period			
Gas		kWh	over 12-month period			
Other						
Water		kg	over 12-month period			
Refrigerants (general)		kg	over 12-month period			Refrigerant loss from air-conditioners

8.8 WORKSHEET: PRE-TRIP

The data entry required in the *Pre-Trip* Worksheet refers to the materials and fishing equipment required to operate the fishing vessels over the twelve month period.

If items listed are not used by the company then the *Value* column should be left blank and a note added in the *Comments* column to indicate that this item is irrelevant.

Also please note the following:

- If an item's lifetime is longer than twelve months, such as a plastic buoy, then this should be allocated evenly over the time period of use. For example, if a buoy weighs 6 kilograms and is used for 3 years, then the allocated weight of the buoy over the 12 month period will be 6kg divided by 3 years, which equates to 2kg.

Figure 8.5 Pre-Trip Worksheet (Illustrative example)

Pre-Trip - materials used in preparation for fishing and during trip

Description	Value	Unit	Output measure	Data source	Reference	Comments
Provisions and consumables (excluding food)						
Paper		kg	over 12-month period			
Chemicals (general)		kg	over 12-month period			
Ice for fish storage						
Ice		kg	over 12-month period			
Slurry ice		litres	over 12-month period			
Salt		kg	over 12-month period			
Packaging and storage of fish products						
Plastic reusable bins		kg	over 12-month period			
Plastic packing		kg	over 12-month period			
Plastic liners		kg	over 12-month period			
Plastic sacks		kg	over 12-month period			
Cardboard packaging		kg	over 12-month period			
Bait (long line and pot)						
Fish - bait		kg	over 12-month period			
Paua - bait		kg	over 12-month period			
Offal - bait		kg	over 12-month period			
Refrigerant recharge (on-vessel)						
Ammonia		kg	over 12-month period			
Freon		kg	over 12-month period			
Repairs and maintenance (onshore and offshore)						
Plate steel		kg	over 12-month period			
Welding gas		no. cylinders	over 12-month period			
Lead weights for ground ropes		kg	over 12-month period			
Timber		kg	over 12-month period			
Steel chain		kg	over 12-month period			
Steel wire		kg	over 12-month period			
Lead weights		kg	over 12-month period			
Steel mesh		kg	over 12-month period			
Steel rods		kg	over 12-month period			
Lead weights for pot/ trap repairs/ construction		kg	over 12-month period			
Nylon rope		kg	over 12-month period			
Plastic buoys		kg	over 12-month period			
Fishing equipment consumed						
Steel mesh dredges		kg	over 12-month period			
Hooks and lures		kg	over 12-month period			
Nets		kg	over 12-month period			
Steel warps		kg	over 12-month period			
Nylon ropes		kg	over 12-month period			
Steel chain		kg	over 12-month period			
Lead lines		kg	over 12-month period			
Plastic buoys		kg	over 12-month period			
Weight belts		kg	over 12-month period			
Plastic fins		kg	over 12-month period			
Wet suit		kg	over 12-month period			
Traps		kg	over 12-month period			
Crew travel						
Air travel - Domestic short haul		passenger.km	over 12-month period			
Air travel - International short haul		passenger.km	over 12-month period			
Air travel - International long haul		passenger.km	over 12-month period			

8.9 WORKSHEET: FISHING VESSELS

The *Fishing Vessels* Worksheet includes the fuel and engine oil consumption of any fishing vessels and pilot vessels operated by the company over the twelve month period.

Note: All fuels and oils consumed should be entered in litres into the *Value* column.

If a specific fuel is listed and not used, leave the *Value* column blank and make a note in the comments column.

Figure 8.6 Fishing Vessels Worksheet

Description	Value	Unit	Output measure	Data source	Reference	Comments
Fishing Vessels						
Marine gas oil (MGO)		litres	over 12-month period			
Marine diesel oil (MDO)		litres	over 12-month period			
Intermediate fuel oil (IFO)		litres	over 12-month period			
Medium fuel oil (MFO)		litres	over 12-month period			
Heavy fuel oil (HFO)		litres	over 12-month period			
Engine oil		litres	over 12-month period			
Pilot Vessels						
Marine gas oil (MGO)		litres	over 12-month period			
Marine diesel oil (MDO)		litres	over 12-month period			
Intermediate fuel oil (IFO)		litres	over 12-month period			
Medium fuel oil (MFO)		litres	over 12-month period			
Heavy fuel oil (HFO)		litres	over 12-month period			
Engine oil		litres	over 12-month period			

8.10 WORKSHEET: SPOTTER PLANE

Similar to the *Fishing Vessels* Worksheet, the *Spotter Plane* Worksheet includes the fuel and engine oil consumed by aircraft operated by the company and used for fishing purposes.

Note: All fuels and oils consumed should be entered in litres into the *Value* column.

Figure 8.7 Spotter Plane Worksheet

Input Description	Value	Unit	Output measure	Data source	Reference	Comments
Fuel and oil use in spotter plane						
Aviation fuel		litres	over 12-month period			
Engine oil		litres	over 12-month period			

8.11 WORKSHEET: TRANSPORT TO PRE-PROCESSING (DIVE AND HAND GATHERING ONLY)

The *Transport to Pre-Processing* Worksheet is only relevant to Dive and hand gathering, and includes the fuel consumed in transporting the unloaded fish to a pre-processing storage facility which may either be onshore or offshore. The vehicle type and transport distance refers to the distance travelled to transport the diesel and gasoline to the vehicle that is delivering the unloaded fish. The vehicle type can only be a truck/lorry in the model and its size can be selected from the dropdown menu.

The helicopter use also refers to transport of the unloaded fish and inputs of fuel and engine oil consumed by this type of transport are required over the 12 month period.

Figure 8.8 ***Transport to Pre-Processing Tab***

Input Description	Value	Unit	Output measure	Data source	Reference	Comments
Fuels and oils						
Diesel		litres	over 12-month period			
Gasoline		litres	over 12-month period			
Vehicle type						
Distance transported		km	over 12-month period			
Helicopter use						
Aviation fuel		litres	over 12-month period			
Engine oil		litres	over 12-month period			

8.12 WORKSHEET: DISCHARGE

The *Discharge* Worksheet includes all fuels, electricity or materials consumed in the process of discharging (or offloading) the fish from the fishing vessels to the wharf. Specifically included is the use of forklifts, cranes and pumps and packaging (used for distribution).

Although it is unlikely that these values have been measured exactly for each company, it may be possible to obtain approximations of fuel consumption, electricity and packaging based upon bills/invoices, or approximations made of the quantities consumed.

Note: All approximations or estimates of data should be indicated in the *Comments* column.

Figure 8.9 ***Discharge Worksheet***

Input Description	Value	Unit	Output measure	Data source	Reference	Comments
Forklifts						
Diesel		litres	over 12-month period			
Propane		litres	over 12-month period			
Electricity		kWh	over 12-month period			
Wharf side cranes or pumps						
Diesel		litres	over 12-month period			
Electricity		kWh	over 12-month period			

8.13 WORKSHEET: TRANSPORT STAGES

The *Transport Stages* Worksheet requests information to input which describes the transport of all materials that are entered into previous Worksheets.

The following data should be entered:

- The location where the items are sourced from and their final destination should be included, as well as the distance (in km) between these two places.

- Four options are then available to assess whether the transport distance provided was *measured*, *calculated*, *estimated* or *assumed*. If this is not known, a best guess is sufficient if documented accordingly in these columns and also in the comments.

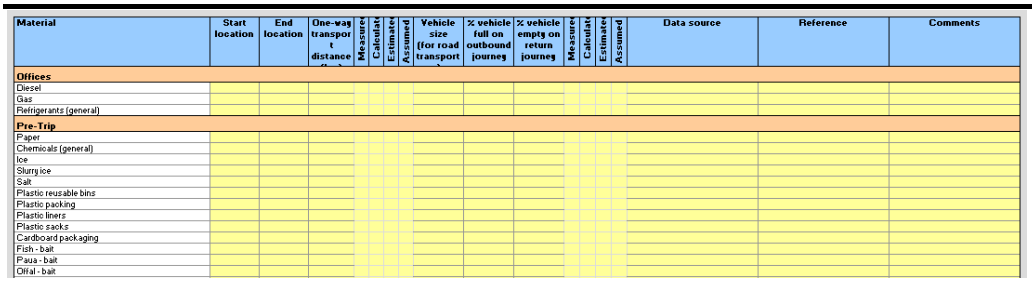
- A *vehicle type* is the required to be selected from the dropdown menu. Currently this can only be transport via road and a number of different truck and lorry types can be selected from a drop-down list.

- The *'% vehicle full on outbound journey'* is required to determine the amount of loading of the truck during the journey. The value in this field should be between 0% and 100%. The default value is 100% and this would normally be used. An input of 100% would mean the truck has a full load during the trip to the final destination and an input of 50% would mean the truck is transporting half of its possible total load. 0% would indicate that the truck was travelling without a load and therefore not transporting the products at all.

- The *'% vehicle empty on return journey'* refers to the percentage of the return trip back to its starting point. The value entered here can range between 0% and 100%. The default value is 100% and this would normally be used. A value of 100% indicates that the truck returns to its original destination full. A value of 0% indicates that the truck transports an empty load.

The *truck type*, *percentage full* and *percentage of return journey* should be described in the *Comments* column as to whether they are *measured*, *calculated*, *estimated* or *assumed*. It is likely that these values will not be known directly and assumptions included.

Figure 8.10 Transport Stages Worksheet



Material	Start location	End location	One-way transport distance	Measured	Calculated	Estimated	Assumed	Vehicle size (for road transport	% vehicle full on outbound journey	% vehicle empty on return journey	Measured	Calculated	Estimated	Assumed	Data source	Reference	Comments
Offices																	
Diesel																	
Gas																	
Refrigerants (general)																	
Pre-Trip																	
Paper																	
Chemicals (general)																	
Ice																	
Slurry ice																	
Salt																	
Plastic reusable bins																	
Plastic packing																	
Plastic liners																	
Plastic sacks																	
Cardboard packaging																	
Fish - bait																	
Paua - bait																	
Offal - bait																	

9 REFERENCES

[1] **BSI**, (2004). *BS EN ISO/IEC 17050-1:2004: Conformity assessment. Supplier's declaration of conformity. General requirements*. The British Standards Institution.

[1] **IPCC**, (2007). IPCC 2007, Fourth Assessment Report. 2007_4AR_Changes in atmospheric constituents and in radiative forcing_IPCC.pdf" P212-213 . www document (accessed March 2009)

[2] **ISO**, (2002). *ISO/TS 14048:2002 Environmental management - Life cycle assessment - Data documentation format*. Geneva, Switzerland.

[3] **ISO**, (2006). *ISO 14040. Environmental management – Life cycle assessment – Principles and framework (Second edition, 2006-07-01)*. Geneva, Switzerland.

[4] **ISO**, (2006a). *ISO 14044. Environmental management – Life cycle assessment – Requirements and guidelines (First edition, 2006-07-01)*. Geneva, Switzerland.

[5] **PAS2050**, (2008). *PAS 2050:2008 – Specification for the assessment of the life cycle greenhouse gas emissions of goods and services (October 2008)*. British Standards Institute (BSI), Department for Environment, Food and Rural Affairs (Defra, UK) and the Carbon Trust (UK).www.bsigroup.com/en/Standards-and-Publications/Industry-Sectors/Energy/PAS-2050/

[6] **PAS2050**, (2008a). *Guide to PAS 2050: How to assess the carbon footprint of goods and services (October 2008)*. British Standards Institute (BSI), Department for Environment, Food and Rural Affairs (Defra, UK) and the Carbon Trust (UK). www.bsigroup.com/en/Standards-and-Publications/Industry-Sectors/Energy/PAS-2050/

Annex A

Terminology

A.1 TERMINOLOGY

Table A.1 provides a list of PAS2050 terminology.

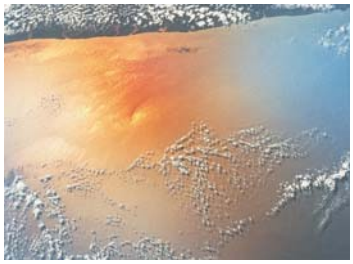
Table A.1 Terms and Definitions

Term	Definitions
Allocation	Partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems.
Biogenic	Derived from biomass, but not fossilized or from fossil sources.
Biomass	Material of biological origin, excluding material embedded in geological formations or transformed to fossil.
Business-to-business	Provision of inputs, including products, to another party that is not the end user.
Business-to-consumer	Provision of inputs, including products, to the end user.
Capital goods	Goods, such as machinery, equipment and buildings, used in the life cycle of products.
Carbon dioxide equivalent (CO_2e)	Unit for comparing the radiative forcing of a GHG to carbon dioxide.
Carbon sequestration	Removal of carbon from the atmosphere.
Carbon storage	Retaining carbon of biogenic or atmospheric origin in a form other than as an atmospheric gas.
Combined heat and power (CHP)	Simultaneous generation in one process of useable thermal, electrical and/or mechanical energy.
Consumable	Ancillary input that is necessary for a process to occur but that does not form a tangible part of the product or co-products arising from the process.
Consumer	User of goods or services.
Co-product	Any of two or more products from the same unit process or product system.
Data quality	Characteristics of data that relate to their ability to satisfy stated requirements.
Downstream emissions	GHG emissions associated with processes that occur in the life cycle of a product subsequent to the processes owned or operated by the organization implementing this PAS.
Economic value	Market value of a product, co-product or waste at the point of production.
Emission factor	Amount of greenhouse gases emitted, expressed as carbon dioxide equivalent and relative to a unit of activity.
Emissions	Release to air and discharges to water and land that result in GHGs entering the atmosphere.
Fossil	Derived from fossil fuel or another fossil source, including peat.
Functional unit	Quantified performance of a product system for use as a reference unit.
GHG emissions	Release of GHGs to the atmosphere.
Global warming potential (GWP)	Factor describing the radiative forcing impact of one mass-based unit of a given greenhouse gas relative to an equivalent unit of carbon dioxide over a given period of time.
Greenhouse Gases (GHGs)	Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds.
Input	Product, material or energy flow that enters a unit process.
Intermediate product	Output from a unit process that is an input to other unit processes involving further transformation within the system.
Life cycle	Consecutive and interlinked stages of a product system, from raw material acquisition or generation of natural resources to end of life, inclusive of any recycling or recovery activity.
Life Cycle Assessment (LCA)	Compilation and evaluation of inputs, outputs and potential environmental impacts of a product system throughout its life cycle.
Life cycle GHG emissions	Sum of greenhouse gas emissions resulting from all stages of the life cycle of a

Term	Definitions
	product and within the specified system boundaries of the product.
Material contribution	Contribution from any one source of GHG emissions of more than 1% of the anticipated life cycle GHG emissions associated with a product.
Offsetting	Mechanism for claiming a reduction in GHG emissions associated with a process or product through the removal of, or preventing the release of, GHG emissions in a process unrelated to the life cycle of the product being assessed.
Output	Product, material or energy that leaves a unit process.
Primary activity data	Quantitative measurement of activity from a product's life cycle that, when multiplied by an emission factor, determines the GHG emissions arising from a process.
Product	Any good or service.
Product category	Group of products that can fulfil equivalent functions.
Product Category Rules (PCRs)	Set of specific rules, requirements and guidelines for developing Type III environmental declarations for one or more product categories.
Product system	Collection of unit processes with elementary and product flows, performing one or more defined functions, that models the life cycle of a product.
Raw material	Primary or secondary material that is used to produce a product.
Renewable energy	Energy from non-fossil energy sources: wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases.
Secondary data	Data obtained from sources other than direct measurement of the processes included in the life cycle of the product.
System boundary	Set of criteria specifying which unit processes are part of a product system.
Unit process	Smallest portion of a life cycle for which data are analysed when performing a life cycle assessment.
Upstream emissions	GHG emissions associated with processes that occur in the life cycle of a product prior to the processes. owned, operated or controlled by the organization implementing this PAS.
Use phase	That part of the life cycle of a product that occurs between the transfer of the product to the consumer and the end of life of the product.
Use profile	Criteria against which the GHG emissions arising from the use phase are determined.
Useful energy	Energy that meets a demand by displacing another source of energy.

Source: (PAS 2050, 2008)

ERM consulting services worldwide **www.erm.com**



ERM New Zealand Ltd

Commerce House
Level 2
13 Commerce Street
Auckland
New Zealand

Telephone + 64 9 303 4664

Facsimile +64 9 303 3254