The South African Fruit & Wine Industry Carbon Calculator

– The Protocol

Version 1.1 – February 2010

This project was made possible by the Regional Standards Program (RSP) of the **ComMark Trust**, the **Post Harvest Innovation Programme**, the **National Agricultural Marketing Council** and the **South African wine and fresh fruit industries** (South African Table Grapes, South African Apple and Pear Producers' Association, South African Stone Fruit Producers' Association, Citrus Research International, Citrus Growers Association of Southern Africa, South African Avocado Growers' Association and Winetech).

Table of Contents

1. Introduction

Following the publication of the IPCC 2007 reports, which were compiled by 2500 of the World's leading scientists, it is now well accepted that human activities are significantly affecting the world's climate (www.ipcc.ch). Particularly, the release of greenhouse gases (GHG) generated through the burning of fossil-fuels and land-use change, has altered the energy balance of the world's atmosphere, leading to changes in climate. The impact of climate change on human economies through changes in rainfall, temperature, and extreme weather events such as floods and droughts is severe. While human-driven climate change will affect all parts of the world to a certain extent, the farmers of southern and eastern Africa have been identified as a group that are particularly vulnerable to climate change.

In South Africa, we do not as yet have a formalized mandatory limit (or "cap") set on our GHG emission levels. However, we are a signatory country of the Kyoto Protocol and are therefore committed to reducing our GHG emissions and developing in a clean and sustainable manner. At the Climate Change Summit in March of this year (2009), broad targets were announced by the Ministerial Council and later confirmed by the president – South Africa is developing a strategic policy where emissions will continue to increase between 2020 and 2025, then stabilize for a decade before declining in absolute terms towards the mid century (Midgley et. al. 2007; President's speech at Summit, 2009). This commitment will require immediate and effective action throughout all industries. Those who use their initiative and are early actors in this area will be better prepared for meeting the mandatory requirements implemented in the future and will have sustainable practices already developed to secure their place in the market going forward.

In response to the threat that climate change presents to South African agriculture, the South African Fruit and Wine Industry is in the process of developing a comprehensive climate change strategy. Part of the development of the strategy is assessing the GHG emission profile of the industry – from individual farms, to exporters, to the industry as a whole. Knowledge of where GHG emissions occur throughout the supply chain and the volume of emissions from each source provides crucial input into developing an appropriate, effective and efficient strategy.

The starting point of such an initiative is for the various entities operating within the fresh fruit and wine export supply chain to gain an understanding of their baseline emissions, from which emission reduction strategies can be developed. This entails doing a carbon audit (also known as a carbon footprint analysis) of the business activities; a process that uses consumption figures (for example kilowatt hours of electricity usage) and details of other activities (such as waste management) to calculate the emissions associated with that specific activity (tonnes of CO_2e). The outcome of the audit is that the entity for which the audit is being done is able to identify key activities throughout their supply chain that contribute to their overall carbon footprint and, with accurate results, they are able to prioritise their emission reduction opportunities and set realistic targets.

The South African Fruit and Wine Industry initiative was initially sparked through retailer and consumer demand for quantifying of the "carbon intensity" of the South African fresh fruit and wine products being sold in the United Kingdom. However, it was soon recognised that an appropriate climate change response should be driven by more than just immediate market pressure, and that there was a need for the industry as a whole to have a common and united position on climate change. Part of the common position is the adoption of a standard protocol for measurement and reporting of GHG emissions across the industry. Previously, individual South African farm managers and exporters used different GHG auditing standards and methodologies, leading to confusion and the inappropriate comparison of emission footprints within the industry and with international competitors.

The South African Fruit and Wine Industry carbon calculator provides a standard protocol for the measurement and reporting of GHG emissions for the industry and as such has been developed in alignment with internationally recognised greenhouse gas accounting standards such as the GHG Protocol, the ISO 14064:1, the PAS 2050:2008, the International Wine Carbon Calculator Protocol, and the recently released Australian Wine Carbon Calculator. The intention of this Protocol document is to serve as a guide for users of the online carbon footprint tool and to clarify the technical approach and parameters behind the GHG calculations. While basic instructions are available on the web-based calculator, it is recommended that this document be used while entering data on-line (www.climatefruitandwine.co.za). As this calculator has been calibrated for the wide spectrum of users within the South African fruit and wine industry, certain elements may not be relevant to all the users, but have been included for consistency and completeness.

Users of this calculator include:

- farm level-users such as the **growers**,
- **production** enterprises such as cold-store and pack-house enterprises, wineries and co-operatives, and
- **exporters** and distribution channels involved in getting the final product to the international port.

This calculator **does not include** the retailer side of the supply chain, nor the consumer use phase or the final disposal phases of packaging and unused product. However, it is recommended that retailers request their South African suppliers to utilize the calculator tool to monitor and report on the GHG emissions throughout their supply chain, thereby allowing the retailer to assess their upstream emissions accurately.

The calculator is intended to be a workable tool that can be calibrated for the individual users' specifically defined boundaries, and the results of the audit provide the information to be interpreted and acted on as the user sees fit. It is intended to be a guidance tool, and is not prescriptive in nature. At this stage, there is no formal verification and/or labelling process in place for users that undertake this carbon calculation. This may be developed in later phases of the project.

Version 1.1 serves as the second version of the Protocol document and associated calculator tool for the South African fruit and wine industry, and is expected to be updated on an annual basis (from 2010) following feedback and progressive research, directed by the industry data. One of the main aims of this process is to maintain direct industry involvement, feeding the comments and suggestions from the industry stakeholders in to the protocol and calculator updates, thereby maintaining transparency throughout the process. In addition, the data analysis of the industry trends is relevant and representative as it is based on the information supplied by the industry users of the calculator. The data that is submitted through the on-line calculator is stored in its generic format (i.e. growing region, commodity type, business activity- not farm name or business unit name) and kept confidential at all times and will not be used for any other purpose except for the industry analysis in line with this project. A benchmarking exercise will be done to compare the South African fruit and wine export industry with our competitive markets, as well as localised internal industry analysis, to gain a better understanding on the greatest risks and opportunities within the industry as a whole. This information will feed directly in to the Strategic Framework for the industry. This Framework aims to outline the long term and short term risks, highlight the realistic opportunities available, and outline the industry trends and future research and development goals of the industry going forward. The projections within the report will closely aligned with current and likely future policy developments and will be grounded within the local context.

Any suggestions, comments or queries are welcome. Please contact the project co-ordinator Hugh Campbell on hugh@dfptresearch.co.za or the project manager Shelly Fuller on shellyf@genesis-analytics.com.

2. Terms and definitions

The following terms form the basis for GHG auditing.

Activity data is the data that is relevant to GHG emissions or removals within a specific boundary and during a given period of time (for example, the calculator requires information on annual production rates, fuel usage and agrochemical application, to name a few). The data is used to calculate the GHG emissions per activity.

Anthropogenic emissions are greenhouse gas emissions that are caused by human activities.

Baseline is a level or year against which subsequent greenhouse gas emissions are measured. For example, the results from a business's first carbon footprint audit will serve as a baseline against which subsequent carbon audits will be compared.

Carbon dioxide (CO_2) is one of the carbon based gases in the atmosphere and is used as the unit of measure against which all other GHG emissions are evaluated.

Carbon dioxide equivalent (CO_2e) is a unit of measurement that values the global warming contribution of other greenhouse gases to that of one unit of carbon dioxide, for standardization. For example, 1 unit of nitrous oxide = 298 units of CO_2e (see *Global Warming Potential* below).

Carbon pool is a component of the air, land or sea that has the capability to store or accumulate GHGs that are removed or captured from the atmosphere. For example, the 'biomass carbon pool' on a farm would be the cumulative carbon stored in biomass (trees and crops) on the farm over a certain time period.

Control approach is one approach offered by the GHG Protocol to allocation of GHG emissions, whereby ownership of the GHG emission is based on whether the entity conducting the audit has financial or operational control of the operation.

Emission factor is the conversion ratio to convert activity data, such as fuel usage (litres), into emission values (tCO2e/litre fuel).

Equity share approach is another approach to allocation of emissions offered by the GHG Protocol, whereby ownership of the GHG emissions are based on the economic interest of the activity and typically, the equity share in the operation is aligned with the percentage ownership of the business entity involved in that specific activity.

Global warming potential (GWP) expresses a gas's heat trapping power relative to carbon dioxide over a particular time period- most commonly a 100 years. Greenhouse gases are compared to their equivalent GWP relative to 1 unit of carbon dioxide (CO_2). The relative GWP of the 6 main greenhouse gases over a 100 year time frame according to the 2007 IPCC figures are:

Greenhouse Gas (GHG)	GWP
Carbon dioxide (CO_2)	1
Methane (CH_4)	25
Nitrous oxide (N_2O)	298
Hydrofluorocarbon (HFCs)	1,430-14,800
Perfluorocarbons (PFCs)	7,390-17,200
Sulphur hexafluoride (SF_6)	22,800

Greenhouse gases (GHGs) are atmospheric gases that regulate the way the atmosphere absorbs and subsequently releases energy from the sun. GHGs are required to keep the earth's surface about 30 degrees Celsius warmer than it would be in their absence, thus allowing life on earth to exist. However, since the industrial revolution, there has been a build up of GHGs. The result is similar to what happens in a greenhouse- additional heat is absorbed and 'trapped' causing temperatures and humidity to change - hence the term 'Greenhouse Effect'. The GHGs included in the Kyoto Protocol and most international reporting protocols are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_20), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

The IPCC (Intergovernmental Panel on Climate Change) is an international scientific body that was established in 1988 with the main objective to provide an assessment of scientific, technical and socio-ecnomic information available relevant to the understanding of human induced climate change. The IPCC releases period assessment reports that are a synthesis of peer reviewed papers and studies of relevance and generally include potential impacts of climate change and options for mitigation and adaptation.

Land use, land use change, and forestry (LULUCF) Land use refers to the type of activity being carried out on a unit of land, such as forest land, cropland and grassland. LULUCF related emissions refers to GHG emissions/removals resulting from land use (involving no change in use, such as forest remaining forest land) and land use changes (involving changes in land use, such as grassland converted to forest land or forest land converted to cropland) which affect the amount of biomass in existing biomass stocks (e.g. forest, village trees, savannah) and soil carbon stocks.

Offsetting is a financial instrument or mechanism that aims to counteract, or offset, the net emissions associated with a process or product through the purchase (or otherwise acquiring or causing) of a reduction in GHG emissions from another location. Offsetting is not included at any point during this GHG audit in order to claim reductions in the emissions associated with the product or activity. It is the intention of this calculator to provide a baseline assessment of the GHG intensity of the product, prior to any external measures that may be implemented to offset the related GHG emissions. This Protocol promotes on-site or direct emission reduction as a priority prior to any offsetting mechanisms.

Organisational boundary is the boundary that determines the operations and subsidiaries owned or controlled by the applicant, depending on the consolidation approach taken (equity or control approach).

Soil carbon is the carbon content that is stored in all organic soil matter.

Source is any process or activity that releases a GHGs into the atmosphere. A carbon pool can be a source of carbon to the atmosphere if less carbon is flowing into it than is flowing out of it.

Sink is an activity, mechanism or process, that removes greenhouse gases from the atmosphere. Such removals typically occur in forests (which remove carbon dioxide from the atmosphere through photosynthesis), soils, and oceans.

The Unit of analysis for this calculator is the mass of CO_2e per functional unit of product within the boundaries of the entity doing the analysis. The results of the analysis are available in several formats – total tonnes of CO_2e for the business unit, or tCO_2e per tonne of fruit or litre of wine produced. It is important to note however, that the results on a unit of product are only the results of the GHG analysis for that specific section of the supply chain (i.e. within the boundaries of the entity doing the analysis). To get a true figure for the carbon footprint of the product would require all entities along the supply chain to add up their contribution to the product. This is known as a fully life cycle analysis (LCA) and is beyond the scope of this project in its current form.

3. Principles and application

This section provides information relevant to GHG accounting and thus serves as an introduction to the process. In the interest of keeping this document informative and concise, elements within the GHG accounting process are explained briefly, with additional links and references are provided for more detail.

3.1 GHG Accounting Principles

GHG accounting and reporting practices are new to many businesses and are continually evolving and developing. However, the principles listed below, outlined by the Greenhouse Gas (GHG) Protocol (WRI, 2004), form the backbone of all GHG accounting processes. These principles are derived from generally accepted financial accounting and reporting principles and reflect the outcome of a collaborative process involving stakeholders from a wide range of technical, environmental and accounting disciplines.

- **Relevance:** Ensure the GHG audit appropriately reflects the GHG emissions of the company and serves the decision making needs of users – both internal and external to the company.
- **Completeness:** Include all relevant GHG emissions and removals. Include all relevant information to support criteria and procedures, within the chosen boundary. Disclose and justify any specific exclusion.
- **Consistency:** Enable meaningful comparisons in GHG-related information.
- **Accuracy:** Reduce bias and uncertainties as far as is practical and achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information.
- **Transparency:** Disclose sufficient and appropriate GHG related information to allow intended users to make decisions with reasonable confidence.
- **Conservativeness:** Use conservative assumptions, values and procedures to ensure that GHG emission reductions or removal enhancements are not over-estimated.

These GHG principles are intended to underpin and guide GHG accounting and reporting and ensure that the disclosed information represents a true account of business entity's emissions. The South African Fruit & Wine calculator and protocol has been developed in line with these guiding principles and is largely based on the **GHG Protocol Corporate Accounting and Reporting standards** for benefits of international recognition, year-on-year consistency and proven scientific rigor.

Elements of the **PAS 2050:2008** *Specification for the Assessment of the Life Cycle Greenhouse Gas Emissions of Goods and Services* have been incorporated in to the development of the South African Fruit & Wine calculator, particularly the utilization of process maps, boundary delineation and data requirements. The WRI/WBCSD GHG Protocol team are currently in the process of developing a similar standard for accounting and reporting GHG emissions throughout the supply chain (based largely on the PAS 2050), which is due for release mid 2010. The South African Fruit & Wine calculator aims to be transparent and flexible so as to align with such international standard development.

3.2 Application

The first step in a greenhouse gas audit begins with defining the boundary of the audit so that the results reflect the substance and economic reality of the company. As this calculator has been developed to include a wide spectrum of stakeholders from the industry, guidance is offered on how to define the auditing boundaries, however no strict rules exist and it is up to the user to decide which boundary is best for their purpose.

3.2.1 System boundary

The GHG Protocol recommends two categories for setting system boundaries: **organisational** and **operational** boundaries. **Organizational boundaries** determine which parts of the company to include in a GHG audit and are thus particularly important for complex organizational structures, for example a business entity that has more than one farm and/or other operation under its umbrella organisation. To assist in simplifying this process, the GHG Protocol recommends choosing between two approaches for defining the organisational boundaries- the control or equity share approach. Under the equity share approach, a company accounts for GHG emissions from operations according to its share of equity in the operation. For example, if a company owns 50% of the operation, then only 50% of the total GHG emissions for that business operation are allocated to the company and thus fall within their responsibility. The equity share reflects economic interest, which is the extent of rights a company has to the risks and rewards flowing from an operation. Under the control approach, the company accounts for the GHG emissions which are a result of activities and processes that are within the company's control. In line with the International Wine Carbon Calculator and for purposes of the South African fruit and wine industry, it is recommended that the control approach will be taken for GHG accounting and reporting. Using this approach means that the responsibility of carbon is shared and emission reduction action is possible through specific technological or operational changes at the source.

Operational boundaries determine which corporate facilities, operations and equipment are included in the GHG audit and which are outside the boundary scope. Operational boundaries distinguish between direct and indirect emissions; **direct emissions** arise from sources that are owned or controlled by the business, while **indirect emissions** are classified as emissions that are the consequence of the activity of the business, but occur at sources owned or controlled by another company (World Resource Institute, 2004). By making this distinction, companies can better manage the full spectrum of risks and opportunities that exist along the value chain (World Resource Institute, 2004).

To further clarify the distinction between direct and indirect emissions, the GHG Protocol (WRI, 2004) uses three different scopes as subcategories (Figure 1). **Scope 1** emissions are termed direct emissions as they result from activities owned and controlled by the company, such as fuel usage in company-owned vehicles and other fuel usage for stationary combustion. Within the fruit and wine industry, other examples of Scope 1 emissions include unintentional (also called fugitive) emissions such as through leaks of HFC-based refrigeration systems, or CO_2 purchase and use during wine fermentation. **Scope 2** emissions are solely from purchased electricity, which within South Africa is all supplied by Eskom. They are regarded as indirect emissions because they occur in equipment owned by another company (a power station). Purchased electricity is separated from other indirect emissions as electricity generation contributes significantly to global warming. For many organisations, electricity consumption is the largest component of their carbon footprint, particularly in South Africa where purchased electricity is largely coal-based and hence carbon intensive. **Scope 3** emissions result from all other indirect emissions, which largely involve contracted or secondary activities (Figure 1). Distinction between Scope 1 and Scope 3 emissions can get confusing, but are related to the control or ownership of the activities or related equipment. For example, if a vineyard owns a harvester then the emissions generated during the usage of the harvester will be classified as Scope 1 emissions. However, if the harvester is not owned by the farm but is a contracted harvester that is brought in during harvest season, then the emissions generated would be classified as Scope 3.

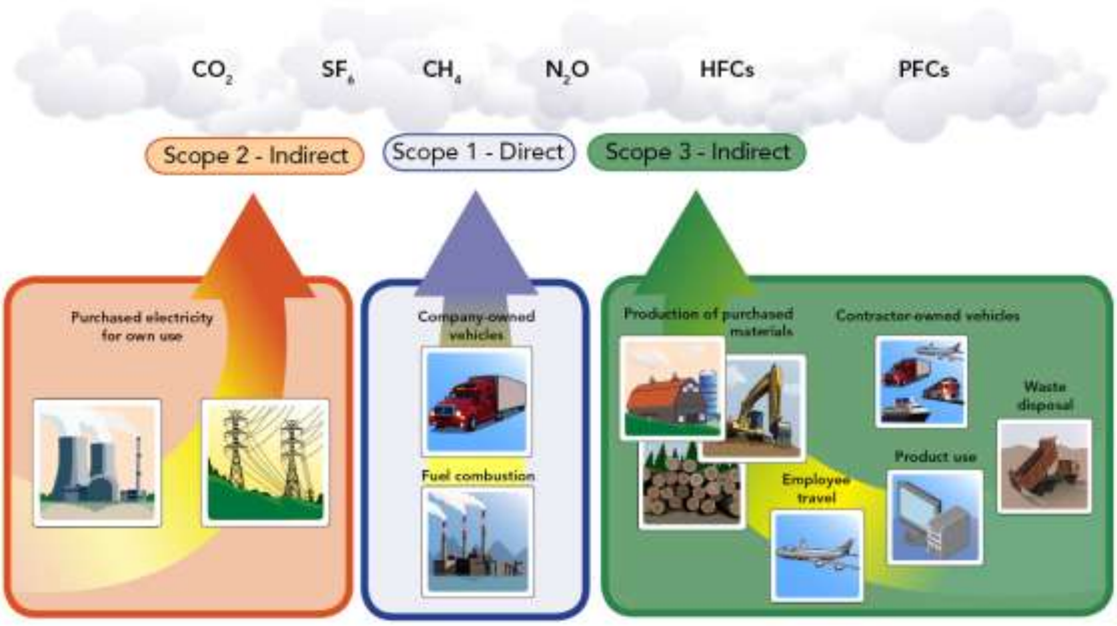

Figure 1: Illustrative representation of the GHG accounting scopes as outlined in the GHG Protocol (WRI, 2004).

For corporate reporting purposes, international GHG accounting standards require reporting according to the above mentioned Scope definitions. Emissions from Scope 1 and 2 activities are mandatory to account for, while Scope 3 emissions are voluntarily reported. Reduction opportunities within Scope 3 emissions may, however, exist and therefore care has been taken to include various aspects of Scope 3 emissions within this calculator. To be consistent with these standards, the results of the South African fruit & wine industry calculator will be made available in the Scope 1, 2 and 3 groupings should the user require that format for reporting purposes. However, as most people may struggle to remember how the scopes are defined, a process-driven approach to the emissions and breakdown of business activities has been chosen for this calculator structure. This means that, for example, all farm related fuel data will be entered together, with the user defining the split according to company-owned vehicles (Scope 2) and contractor vehicles (Scope 3). This design has been structured to make the calculator more user-friendly and to align with other financial accounting and reporting systems.

Please take care to properly define your boundaries according to which activities are representative of your business and which you have control over as this will impact which elements of the calculator you are required to complete. The level of control may extend both up- and down-stream[1] and it is strongly recommended that close collaboration along each supply chain be established to effectively monitor and manage GHG emissions through a shared-responsibility approach.

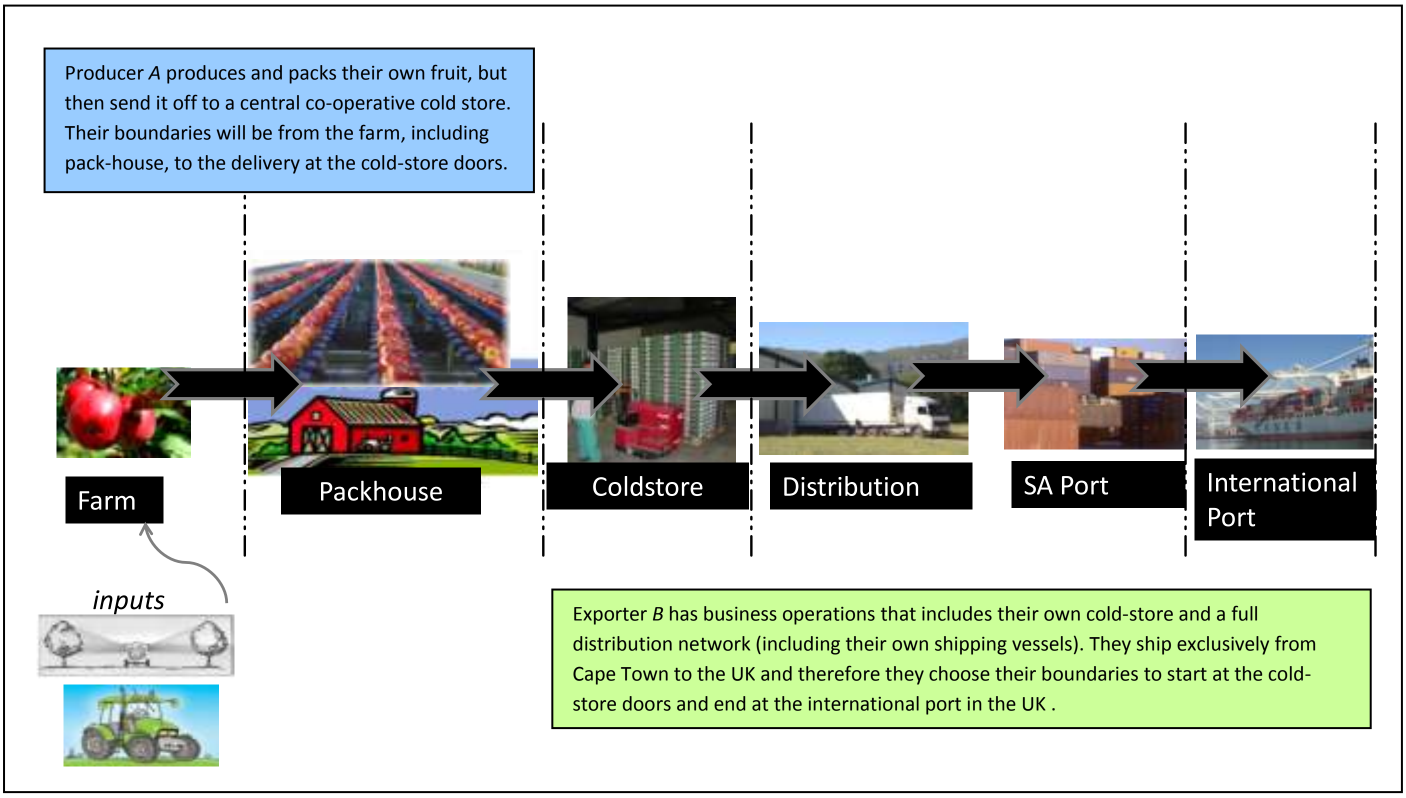

Figure 2: An example of the different elements of a fresh fruit supply chain and the relative boundaries as defined by this Protocol.

[1] Upstream emissions are those that result from input-related elements of your supply chain, while downstream emissions are those relating to the subsequent use of the product down the supply chain.

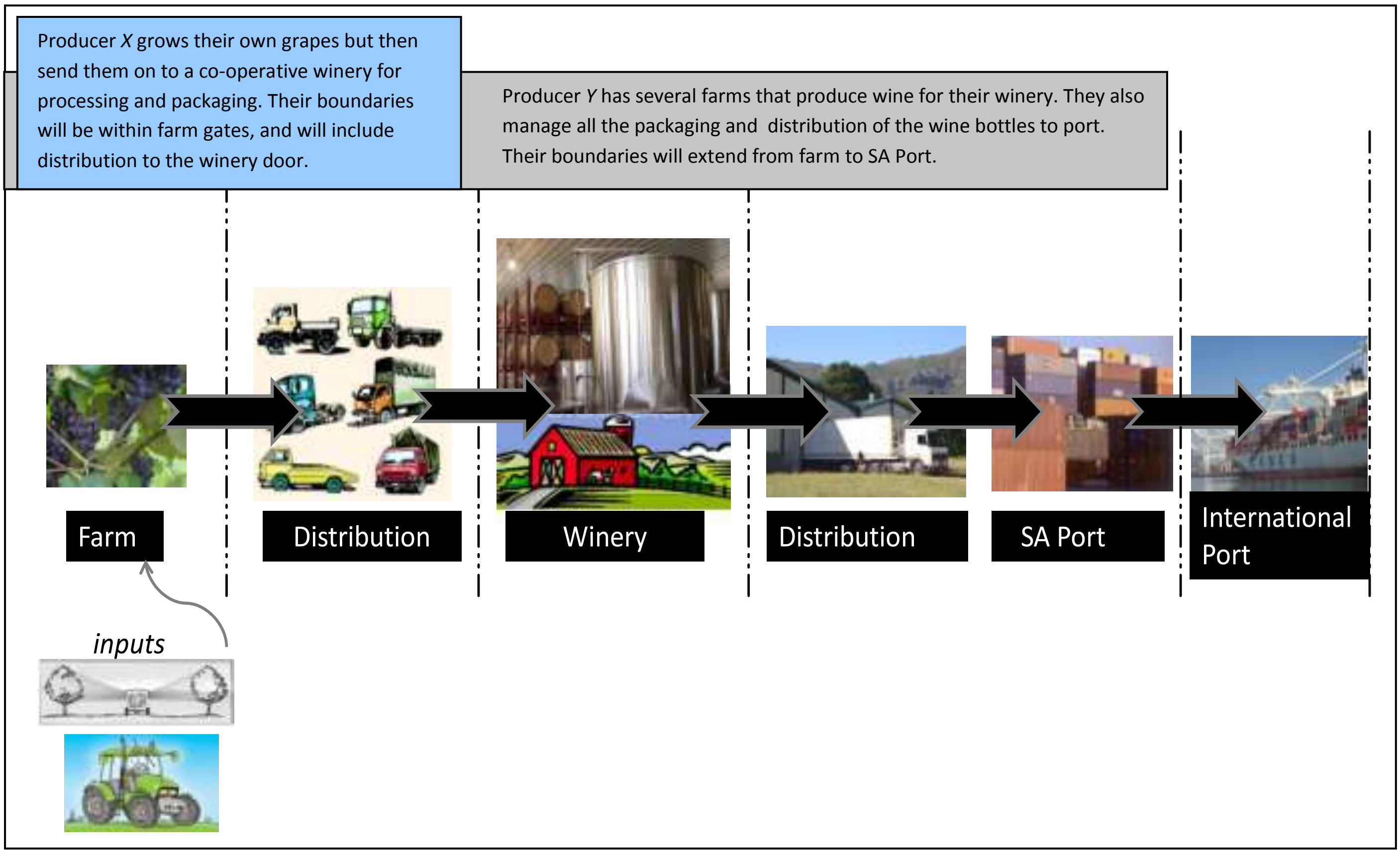

Figure 3: An example of the different elements of a wine production supply chain and the relative boundaries as defined by this Protocol.

3.2.2 Data quality

By providing this greenhouse gas accounting tool for free use, we are handing the quality control of the data over to the user and thereby cannot take responsibility for the quality of data. It is in the best interest of the user to provide the best quality data possible, as it directly impacts on the quality of the results.

At various sections in the calculator (specifically in fuel-, electricity-, and agrochemical- usage), a break-down of the total usage is requested and two options are provided in terms of data entry; based on quantity or percentage estimate split. Where possible, it is suggested to enter the quantity data, however, should the user not monitor the usage within that specific category accurately, the percentage estimate tool can be used to calculate the proportion of the total usage. A control total can be used to see how the break-down matches to the actual total figure provided by the user. For example, if the total diesel fuel quantity is 20 000 litres per year, then when the split is entered according to vehicle types or activity, the control total will indicate how close to 20 000 litres the sum of the split is. The user is able to utilize both the percentage estimate and the quantity approach to the split, and the tool will calculate the alternative amount. The calculator will compute any split of information that is entered, and in absence of that, will use the total figure. The control figure is never used in the calculation, and is only available as tool to establish the accuracy of the split of data.

The emissions factors used in this calculator are from the most relevant scientific sources and are referenced in Appendix A..

3.3 Using the Calculator

3.3.1 The step-by-step process

Registration

The first step to accessing the calculator is to register as a user. Like most on-line registration processes, this involves providing basic contact information in relation to your business unit for data capturing and identification processes. A username and password function is requested and is it suggested that the username be the applicants email address for reasons of consistency and contactability. A confirmation email will then be sent to the applicant's email address as specified, and following the verification process, full access to the calculator page of the website will be granted.

Overview

The overview page shows the user a summary of their business unit/s defined and audited in previous log-ons, and the status of the audits (completed or started).

Manage Boundaries

The user is able to view, select and edit the boundaries that pertain to their specific business unit. The boundaries used in the calculator are:

- General (electricity and fuel usage) which is to be completed by all users
- Farm
- Pack-house facilities
- Cold-store facilities
- Winery facilities
- Distribution

The user is expected to define the correct boundaries according to their business activities. Should the boundaries change from one auditing period to the next, the user is able to edit the boundaries accordingly within the Manage Boundaries section. It is however, recommended to maintain the boundaries for consistency and accurate data comparison. Please see the Boundaries section for more details.

Begin Audit

The Begin Audit link opens the first page of the data entry process. Please note that only the pages relevant to the business boundaries will be available to the user and it is therefore vital to accurately define the boundaries accordingly.

Reports

The report function allows the user to easily access and download the reports from previous audits. There are various report formats available (for example, .pdf or Excel-based) and the user can specify which reporting format they wish to use.

3.3.2 Protocol inclusions and exclusions

International GHG accounting and reporting guidelines offer support and guidance as to inclusions and exclusions of most corporate GHG accounting systems. However, this Protocol and tool incorporates several additional parameters to accommodate for the complexities within the industry. The inclusions and exclusions are aimed offer guidance and are not mandatory or prescriptive as this stage. However, it is recommended that consistency is maintained between subsequent audits as to the boundaries of the study and the relevant inclusions and exclusions. Amendments should be clearly noted and clarified in the reporting.

Annual Audit period

The user is able to define their 12 month auditing period. This was allowed to account for the different harvesting periods. For ease of data capture and data entry, it is suggested to align the annual carbon auditing period with other existing auditing periods, for example the financial auditing cycle.

The user is prompted to choose the 12 month period, and the relevant year, for their auditing period. The year is linked to the starting month of the audit, for example, March, 2007 is for the period March 2007 to February 2008.

The calculator tool will record the data according to the period selected, and will send the user a reminder approximately 3 months prior to the next carbon footprint audit cycle. This will be in the form of an email requesting the data collection period to begin, so as to be ready for the commencement of the next annual auditing period. It is recommended that the user maintain the same auditing period year-on-year, to allow for accurate data comparison.

Business Unit

The user is required to enter data per business unit, as defined by their existing financial and operational structures. If more than one farm or business activity exists under one business unit, for ease of data collection, the user is requested to do a separate carbon calculation per farm or business activity. This level of analysis enables the results to be applicable on the individual farm- or business activity- level. Should the user wish to report on their business unit as a whole, the individual carbon emission figures can then be summed to make a total and reported on accordingly. Infrastructure and capital investment is excluded from the carbon calculation in line with generally accepted GHG accounting practices.

Location data

The calculator has been developed for the South African industry, and therefore users outside of South Africa are advised not to use it as it will not be representative. Should the user reside outside the country, but have a business unit within South Africa, then the calculator would be relevant for the local business activities. [2]

Please use the options provided to narrow the location of your business unit. The province level category is representative of all the major provinces in South Africa. Regions have been defined by the commodity representatives as indicative and representative of the different growing regions. If you have more than one farm within your business unit and/or grow more than one commodity, please do a carbon footprint audit per farm unit and please define your business entity region based on your *dominant commodity type*. If you are not a grower and/or your business unit is not influenced by the growing, then please use the “Not a grower” category. The growing region data is requested so that the data analysis can be comparable at a growing region level as it is understood that specific environmental conditions are unique to each growing area.

Subtropical fruit growing regions include: Soutpansberg, Letaba, Hoedspruit, Hazyview/Kiepersol, White River/Nelspruit/Barberton, KZN North Coast, KNZ South Coast, and KZN Midlands.

Deciduous Fruit growing regions include: Namaqualand, Orange River, Langkloof, Klein Karoo, Ceres, Wolseley/Tulbagh, Piketberg, Olifants River, Groenland/Grabouw, Vyeboom, Villiersdorp, Berg River, Franschhoek, Stellenbosch, Somerset West, Hex River and Worcester.

Citrus fruit growing regions include: Northern Limpopo (north of Soutpansberg), Limpopo south of Soutpansberg, Mpumalanga Highveld, Mpumalanga Lowveld (including Nelspruit), Northern KZN (Pongola), KZN (excluding Pongolo), Eastern Cape – Kat River area,– Sundays River area, and – Gamtoos River area, Western Cape – Olifants River area (including Citrusdal and Clanwilliam), - and Berg River area (including Piketberg, Paarl, and Stellenbosch).

Wine growing regions include: Robertson; Worcester/Breedekloof; Swellendam; Klein Karoo (includes Calitzdorp, Montagu, Tradouw, Upper Langkloof, Outeniqua); Cape Point (includes Constantia, Hout Bay); Tygerberg (includes Durbanville,Philadelphia); Paarl; Stellenbosch; Swartland/Darling; Tulbagh; Olifants River (includes Koekenaap, Spruitdrift, Vredendal, Piekenierskloof, Bamboesbay); Overberg (includes Elgin, Klein River, Theewater, Greyton); Groenland/Grabouw; Cape Agulhas (includes Elim); Walker Bay (includes Hemel-en-Aarde Vallei, Bot River, Sunday's Glen); and then regions that are not part of any of the above regions and therefore form their own regions; Douglas, Benede Oranje, Ceres, Hartswater, Lamberts Bay, Prince Albert Valley, Swartberg, Rietrivier, Herbertsdale, Cederberg.

Electricity usage

Within South Africa, the emissions that result from grid-supplied electricity consumption are often a significant part of a business’s carbon footprint. This is because grid-supplied electricity is provided by Eskom, through coal-based power stations, which are inefficient and carbon intensive. The emission factor reported in the Eskom Annual report, however, does includes the renewable energy sources that are supplied to the grid, such as hydro-power and nuclear.

Procedure

The user is required to supply the total annual amount (in kWh) of electricity consumed for the business unit. The calculator does not allow for Rand value of electricity consumption due to the volatility of electricity prices. The user is then requested to break down the total electricity usage per category within the business unit by one of two means- if the kilowatt usage is monitored per category (see below) then the actual kWh figure can be entered, OR, should no exact kWh figure be available, a percentage estimate approach can be used to split the electricity usage. The control total can be used to see how the breakdown compares to the actual total figure provided by the user.

[2] In the interest of the industry benchmarking exercise and strategic framework data analysis, the information that is entered from non-SA users will be stored separately from South African data, so as not to dilute or skew the local data for analysis.

The categories chosen for the electricity split are intended to represent the common facilities or consumption activities throughout the supply chain. They include:

- office buildings,
- housing facilities (staff and management),
- irrigation pumps,
- pack-house facilities,
- other sheds (e.g. machinery storage, nursery),
- cold-store facilities,
- winery facilities,
- waste water treatment facilities,
- de-greening (if applicable),
- other (please specify).

Calculation methodology

Eskom grid-supplied electricity is assumed to be the main source of electricity to the user. The relevant emission factor is applied on a per kilowatt hour (kWh) basis as per the Eskom Annual Report figures (Eskom, 2009).

Fuel usage

Emissions from fuel usage are calculated based on the amount and type of fuel combusted. Within this Protocol and as per standard GHG accounting principles, this is divided into direct and indirect fuel usage.

Direct fuel is that which is consumed through vehicles and/or machinery owned and controlled by the company.

Indirect fuel is that which is consumed through vehicles and/or machinery NOT owned or controlled by the company.

Both are treated equally in terms of fuel types, vehicle types and relevant emission factors in the calculator. The separation is requested in order to identify and prioritize areas where fossil-fuel consumption that is within the company's control (direct fuel) can be reduced. According to standard GHG accounting principles, accounting for direct fuel consumption is mandatory, while accounting for indirect fuel consumption is not. This Protocol recommends accounting for both direct and indirect fuel usage as fossil-fuel consumption is noted to be a major source of GHG emissions throughout the supply chain and therefore should be monitored.

Procedure

Direct Fuel is broken down into mobile and stationary combustion and the relevant fuel types are modelled.

- Mobile combustion: diesel, petrol (gasoline), LPG, oil (lubricants), natural gas, aviation gas, and biofuels.
- Stationary combustion: diesel, petrol (gasoline), burning oil (paraffin), LPG, coal, anthracite, biofuels, wood (renewable, on-site), and wood (un-known, brought in).

The user is requested to enter the volume (litres) of fuel used for each type of fuel. Please note, the measure of vehicle/equipment efficiency is directly related to the quantity of fuel used, and is therefore incorporated in the fuel usage figure. The user is expected to add all the separate accounts for the same fuel type, in order to give the annual total. The further break down of how the fuel is used is requested per vehicle type. The user is then able to further split the total annual fuel amount per fuel type according to the activities within the supply chain which were responsible for the fuel combustion – i.e. within on-site activities, or within the different distribution legs. As per electricity, all above mentioned consumption splits are requested on a quantity or percentage estimate basis.

Four distribution legs are offered:

- farm gate to pack-house or winery
- pack-house or winery to cold-store
- winery to SA port
- cold-store to SA port

These groupings are thought to be representative of the different elements within the fruit and wine supply chain and account for only the road transport elements within the distribution that are owned by the business unit.

Indirect Fuel includes any contractor-owned vehicles such as those used only during harvesting or for product distribution, as well as any staff-related travel, which includes staff transport to- and from- work and business-related travel in hired vehicles or airlines. It is broken down in to three subsections : on-site vehicles/equipment usage

: distribution of product

: business and employee travel

On-site vehicles/equipment

Due to the lack of accurate quantity-based data (litres of fuel used) for contracted or hired vehicles and equipment, this section allows the user to input their data in one of three ways: quantity-based (litres); distance-based (kilometres driven); or time-based (hours equipment was running for). The first option is the preferred one as it allows for the most accurate analysis, while the kilometres- and time-based equations are less robust and are therefore less accurate. All three options (quantity- ,distance- or time-based) are offered for the user to input data, however, the user must take care NOT to double count their *Indirect fuel* by entering the data in more than one column. The vehicles listed are believed to be the most commonly hired vehicles/equipment within the South African fruit and wine industry.

Distribution of product (transport - contracted)

Please note the boundary issues relating to this grouping. If distribution vehicles are owned by the business, then the emissions related to distribution will be part of the Scope 1 emissions, and will be reported for under *Direct Fuel* usage. If, however, the distribution vehicles are contracted and not owned by the business, then the distribution related emissions will be part of Scope 3 emissions, and reported for under here under *Indirect Fuel - Distribution*. It is expected that most of the users make use of external transport and logistics companies for certain sections of their distribution, and will therefore account for those sections of the distribution here.

Three distribution options exist: road-freight, rail-freight, sea-freight and air-freight.

The emissions from all transport modes (road-, rail-, sea- and air- freight) are all quantified by accounting for the weight of produce transported, and the distanced travelled. The user is required to provide the total annual figures and is therefore required to sum the total annual amount of produce transport (total weight of final product- packaging included) and sum the total distance travelled (total kilometres) on an annual basis. As there is currently no consistent manner to accurately account for return legs and levels of responsibility, it has currently been excluded from this calculator. This may, however, change in later versions of this calculator.

Average international distances (i.e. from South Africa to the major international destinations) are offered as guidance:

- North America = 11,000km
- Asia/Far East = 13,000km
- UK/Europe = 10,000km
- South America = 7,000km

Employee business travel

The user is required to account for the total number of trips incurred on an annual basis and the total distance travelled. Two transport modes exist within employee business travel: hired vehicles (i.e. cars) and air travel. The user is required to quantify the total distance travelled (in kilometres) per vehicle on an annual basis.

Air travel is grouped according to the distance of the flight, where local trips are accounted for as short-medium haul flights (<1500km) and all international trips are accounted for as long haul flights (>1500km). The user is required to quantify the total distance travelled (including return leg) and the number of trips (per person) on an annual basis. All air travel definitions and emission factors are taken from the GHG Protocol Mobile Combustion Tool (WRI, 2004) and DEFRA guidelines (2009). Average distances to international destinations are given as outlined in the *Distribution* section above.

Biofuels and wood fuel sources

The emission factor for biofuels is calculated as per the Australian Wine Carbon Calculator figures (2009), and includes emissions from methane and nitrous oxide. Current international practice is to exclude biofuel combustion from GHG emission calculation as it considered a renewable source and its combustion is assumed to be in balance with the short term carbon cycle (*see carbon sequestration and the short term carbon cycle section below*). However this Protocol and carbon calculator tool has included it as so as to gather data on the extent of biofuel usage within in the industry, and to provide a comparative tool for the user to evaluate the difference between fossil-fuel based emissions, and emissions from biofuel usage. As the science and understanding of this topic improve, however, the relevant emission factor for biofuels as outlined in this Protocol may change with updated research.

Emissions associated with using wood as a fuel source can be highly variable due to the differences in burning capacity, which is influenced by the moisture content, burning conditions and the vegetation species. As with biofuels above, most current GHG accounting processes do not require the GHG emissions from wood burning to be accounted for, as it is understood to be part of the short term carbon cycle. For purposes of this Protocol, however, as this fuel source is readily available (from alien vegetation clearing) and is therefore a regularly used fuel source on many farms and is therefore required to be accounted for. Wood has been divided into that which is from a renewable source and is from on-site (for example, biomass from on-site alien vegetation clearing processes) and that which is from an off-site source and whose renewable status is therefore not known. Emissions from the on-site renewable wood are negligible and are equated to zero within the calculations. The emission factor for off-site unknown sourced wood is calculated based on the standard carbon-to-carbon dioxide equation, where it is assumed that 50% of the biomass is carbon, and then converted to carbon dioxide through combustion by multiplying by a factor of 44/12, which is the ratio of molar masses of CO_2 to carbon.

In other words, where 20 kg of dry wood is combusted, the equation would be:

(20*0.5) to get the carbon content,

Then * (44/12) to get the CO_2e = 37 kg CO_2e

This calculation is thought to be robust, but may be updated with further research.

Agrochemicals

The production and application of certain agricultural chemicals (hereafter referred to as "agrochemicals") is noted to emit significant quantities of GHGs, most notably nitrous oxide from nitrogen-based fertilizers. The user is requested to account for the various agrochemicals used on an annual basis. The categories of agrochemicals broadly include fertilizers and pesticides, with further sub-categories within each group, as outlined below.

- **Fertilizers**
  - Synthetic[3]
    - Nitrogen-based
    - Other: Incorporating all phosphorus-, potassium, lime, and sulphur-based synthetic fertilizers
  - Organic[4]
    - Liquid manure
    - Solid manure
- **Pesticides**
  - Herbicides
    - Paraquat-based
    - Diquate-based
    - Glyphosate-based
    - Other
  - Fungicides
  - Insecticides

[3] Applies to both the liquid and granule forms of synthetic fertilizers

[4] Please note compost is part of short term carbon cycle and is therefore not included in this section.

Due to the global warming potential of nitrous oxide (GWP= 298), a GHG released during both the manufacture and use of nitrogen based fertilizers, accounting for the emissions associated with the use of nitrogen based fertilizers is the most important in terms of agrochemicals. For this reason, most other GHG accounting tools require information on nitrogen-based fertilizers *only* and do not look in to the other agrochemicals. It is predicted, however, that as the global trends shift to more conservation farming techniques, accounting for all other agrochemicals may become a mandatory requirement in the future. It is therefore thought valuable to account for the relative GHG emissions from all agrochemical usage, to as much detail as possible, so as to fully understand the impact of different farming techniques on the carbon footprint of the business unit and/product.

Procedure

The user is requested to account for the annual total **active ingredient** of each type of agrochemical group, as listed above, and then to break down the usage per commodity type. The usage split is requested on either a quantity used (kilograms of active ingredient), or percentage estimate basis per commodity type. The reason for this commodity-based split is to accurately account for the GHG emissions on a per commodity type or product basis. It is assumed that most growers have a good understanding of the main active ingredients in the agrochemicals they use. If there is more than one active ingredient present, please account only for the *dominant* one only. Please see Appendix B for additional guidance on the active ingredients of the most common agrochemicals.

Synthetic fertilizer groups include Nitrogen-based, and Other which incorporates phosphorus-, potassium-, lime-, and sulphur-based synthetic fertilizers in to one group. This split was made on the basis that there is only a very small difference in the emission factors between the different chemical ingredients in the Other group. **Of all the agrochemicals, nitrogen-based fertilizers are used in the largest quantities and have the greatest GHG emissions per product used. It is therefore in the interest of the user to monitor and account for the nitrogen-based fertilizer usage as accurately as possible**.

The organic fertilizers currently include only liquid and solid manure, as outlined in the IPCC Guidelines (2006). However this group is expected to be expanded in Version 2 of the calculator, once more information on the commonly available organic fertilizer products and related GHG emissions becomes available. This extension will allow the user to determine the difference in impacts between synthetic and organic fertilizers when used in the same application.

In line with international practices, pesticides are grouped into herbicides, fungicides and insecticides. As with the fertilizers, the user is requested to account only for the *dominant* active ingredient in each group. The herbicide grouping is further broken down in to Paraquat-, Diquat-, and Glyphosate- based herbicides, due to the different emission factors associated with these products. For fungicides and insecticides, the user is requested to account for their TOTAL annual usage, based amount of active ingredient.

Calculation methodology

All emission factors account for the production of the agrochemicals, with the exception of the nitrogen-based emission factor, which accounts for both the production and application of the nitrogen-based synthetic fertilizers. The relevant IPCC application emission factor of 3.88kg CO_2e/kg product applied was used, and was added to the production emission factor of 12.33 (Lal, 2004) . This is to more accurately account for the resulting nitrous oxide emissions. The reference paper (Lal, 2004) gives the emission factors in tonnes of carbon per tonne of active ingredient applied. These figures were then converted to CO_2e by multiplying by 44/12, as is the standard practice for this conversion.

Livestock

Livestock and manure management can contribute a significant proportion of the total carbon footprint due to the high levels of methane that are emitted from these activities. As this Protocol and relevant calculator tool is specifically designed for the fruit and wine industry, the livestock element is not very detailed, but is included to allow the user to account for livestock rearing within their farms. Manure management is not included in the current version of the calculator.

Procedure

The user is requested to account for the total number of livestock (on a per head/year basis). This means that the average stock count numbers can be used. The livestock groupings are thought to represent the livestock categories within South Africa. These groupings are; dairy cows, non-dairy cows, sheep, goats, swine, poultry, horses, and ostriches. The "Other" category is available should the users livestock not fit in to the above groupings, and specification is requested so that exclusion may be incorporated in later versions of this calculator. Please note that although the international standard poultry group includes chicken, duck, goose, domesticated guineafowl, turkey, ostrich and pheasant. At this stage, different farming methods are not accounted for in the calculations but may be incorporated in later versions should it prove to be representative to a substantial portion of the industry.

Calculation methodology

As no local emission factors exist for livestock categories, the standard IPCC (2006) figures have been used which account for the methane emissions that result from enteric fermentation. The methane emissions are then converted to CO_2e by multiplying it by 25 (the GWP of methane) to get an emission on a kilogram CO_2e per head, per year basis. The average annual stocking rate is suggested to be used (i.e. to account for the numbers of births, deaths, and sold animals on an annual basis).

Winery processes

Most of the CO_2 that is emitted during the wine-making processes is due to fermentation and is part of the short-term carbon cycle, and is therefore not accounted for or reported on. However, the CO_2 that is directly purchased for use during the process is required to be accounted for (as Scope 1) and reported on.

Packaging figures are accounted for as part of the user's Scope 3 emissions. The groupings for the packaging types have been chosen to represent the most commonly used within the South African fruit and wine industry. The 1% rule for inclusion of packaging materials was used[5] to establish which materials were to be accounted for, and as such, the corks and closures were not included. This may change in later versions of this calculator, due to industry requirements.

These groupings include:

- glass
- corrugated cardboard
- paper
- PET
- LDPE
- HDPE
- pallets, non-returnable
- pallets, returnable
- 6-pack cartons (including 6 pack dividers)
- 12-pack cartons (including 12 pack dividers)

To account for users that utilize recycled materials in their packaging, a function is available for the user to allocate what percentage of the total figure is from recycled materials. This distinction is only available for glass, paper/cardboard and plastic materials as it understood that these materials are most likely to be available and actively used in recycled forms. The user is requested to estimate what percentage of the TOTAL figure (i.e. of all of cardboard used) is made up of recycled materials. The tool then adjusts the total packaging quantity by incorporating the recycled element and reflects the figure in both the calculator page and the final report. This function is included with the aim of raising awareness of the impact of responsible packaging as the incorporation of recycled materials in to packaging will reflect a lower footprint figure than that which uses only virgin packaging materials.

Several processes within wine making are currently not included in carbon footprint calculations but, are as they may be included in later versions, are built-in for the user to begin measuring and monitoring. Such processes include the emissions from the fermentation of wine, the wash-water usage, and the disposal and management of organic waste.

[5] The 1% inclusion rule declares that if the input material being assessed makes up less than 1% of the end product's footprint, it may be omitted from the product assessment (PAS 2050).

Procedure

Electricity consumption from winery processes is accounted for the electricity usage section and is therefore not included in the winery process questionnaire to avoid double counting.

The user is required to firstly quantify the total litres of wine that is produced in their winery, and then break that total figure down in to litres exported and litres for local market. This function will allow the user to determine the carbon footprint figure based on litres for the relevant market (i.e. total tCO_2e/ litre exported) within the reporting mechanism. The user is then required to provide the total kilograms of CO_2 that is purchased and used for wine processessing on annual basis. As stated above, the CO_2 purchased is the only figure from the wine making process that is included in the carbon footprint calculation.

GHG emissions from waste water treatment include both methane and carbon dioxide. The carbon dioxide is not included in the footprint calculation as it is part of the short term carbon cycle. The calculation used is the total emissions from both sludge and waste water treatments, as measured by the chemical oxygen demand (COD) of the waste. Any methane that is captured and used on-site is subtracted from the emission total (see below for equation used).

The user is then requested to provide annual quantities of the dominant packaging materials based on the packaging groupings. The quantities are for total packaging material, excluding the wine product (i.e. total glass bottles used, not weight of glass bottles *with* wine inside). The usage of packaging material is understood to be significant in the industry and is therefore an area that offers emission reduction potential.

Information on refrigeration gas leakage is requested as the annual average re-charge quantity per refrigerant type.

Non-inclusions:

The quantity of wash-water used is recorded as annual litres used and is available as a monitoring tool for the user.

Similarly, annual quantities of white and red wine produced is recorded on a litre basis to monitor the natural fermentation figures per wine type.

Information on the quantity, storage and utilization of organic waste is also requested. The user is firstly asked to determine the location site of the waste disposal; whether at a municipal landfill or alternative location off-site, or incorporated in to an on-site compost heap. This is to determine whether the organic waste calculations fall within a Scope 1 (on-site) or Scope 3 (off-site) boundary, for reporting purposes. The user is then required to estimate the main components of the on-site compost heap in the following groupings:

- vineyard/orchard pruning's and leafy waste
- grape marc, pumice, stems, stalks
- mixed

The relevant emission factors, which are based on the International Wine Carbon Calculator (Provisor, 2008) figures, are used to get a total CO_2e per tonne of waste produced and stored. This figure includes the methane and CO_2 generated from the organic waste. The user is also required to specify how the organic waste is stored on-site, whether in a compost heap over the season, or if it is incorporated immediately in to the soil. This is to account for the possible methane emissions that result from the anaerobic[6] breakdown of organic waste if the waste is stored in a pile for an extended period. These figures will not be included in the carbon calculation, but will be used to gather data on the trends within the industry, and may be included in later versions of the calculator.

Much uncertainty exists within these calculations due the different levels degradable organic carbon (DOC) content in the various waste substances. As industry-based information becomes more available, this uncertainty may decrease and the relevant updates will incorporate upgrades to this section.

[6] Anaerobic breakdown of organic waste occurs in the absence of oxygen, which results in large quantities of methane being emitted. Aerobic breakdown of organic waste is aerated (i.e. has oxygen) and can occur naturally when the organic matter is incorporated straight in to the soil (through an aeration process), which releases marginal quantities of methane. Alternatively, organic matter can be retained in the soil (does not break down) and is stored as soil carbon.

Calculation methodology

To calculate the emissions from waste water treatment, the following equation is used (Provisor, 2008):

$tCO_2e= (Ww . COD . (0.1949) - Rm) . (21/1000)$

where Ww is the volume of waste water generated in cubic meters or kL,

COD is chemical oxygen demand in kg per kL

Rm is the recovered methane (tonnes).

The figure is then multiplied by 21 to convert the methane into CO_2e and then divided by 1000 to convert kg into tonnes. It is assumed that the industry has a good understanding of these figures and that such information will be readily available.

Information on refrigeration gas leakage is requested on the annual average re-charge quantity per refrigerant type. Because refrigerant gases have very powerful global warming potential figures, care must be taken to enter only the RECHARGE figure in terms of the "top-up" required per year, NOT the annual amount of refrigerant gases purchased for the pack-house. The refrigerant groupings are selected as they are believed to represent the most commonly used within the South African fruit and wine industry. These groupings include:

- R-22
- R-134
- HCFC-22
- HCFC-142b
- HCFC-152a
- R-318
- SF6
- Ammonia

It is assumed that most wine-producing users will have a good understanding of these figures. Please contact the project team should you have any queries or suggestions.

All packaging figures are aligned with the latest version of the Australian Wine Carbon Calculator (2009) figures, International Wine Carbon Calculator Protocol guidelines (Provisor, 2008), and the United States Environmental Protection Agency report (2002), as well as local industry knowledge. All packaging emission factors include the production and use of the materials. As local emission estimates from packaging material become available, these figures will be updated.

Non-inclusions:

All calculations related to wine processing are in accordance with Boulton et. al (1999) and the International Wine Carbon Calculator Protocol equations (Provisor, 2008). Once local information is available and scientifically tested, these equations will be updated to represent South African conditions. The total figure for CO_2 purchased and used during fermentation is supplied by the user.

The calculation for CO_2 emitted during fermentation is based on the following figures and local industry norms:

- 1 mole of grape sugar is 180grams.
- White wine is picked at a sugar level of 22 Balling with an average sugar content of 240g.
- Red wine is picked at a higher sugar level of 26 Balling with an average sugar content of 288g sugar.

Based on Boulton et al. (1999) the following emission factors apply:

- White wine = $0.12kgCO_2$/litre produced
- Red wine = $0.16kgCO_2$/litre produced

The above white wine figure excludes the incorporation of additional CO_2 that is added during fermentation, however this is captured in the "purchased and used CO_2" figures of the calculation. The red wine emission factor includes malolactic fermentation. As mentioned, the above CO_2 figures are part of the short term carbon cycle and are therefore not included in the carbon calculation, but are stored as industry data for internal analysis.

Emissions generated from off-site waste is beyond the control of the user, and is hence excluded from the carbon footprint calculations. Emissions from on-site waste management and storage is classified as Scope 1 emissions. Waste calculations are based on the type of organic material as per the International Wine Carbon Calculator (Provisor, 2008) figures.

To simplify the organic compound groupings, vineyard/orchard prunings and leafy waste have been combined and an average emission factor of 2.05 tCO_2e/tWaste is estimated[7]. A yes/no mechanism is used within the calculator to gather information on the storage of the organic waste – whether stock-piled for the season (releasing methane) or incorporated in to the compost/ soil immediately. This data is not included in the current carbon calculation but is available for industry analysis and to be incorporated in later versions of the tool.

Pack-house processes

The majority of pack-house related emissions are expected to come from refrigerant leakage and packaging material. Electricity consumption (including lighting and heating requirements) from pack-house processes is accounted for the electricity usage section and is therefore not included here in the pack-house process questionnaire to avoid double counting.

Procedure

The user is required to firstly specify the total tonnes of fruit that is packed in their pack-house, and then break that total figure down in to quantity (tonnes) exported, quantity (tonnes) for local market and quantity (tonnes) "Other" (specify) . This function will allow the user to calculate the carbon footprint figure based on quantity for the relevant market (i.e. total tCO_2e/ total tonnes exported) within the reporting mechanism.

Information on refrigeration gas leakage is captured within the cold-store section only, so as to avoid double counting. It is assumed that a farm will not have refrigeration units in both the pack-house and cold-store facilities.

Annual quantities of the dominant packaging materials is requested, based on the packaging groupings as identified by the industry. The 1% rule for inclusion[8] of packaging materials was used to establish which material were to be accounted for. These groupings include:

- Bulk bin (wood)
- Pallet (wood)
- Pallet cover (cardboard)
- Carton (corrugated cardboard)
- Pulp tray (waste cardboard/newspaper)
- Plastic containers (including polypropylene, co-polymer)
- Plastic bag & plastic wrapping (polyethylene)
- Polystyrene tray

To account for users that utilize recycled materials in their packaging, a function is available for the user to allocate what percentage of the total figure is from recycled materials. This distinction is only available for glass, plastic and paper/cardboard materials as it understood that these materials are most likely to be available and actively used in recycled forms. The user is requested to estimate what percentage of the TOTAL figure (e.g. of all of cardboard used) is made up of recycled materials. The tool then adjusts the total packaging quantity by incorporating the recycled element and reflects the figure in both the calculator page and the final report. This function is included with the aim of raising awareness of the impact of responsible packaging as the incorporation of recycled materials in to packaging will reflect a lower footprint figure than that which uses only virgin packaging materials. The usage of packaging material is understood to be significant in the industry and is therefore an area that offers emission reduction potential.

Non-inclusions:

Greenhouse gas emissions from fruit waste are expected to be significant, depending on how the waste is managed[9]. Therefore, information on the quantity, storage and utilization of organic waste is requested. The user is firstly requested to state the

[7] (3 + 1.1 respectively as outlined in the from International Wine Calculator)

[8] See Footnote 5 for definition

[9] This refers to the aerobic or anaerobic breakdown of organic waste. Please see explanation in Footnote 6 (winery processes) above.

location site of the waste disposal; whether at a municipal landfill or alternative location off-site, or incorporated in to an on-site compost heap. This is to determine whether the organic waste calculations fall within a Scope 1 (on-site) or Scope 3 (off-site) boundary for reporting purposes. The user is then required to estimate the main components of the on-site compost heap, as well as defining how the organic waste is stored; whether stock-piled for the season or incorporated in the soil immediately[10]. These figures will not be included in the carbon calculation as they are incorporated as part of the short-term carbon cycle, but will be used to gather data on the trends within the industry, and may be included in later versions of the calculator.

Additional operation activities such as fruit washing (fungicide bath usage), drying (heating equipment) and waste-water usage. are outlined where relevant to energy usage and/or GHG emissions. As no scientific emission factor or equation currently exists, this process is used as a data collecting exercise for the industry and is not currently included in the carbon calculation. It may however, be included in later versions of the calculator and is therefore provided as a monitoring tool.

Calculation methodology

The methodology for the refrigerant leakage, packaging materials and organic waste calculations are consistent with winery processes as outlined above.

Information is gathered on the additional operation activities such as fruit washing (fungicide bath usage), drying (heating equipment) and waste-water usage, to be incorporated where relevant in later versions of this calculator.

Cold-store processes

Cold-store related emissions are expected to come exclusively from refrigerant leakage. Electricity consumption (including lighting and heating/cooling requirements) from cold-store processes is accounted for the electricity usage section and is therefore not included here in the cold-store process questionnaire to avoid double counting.

Procedure

Information on refrigeration gas leakage is entered as the annual average re-charge quantity per refrigerant type. Because refrigerant gases have very powerful global warming potential figures, care must be taken to enter only the RECHARGE figure in terms of the "top-up" required per year, NOT the annual amount of refrigerant gases purchased for the pack-house. The refrigerant groupings are selected as they are believed to represent the most commonly used within the South African fruit and wine industry. These groupings are:

- R-22
- R-134
- HCFC-22
- HCFC-142b
- HCFC-152a
- R-318
- SF6
- Ammonia

It is assumed that most users will have a good understanding of these figures. Please contact the project team should you have any queries or suggestions.

It is expected that in later versions of this calculator, the time spent in cold-storage (measured in days) will be added to the total calculation so as to more accurately account for the total cold-storage requirement throughout the supply chain, including during distribution and storage at port. This function is currently a place setting until further testing is completed.

3.4 Carbon sequestration and the short term carbon cycle

The short term carbon cycle refers to the rapid exchange of carbon between plants and animals through photosynthesis and respiration respectively, as well as through the gaseous exchange that occurs between the ocean and the atmosphere (Figure 4). Within the fruit and wine industry, the short term carbon cycle includes CO_2 emissions related to fermentation, from waste-

[10] The methodology and procedures behind this requirement are outlined in the winery processes above and are not repeated here in order to keep the protocol document concise.

water and landfill, and sequestration within the vineyards and orchards. At this stage, emissions that arise directly from the combustion or degradation of biomass are also treated as part of the short-term carbon cycle, however much debate exists around this issue and this status may change in future.

In summary, the following sources and sinks are excluded from this calculator as they are termed to be part of the natural short-term carbon cycle:

- Fermentation
- Vineyard and orchard growth (sequestration)
- CO_2 emissions from aerobic both solid and liquid waste treatment
- CO_2 emissions from the combustion of biomass fuels

Emissions of other non-CO_2 emissions from these sources are not part of the short term carbon cycle and are therefore included in GHG accounting. Such emissions include methane emissions from waste systems and nitrous oxide from fertilized soils. In addition, many of the above mentioned emissions related to the short term carbon cycle have been incorporated in to the tool as a data gathering exercise (i.e. it is not part of the calculation) to assist with industry trend analysis and allow for the user to begin measuring and monitoring the extent of positive action (through sequestration for example) and the impact of activities that may be included in later versions of the calculator.

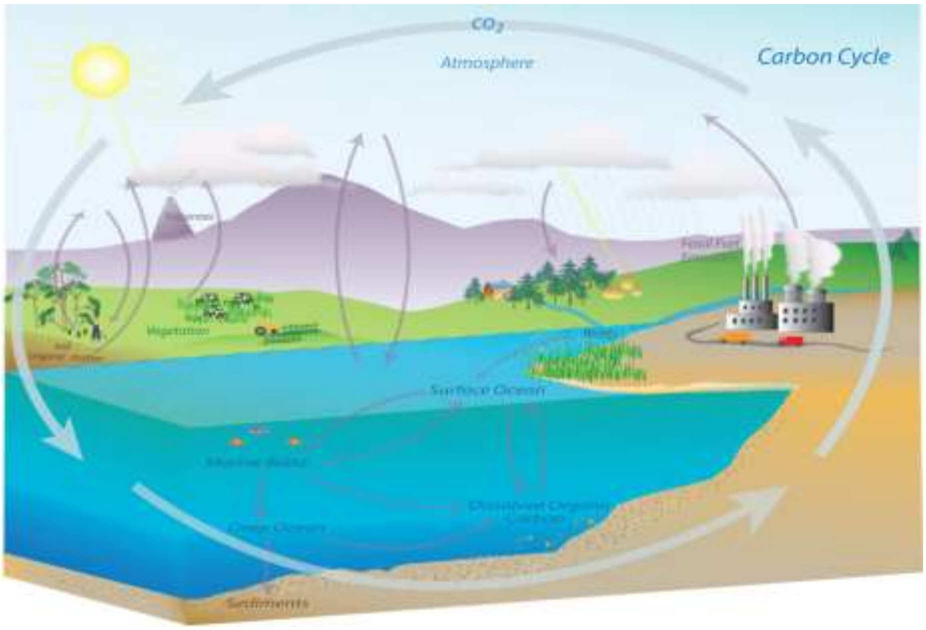

Figure 4: The Carbon Cycle (source: National Oceanic and Atmospheric Administration)

The absorption and storage of carbon from the atmosphere (as illustrated above) through the process of photosynthesis, is called sequestration. In recent years, knowledge on the value of carbon sequestration in reducing the global GHG emission levels is increasing. Although the agricultural sector is notorious for the GHG emissions that result from activities such as tillage, fertilizer application and manure management, it is also noted as the sector with the most potential to reduce GHG emissions (by increasing the soil carbon sink capacity) on a global scale.

Sequestration – Step one: Getting a baseline

Annual sequestration rates from permanent land-use types such as forestry and orchard areas can only be determined once a baseline figure has been established. Thereafter, the difference in carbon stored between year 1 and year 2 can be quantified and included in annual carbon footprint calculations. As this is the first year of the audit, the user is required to supply the data which will be stored as their baseline sequestration figure for subsequent auditing calculations.

The user is requested to quantify the size (hectares) of forested area according to the following groupings:

- Orchard

- Forestry (indigenous, including riparian)
- Forestry (non-indigenous Pine spp.)
- Forestry (non-indigenous Gum spp.)
- Forestry (non-indigenous Acacia spp.)

The user is then required to input the age and density of the forest to allow for carbon accumulation rates to be calculated for the subsequent audit.

- Planting density (number of trees per hectare)
- Average age of trees per stand according to the following categories:
    - 0-5 years
    - 6-15 years
    - 15-20 years
    - 25+ years

Calculating carbon sequestration rates is a complex process. In order to simplify this process and to keep the calculator user-friendly, average carbon sequestration rates are incorporated based on the above groupings. These average sequestration rates are not precise due the variability of climate within the different regions, however this is the first estimate of relevant sequestration rates for agricultural commodities and improvements will be included in future updates of the calculator.

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5. Appendix A

Emission factors

Source	Emission factor	Unit *	Reference
Electricity	1.03	$kgCO_2$/kWh	Eskom Annual Report 2009
Fuel			
Petrol	2.40	$kgCO_2$/litre fuel	IPCC (2006)
Diesel	2.87	$kgCO_2$/litre fuel	IPCC (2006)
LPG	0.63	$kgCO_2$/kg fuel	Lal (2004)
Natural gas	0.85	$kgCO_2$/kg fuel	Lal (2004)
Fuel oil	1.01	$kgCO_2$/litre fuel	Lal (2004)
Biofuels	0.11776	$kgCO_2$/litre fuel	Aus. Wine Calc. (2009)
Aviation gasoline	2.37	$kgCO_2$/litre fuel	Aus. Wine Calc. (2009)
Burning oil (paraffin)	2.57	$kgCO_2$/litre fuel	Defra (2009)
Coal	2.28	$kgCO_2$/kg fuel	Defra (2009)
Anthracite	2.66	$kgCO_2$/kg fuel	Defra (2009)
Wood (renewable, on-site)	0.11776	$kgCO_2$/kg fuel	Based on the biofuel calc in Aus Wine Calc (2009)
Wood (unknown, brought-in)	1.83	$kgCO_2$/kg fuel	Carbon conversion (*.05) 44/12
Agrochemicals			
Fertilizers: Synthetic – Nitrogen based	19.21	$kgCO_2$/kg active ingredient	Adapted from Lal (2004), *including application rate of 3.88/kg applied*
Synthetic – Other	0.55	$kgCO_2$/kg active ingredient	Adapted from Lal (2004), *incorporating the average of other – including phosphorus-, potassium-, lime- & sulphur-based fertilizers*
Organic- Solid Manure	5.92	$kgCO_2$/kg applied	Lal (2004)
Organic- Liquid Manure	0.30	$kgCO_2$/kg applied	Lal (2004)
Herbicide: Paraquat based	33.0	$kgCO_2$/kg active ingredient	Lal (2004)
Diquat based	33.0	$kgCO_2$/kg active ingredient	Lal (2004)
Glyphosate based	33.0	$kgCO_2$/kg active ingredient	Lal (2004)
Herbicide Other	16.13	$kgCO_2$/kg active ingredient	Lal (2004)
Fungicide	17.6	$kgCO_2$/kg active ingredient	Lal (2004)
Insecticide	16.9	$kgCO_2$/kg active ingredient	Lal (2004)
Livestock			
Dairy cows	46	$kgCO_2e$/head/yr	IPCC (2006)
Non-Dairy cows	31	$kgCO_2e$/head/yr	IPCC (2006)
Sheep	5	$kgCO_2e$/head/yr	IPCC (2006)
Goats	4.75	$kgCO_2e$/head/yr	IPCC (2006)
Swine	1	$kgCO_2e$/head/yr	IPCC (2006)
Poultry	1.95	$kgCO_2e$/head/yr	IPCC (2006)
Horses	18	$kgCO_2e$/head/yr	IPCC (2006)
Winery processes			
CO_2 from red wine production (including malo-fermentation)	0.16	$kgCO_2e$/litre produced	Boulton et. al (1999)
CO_2 from white wine production	0.12	kg CO_2e/litre produced	Boulton et. al (1999)
Organic waste			
Vineyard/orchard pruning's & leafy waste	4.1	$kgCO_2e$/kg waste	Adapted from Provisor (2008)
Grape marc, pummice, stems & stalks	0.9	$kgCO_2e$/kg waste	Provisor (2008)
Mixed compost heap	5	$kgCO_2e$/kg waste	Provisor (2008)
Packaging Materials – wine			
Glass	2.20	$kgCO_2e$/kg product	Aus. Wine Calc. (2009)
Cardboard	1.79	$kgCO_2e$/kg product	Aus. Wine Calc. (2009)
Paper	1.79	$kgCO_2e$/kg product	Aus. Wine Calc. (2009)
PET	3.22	$kgCO_2e$/kg product	Aus. Wine Calc. (2009)
Pallets, non-returnable	0.70	$kgCO_2e$/kg product	Aus. Wine Calc. (2009)
Pallets, returnable	0.1	$kgCO_2e$/kg product	Adapted from Aus. Wine Calc. (2009)
6-pack cartons (plus dividers)	3.60	$kgCO_2e$/kg product	Aus. Wine Calc. (2009)
12-pack cartons (plus dividers)	3.60	$kgCO_2e$/kg product	Aus. Wine Calc. (2009)

Continued...

Source	Emission factor	Unit*	Reference
Packaging Materials – fruit			
Bulk bin (wood)	0.60	$kgCO_2e$/kg product	Adapted from Aus. Wine Calc. (2009)
Pallet cover (cardboard)	0.22	$kgCO_2e$/kg product	USEPA (2002)
Carton (corrugated cardboard)	0.22	$kgCO_2e$/kg product	USEPA (2002)
Pulp tray (waste cardboard/newspaper)	0.22	$kgCO_2e$/kg product	Adapted from USEPA (2007)
Paper	0.27	$kgCO_2e$/kg product	USEPA (2002)
Plastic containers (polypropylene, co-polymer)	1.98	$kgCO_2e$/kg product	Adapted from Aus. Wine Calc. (2009)
Plastic Bag & plastic wrapping (polyethylene)	1.98	$kgCO_2e$/kg product	Adapted from Aus. Wine Calc. (2009)
Polystyrene tray	4.96	$kgCO_2e$/kg product	Defra (2009)
Refrigerants			
R-22	1900	$kgCO_2$/kg leaked	Global Warming Potential listed in IPCC (2006)
R-134 (includes HFC 134 or 134a)	1000	$kgCO_2$/kg leaked	Global Warming Potential listed in IPCC (2006)
HCFC- 22	1780	$kgCO_2$/kg leaked	Global Warming Potential listed in IPCC (2006)
HCFC- 142b	2270	$kgCO_2$/kg leaked	Global Warming Potential listed in IPCC (2006)
HCFC- 152a	122	$kgCO_2$/kg leaked	Global Warming Potential listed in IPCC (2006)
R-318	10090	$kgCO_2$/kg leaked	Global Warming Potential listed in IPCC (2006)
HFC – 134a	1430	$kgCO_2$/kg leaked	Global Warming Potential listed in IPCC (2006)
SF6	23900	$kgCO_2$/kg leaked	Global Warming Potential listed in IPCC (2006)
Ammonia	0	$kgCO_2$/kg leaked	Global Warming Potential listed in IPCC (2006)
Distribution			
Sea freight	0.015	$kgCO_2e$/t Product/km	Defra (2009) *Small container vessel*
Rail freight	0.03	$kgCO_2e$/t Product/km	Defra (2009)
Air freight	0.60	$kgCO_2e$/t Product/km	Defra (2009) *Long haul*
Road freight (distance based)	0.40	$kgCO_2e$/t Product/km	Defra (2009) *Van/Light Commercial Truck*
Road freight litres consumed see Fuel usage above			
Staff business travel			
Hired vehicles: Average passenger vehicle (petrol)	0.22	$kgCO_2e$ /km	Defra (2009) *Average petrol passenger car*
Average passenger vehicle (diesel)	0.20	$kgCO_2e$ /km	Defra (2009) *Average diesel passenger car*
Average delivery truck (diesel)	0.16	$kgCO_2e$ /km	Defra (2009) *Diesel van Class I*
Air travel: Local flights (short haul <1500km)	0.13	$kgCO_2e$ /person/km	Defra (2009) *Average of "Domestic" & "Short haul international" distances and class seats*
International flights (long haul >1500)	0.11	$kgCO_2e$ /person/km	Defra (2009) *Average of all class seats*
Useful conversion ratios			
Carbon to carbon dioxide	44/12	tCO_2	
Carbon content of wood	0.5	tC /t Wood	

*Please note, that units kg/kg and tonne/tonne can be interchangeable as long as both sides of the equation are the same unit (i.e. the emission factor for $kgCO_2$/kg product will work for tCO_2/t product).

6. Appendix B

Agrochemical active-ingredient sheet

Synthetic fertilisers

trade name	*active ingredient group*
1:0:0 (40)	Nitrogen
1:0:1 (36)	Nitrogen + Potassium
3:0:5 (39)	Potassium + Nitrogen
6:1:0 (19)	Nitrogen + Phosphorus
Gluco-K	Potassium
Kan 28% GR	Nitrogen
K-Max	Potassium
Pluto	Nitrogen + Potassium
Potassium sulphate	Potassium + Sulphur
Terramaz 10:2:6 (18)	Potassium + Sulphur
Urea LB	Nitrogen
Venus Clear Liquid 3:2:10 (12)	Nitrogen + Sulphur

Herbicides

trade name	*active ingredient group*
Gramaxone	paraquat
WPK Paraquat	paraquat
Paraquat SL	paraquat + diquat
Midstream	diquat
Reglone	diquat
Clearour 180/ 360	glyphosate
Cobra	glyphosate
Glyphofix	glyphosate
Glyphogan	glyphosate
Mamba	glyphosate
Mamba Max	glyphosate
Roundup (any kind)	glyphosate
Sting	glyphosate
Touchdown	glyphosate
UAP Glyphosate	glyphosate
Erase 360SL	glyphosate
Glyphosate 180	glyphosate
Glyphosate 360	glyphosate
Glyphosate WSG	glyphosate

Fungicides

trade name	*active ingredient group*
Fighter	phosphorus
Hyperphos	phosphorus
Microthiol Special	sulphur
Phosphite	phosphorus
Rootmaster	phosphorus
Sulfurstars	sulphur
Thiritget	sulphur

Pesticides

trade name	*active ingredient group*
Kumulus	sulphur

7. Appendix C

Data entry sheets as per the on-line calculator

Page 1. Electricity

Electricity consumption from grid electricity
Please enter figures available on your Eskom bill in terms of kWh - NOT RAND VALUE.
These figures are ANNUAL figures for consumption, broken down as much as possible.
Fill in the figures in the relevant columns according to the boundaries of your audit and the type of activities your entity is involved in. Leave non-relevant ones blank.

There are two options for you to enter your data:

1. If you have monitored your grid-supplied electricity usage, please specify how the electricity is used (annual kWh per unit).
2. If you have only got one Eskom bill for all your electricity usage, please provide an estimate of how the electricity use is split up (% based).

When breaking down the electricity usage, please use the control total to ensure your data is accurate and adds up to the correct total annual usage figure.

Next | Select Page previously completed: | -Select Page- | GO

Total electricity usage
Remember - only include the electricity that is supplied from the grid (Eskom).
If your main power source is diesel generators then it will be captured in the fuel consumption section.

User to input full amount	0 (kWh)	0 (Control Total)

Electricity consumption facility Breakdown of electricity usage:

Office buildings	0 (kWh)	0 (%)
Housing	0 (kWh)	0 (%)
Packhouse	0 (kWh)	0 (%)
Other Sheds (e.g. machinery storage, nursery)	0 (kWh)	0 (%)
Cold-storage	0 (kWh)	0 (%)
Winery	0 (kWh)	0 (%)
Waste water treatment	0 (kWh)	0 (%)
Irrigation pumps	0 (kWh)	0 (%)
De-greening	0 (kWh)	0 (%)
Other (specify) (e.g. Battery powered forklifts) folklifts	0 (kWh)	0 (%)

Page 2. Direct fuel usage

Mobile combustion – petrol-diesel

Direct fuel usage

Please enter all the fuel consumption from both mobile (for example, cars) and stationary (for example, generators) combustion equipment that are OWNED by your business.
If the fuel is used in equipment that is not owned by the business (i.e. it is contracted or staff owned) then please enter it in the INDIRECT fuel usage page.
Use the function options to separate the usage according to the fuel type, vehicle type, and activity usage within the supply chain.
The more detail you provide, the more valuable your results will be.

Back | Next | Select Page previously completed: | Electricity | GO

Mobile Combustion - Petrol

User to input full amount Breakdown per vehicle type	0 (l)	0 (Control Total)
delivery truck	0 (l)	0 (%)
4 x 4 bakkie-like vehicle	0 (l)	0 (%)
small bakkie, non - 4x4	0 (l)	0 (%)
passenger vehicle	0 (l)	0 (%)
motorbikes/quad bikes	0 (l)	0 (%)
staff buses	0 (l)	0 (%)
earthmoving equipment - owned by the business	0 (l)	0 (%)
frost prevention equipment	0 (l)	0 (%)
Other motorised machinery (specify) lawnmowers	0 (l)	0 (%)
Please give an estimate break down of how the total fuel is used through the supply chain, between on-site activities or the various distribution options		
Total	0 (l)	0 (Control Total)
on-site	0 (l)	0 (%)
distribution legs (1) farm gate to packhouse/winery	0 (l)	0 (%)
distribution legs (2) packhouse/winery to coldstore	0 (l)	0 (%)
distribution legs (3) winery to SA port	0 (l)	0 (%)
distribution legs (4) coldstore to SA port	0 (l)	0 (%)

Mobile Combustion - Diesel

User to input full amount Breakdown per vehicle type	0 (l)	0 (Control Total)
small tractor(25kW)	0 (l)	0 (%)
vineyard tractor (40kW)	0 (l)	0 (%)
orchard tractor (50kW)	0 (l)	0 (%)
large tractor (70+ kW)	0 (l)	0 (%)
delivery truck	0 (l)	0 (%)
4 x 4 bakkie-like vehicle	0 (l)	0 (%)
small bakkie, non - 4x4	0 (l)	0 (%)
passenger vehicle	0 (l)	0 (%)
motorbikes/quad bikes	0 (l)	0 (%)
staff buses	0 (l)	0 (%)
earthmoving equipment - owned by the business	0 (l)	0 (%)
frost prevention equipment	0 (l)	0 (%)
Other motorised machinery (specify)	0 (l)	0 (%)

Page 2. Direct fuel usage continued

Mobile combustion – biofuels-LPG-natural gas-fuel oil-aviation gasoline

Stationary combustion – petrol-diesel

Mobile Combustion - Biofuels

small tractor(25kW)	(l)
vineyard tractor (40kW)	(l)
orchard tractor (50kW)	(l)
large tractor (70+ kW)	(l)
4 x 4 bakkie-like vehicle	(l)
small bakkie, non - 4x4	(l)
passenger vehicle	(l)
motorbikes/quad bikes	(l)
Other motorised machinery (specify)	(l)

Mobile Combustion - LPG

fork-lift	(kg)
other (specify)	(kg)

Mobile Combustion - Natural Gas

other (specify)	(kg)

Mobile Combustion - Fuel Oil

other (specify)	(l)

Mobile Combustion - Aviation Gasoline

helicopter (medium) - owned by the business	(l)

Stationary Combustion - Petrol (gasoline)

User to input full amount Breakdown per equipment type	0 (l)	0 (Control Total)
generator small (20kva)	0 (l)	0 (%)
generator medium (50kva)	0 (l)	0 (%)
generator large (150kva)	0 (l)	0 (%)
heating equipment (fires)	0 (l)	0 (%)

Stationary Combustion - Diesel

User to input full amount Breakdown per equipment type	0 (l)	0 (Control Total)
generator small (20kva)	0 (l)	0 (%)
generator medium (50kva)	0 (l)	0 (%)
generator large (150kva)	0 (l)	0 (%)
heating equipment (fires)	0 (l)	0 (%)

Page 2. Direct fuel usage continued

Stationary combustion – LPG-burning oil-other-coal-anthracite-wood

Stationary Combustion - LPG (kg)

heating equipment (fires)		(kg)

Stationary Combustion - Burning Oil (e.g. Paraffin)

heating equipment (fires)		(l)

Stationary Combustion - Other (biofuels)

heating equipment (fires)		(l)

Stationary Combustion - Coal

heating equipment (fires)		(kg)

Stationary Combustion - Anthracite

heating equipment (fires)		(kg)

Stationary Combustion - Wood (renewable, on site)

heating equipment (fires)		(kg)

Stationary Combustion - Wood (brought in)

heating equipment (fires)		(kg)

Page 3. Indirect fuel

On site vehicles/equipment – petrol-diesel-aviation gasoline

Indirect fuel combustion

Please enter all the fuel consumption from both mobile (cars, trucks, air or sea crafts) and stationary (generators) combustion equipment that are NOT OWNED by your business (i.e. Contractor vehicles and/or staff-owned vehicles).
This section includes any fuel used in contracted vehicles involved in 1.) on site activities 2.) distribution transport, 3.) business & staff travel.
Use the function options to separate the usage according to the fuel type, vehicle type, and activity usage within the supply chain.
The more detail you provide, the more valuable your results will be.

Back Next Select Page previously completed: Direct Fuel GO

ON SITE - Contracted or hired vehicles/equipment - Petrol

delivery truck	0 (l)	(Km)	(hrs)
staff buses	(l)	0 (Km)	(hrs)
earthmoving equipment - NOT owned by the business	(l)	(Km)	0 (hrs)
Other motorised machinery (specify) lawn mowers	(l)	(Km)	0 (hrs)

ON SITE - Contracted or hired vehicles/equipment - Diesel

harvestor tractor	(l)	0 (Km)	0 (hrs)
delivery truck	(l)	0 (Km)	(hrs)
staff buses	(l)	(Km)	(hrs)
earthmoving equipment - NOT owned by the business	(l)	(Km)	(hrs)
Other motorised machinery (specify)	(l)	(Km)	(hrs)

ON SITE - Contracted or hired vehicles/equipment - Aviation gasoline

helicopter (medium) - owned by the business	(l)	0 (hrs)

Page 3. Indirect fuel continued

Export Distribution –air-, rail-, road- & sea-freight

Staff Business Travel- vehicles-air travel

Export Distribution Help
Please provide the total distance travelled and the total weight transported per year, to reach your total distribution figures. Use the help function for estimate distances to the major destinations.

Air Freight Weight & Distance Product Transported	(Km)	(Tonne)
Rail Freight Weight & Distance Product Transported	0 (Km)	(Tonne)
Road Freight Weight & Distance Product Transported	0 (Km)	0 (Tonne)
Sea Freight Weight & Distance Product Transported	0 (Km)	0 (Tonne)

Staff Business Travel - Vehicles

Average passenger petrol car	(Km)
Average passenger diesel car	(Km)

Staff Business Travel - Air flights (including return flight) Help

Short haul flights (1000km return trip)	0 (Km)	0 (number of flights)
Long haul flights (international)	(Km)	(number of flights)

Page 4. Land-usage

Farm size and production (tonnes)

Land usage

Next   Select Page previously completed: -Select Page- GO

Total farm size and ton production

Total farm size define the business unit size in hectare (i.e. farm unit by name or ownership or according to billing arrangements)	0 (ha)	0 (Control Total)
How many tonnes do you produce per year for the whole farm?	0 (Tonne)	0 (Control Total)

Commodities

Grapes wine	0 (ha)	(Tonne)
Grapes table	(ha)	(Tonne)
Pome fruit apple, pear	(ha)	(Tonne)
Stone fruit nectarines, plums, apricots	(ha)	(Tonne)
Citrus Lime, lemon, oranges, soft citrus	(ha)	(Tonne)
Tropical fruit kiwi	(ha)	(Tonne)
Tropical fruit avos	(ha)	(Tonne)
Tropical fruit banana	(ha)	(Tonne)

Page 4. Land-usage continued

Forestry and Other land uses

Forestry Forestry (sequestration)

Forestry indigenous, including riparian	(ha)	density (#trees / ha)	6-15 years (age)
Forestry non-indigenous Pine	(ha)	density (#trees / ha)	0-5 years (age)
Forestry non-indigenous Gum	(ha)	density (#trees / ha)	0-5 years (age)
Forestry non-indigenous Acacia	(ha)	density (#trees / ha)	0-5 years (age)

Other

Agricultural land use - livestock	(ha)
Agricultural land use (specify)	(ha)
Fallow lands	(ha)
Dams	(ha)
Rivers	(ha)
Semi desert	(ha)
Degraded land	(ha)
Indigenous grassland	(ha)
Indigenous bush (tropical)	(ha)
Fynbos	(ha)
Wetlands	(ha)

Page 5. Agrochemical usage

Synthetic fertiliser – nitrogen-based

Agrochemical usage

Please fill in the TOTAL amount of agrochemical applied per commodity type, per year.
If you have accurate data, please provide the unit figures (litres or kg applied). As products come in different states, the units of litres and kilograms of produce applied are interchangeable on a 1:1 ratio-basis If you do not have accurate figures, please provide an estimate of how the agrochemicals are used per commodity type (% split).
The figure for liquid fertilizer is the concentrated amount applied, not the diluted amount applied, as dilution preferences differ.

Please note - fertilizer and herbicide usage is broken down based on active ingredient groups. Please group your agrochemical type according to the dominant active ingredient. If you do not know what the main active ingredient is, please use the help function for guidance on the common agrochemicals used in the industry. Only those with global warming impacts are listed and need to be accounted for. The input figure required is total fertilizer/herbicide applied per active ingredient group per year.
All emission factors account for the production, packaging and transport of the listed agrochemicals. The emission factor of nitrogen based fertilizers, however, includes the application rate of (3.88kgCO2/kg applied) to account for the release of nitrous oxide through nitrification. Nitrous oxide has a global warming potential of 296 and therefore must be accounted for.

Back Next | Select Page previously completed: Land Usage GO

Synthetic Fertilizer - Nitrogen-based

User to input full amount Breakdown per commodity type	0 (kg)	0 (Control Total)
grapes (wine)	0 (kg)	0 (%)

Page 5. Agrochemical usage continued

Synthetic fertiliser – other (phosphorus, potassium, sulphur & lime-based)

Liquid fertilizer –nitrogen-based, other

Organic fertilizer – liquid manure- solid manure- other

Pesticide- herbicide- paraquat-diquat-glyphosate-other

Synthetic Fertilizer - Other

User to input full amount Breakdown per commodity type	0 (kg)	0 (Control Total)
grapes (wine)	0 (kg)	0 (%)

Liquid Fertilizer - Nitrogen-based

User to input full amount Breakdown per commodity type	0 (l)	0 (Control Total)
grapes (wine)	0 (l)	0 (%)

Liquid Fertilizer - Other

User to input full amount Breakdown per commodity type	0 (l)	0 (Control Total)
grapes (wine)	0 (l)	0 (%)

Organic Fertilizer - Liquid Manure

User to input full amount Breakdown per commodity type	0 (l)	0 (Control Total)
grapes (wine)	0 (l)	0 (%)

Organic Fertilizer - Solid Manure

User to input full amount Breakdown per commodity type	0 (kg)	0 (Control Total)
grapes (wine)	0 (kg)	0 (%)

Organic Fertilizer - Other

User to input full amount Breakdown per commodity type	0 (kg)	0 (Control Total)
grapes (wine)	0 (kg)	0 (%)

Pesticides - Herbicide - Paraquat

User to input full amount Breakdown per commodity type	0 (kg)	0 (Control Total)
grapes (wine)	0 (kg)	0 (%)

Pesticides - Herbicide - Diquat

User to input full amount Breakdown per commodity type	0 (kg)	0 (Control Total)
grapes (wine)	0 (kg)	0 (%)

Pesticides - Herbicide - Glyphosate

User to input full amount Breakdown per commodity type	0 (kg)	0 (Control Total)
grapes (wine)	0 (kg)	0 (%)

Pesticides - Herbicide - Other

User to input full amount Breakdown per commodity type	0 (kg)	0 (Control Total)
grapes (wine)	0 (kg)	0 (%)

Page 5. Agrochemical usage continued

Pesticides– fungicide-insecticide-other

Pesticides - Fungicide

User to input full amount Breakdown per commodity type	0 (kg)	0 (Control Total)
grapes (wine)	0 (kg)	0 (%)

Pesticides - Insecticide

User to input full amount Breakdown per commodity type	0 (kg)	0 (Control Total)
grapes (wine)	0 (kg)	0 (%)

Pesticides - Other

User to input full amount Breakdown per commodity type	0 (kg)	0 (Control Total)
grapes (wine)	0 (kg)	0 (%)

Page 6. Livestock emissions

Livestock emissions

Back Next Select Page previously completed: Agrochemicals GO

Livestock based emissions (Enteric fermentation)

Dairy Cows	(heads)
Non-dairy Cows	(heads)
Sheep	(heads)
Goats	(heads)
Swine	(heads)
Poultry	(heads)
Horses	(heads)
Ostriches	(heads)

Page 7. Pack-house

Total tonnage packed-de-greening (if relevant)-washing & drying- waste-packaging

Total tonnes packed

How many tonnes of fruit does this packhouse pack?	0 (Tonne)	0 (Control Total)
How many tonnes of fruit are for EXPORT market?	0 (Tonne)	0 (%)
How many tonnes of fruit are for the LOCAL market?	0 (Tonne)	0 (%)
How many tonnes are for other usage (i.e. Juicing or drying)?	0 (Tonne)	0 (%)

De-greening facilities? citrus only

Do you have De-greening facilities?	Yes	○
	No	◉
If yes- What % of fruit (total tonnes) is de-greened?	(%)	

Washing

Fruit washing - do you use a fungicide bath?	Yes	◉
	No	○
Fruit drying - do you use electrical heaters?	Yes	◉
	No	○

Waste

waste storage location	Waste goes off-site	○
	Waste stays onsite	◉
What is your waste made-up of?		
Vineyard/Orchard pruning's and leafy waste	(Tonne)	
fruit skins and pulp	(Tonne)	
mixed compost heap	(Tonne)	
How long do you store your waste onsite?		
incorporate in to soil immediately	Yes	○
	No	◉
stock pile until the end of the season	Yes	◉
	No	○

Take note: Packaging unit required is total packaging materials used (in kilograms) NOT total tonnes of fruit packed.**Packaging**

Bulk bin (wood)	(kg)
Pallet (wood)	(kg)
Pallet cover (cardboard)	(kg)
Carton (corrugated cardboard)	(kg)
Paper	(kg)
Pulp tray (waste cardboard/newspaper)	(kg)
Plastic containers (polypropylene, co-polymer) - non recycled	(kg)
Plastic Bag & plastic wrapping (polyethylene)	(kg)
Polystyrene tray	(kg)
Recycled materials	
What % of your plastic are from recycled sources?	(%)
What % of your cardboard/paper are from recycled sources?	(%)

Page 8. Cold-storage

Fugitive emissions from refrigeration leakage

Leakage What is your average re-charge quantity (on an annual basis) per refrigerant type?

R - 22	(kg)
R - 134	(kg)
R - 318	(kg)
HCFC - 22	(kg)
HCFC - 142b	(kg)
HCFC - 152a	(kg)
SF6	(kg)
Ammonia	(kg)