DEPARTMENT OF FORESTRY, FISHERIES AND THE ENVIRONMENT

NO. 1700 **28 January 2022**

NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT, 2004 (ACT NO. 39 OF 2004)

METHODOLOGICAL GUIDELINES FOR QUANTIFICATION OF GREENHOUSE GAS EMISSIONS - CARBON SEQUESTRATION IN THE FORESTRY INDUSTRY

I, Barbara Dallas Creecy, Minister of Forestry, Fisheries and the Environment, hereby, in terms of section 12 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), read with Regulation 10 of the National Greenhouse Gas Emission Reporting Regulations, published under General Notice No. 275 in *Government Gazette* 40762 of 3 April 2017, as amended, publish the Methodological Guidelines for quantification of greenhouse gas emissions - carbon sequestration in the forestry industry, in the Schedule hereto, for implementation.

The MRV tool complimenting the Methodological Guidelines can be accessed at the following link: https://ghgreporting-public.environment.gov.za/GHGLanding/SAGERSHome.html

BARBARA DALLAS CREECY
MINISTER OF FORESTRY, FISHERIES AND THE ENVIRONMENT

SCHEDULE

Methodological Guidelines for Quantification of Greenhouse Gas Emissions – Carbon Sequestration in the Forestry Industry

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

Acronyms

ΔC_B	Annual change in carbon stocks in biomass
BEF	Biomass Expansion Factor
BCEF	Biomass Conversion and Expansion Factor
C	Carbon
CAI	Current Annual Increment
CF	Combustion factor
CH_4	Methane
CO_2	Carbon dioxide
CO_2eq	Carbon dioxide equivalents
COC	Chain of custody
D	Density
DFFE	Department of Forestry, Fisheries and the Environment
DOM	Dead organic matter (composed of dead wood and litter)
d.m.	dry matter
DW	Dead wood (sub-pool of DOM)
FES	Forest Economic Services
FSC	Forest Stewardship Council
GC	Growth curve
GHG	Greenhouse gas
GS	Gold Standard
ha	hectares
HWP	Harvest wood products
IPCC	Inter-governmental Panel on Climate Change
ISO	International Organisation for Standardisation
KP	Kyoto Protocol
LCA	Life cycle analysis
LT	Litter (sub-pool of DOM)
LULUCF	Land use, land use change and forestry
MAI	Mean Annual Increment
MRV	Monitoring, reporting and verification

SCHEDULE

N_2O	Nitrous oxide
NAEIS	National Atmospheric Emissions Inventory System
NFA	National Forest Act 1998 (Act No. 84 of 1998)
NGER	National GHG Emissions Regulation
NGHGIS	National GHG Information System
PAMSA	Paper Manufacturers Association of South Africa
PEFC	Programme for the Endorsement of Forest Certification
QA/QC	Quality Assurance and Quality Control
R	Ratio of below-ground biomass to above-ground biomass
S_B	CO_2 component of biogenic fuel emissions from the combustion of biogenic fuels from plantations
S_{fert}	Emissions from fertilisers
S_{fire}	Emissions from fires
S_{HWP}	Emissions/removals from HWP
SAGERS	South Africa's GHG Emissions Reporting System
SOC	Soil organic matter
TAR	Third Assessment Report
TUP	Temporary Unplanted Areas
UNFCCC	United Nations Framework Convention on Climate Change
VCS	Verified Carbon Standard
WBP	Wood-based panels
wwt	wet white tonnes

SCHEDULE

Definitions

"**3rd party forests**" is defined as a forest land area or ownership that is not eligible under the Carbon Tax Act 2019, (Act No. 15 of 2019) (C Tax Act). Its participation in the scheme is only possible through eligible entities which report emissions from fossil fuels "E" under the C tax.

"accounted data" means the data in the MRV tool which is included in the accounted taxable amount.

"accounting" is a method to calculate the amount of emission reduction or sequestration, following the rules defined in this rulebook, by an eligible company.

"**accounting period**" is the period over which for which emissions reduction or removals by forestry activities are reported and accounted, which is annually from 1st of January to December the 31st, submissions are due at the end of each fiscal year.

"**accounting rulebook**" refers to the Forestry Accounting Rulebook provided in Chapter B.

"**afforestation**" is the direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources.

"**deforestation**" is the direct human-induced conversion of forested land to non-forested land (consistent with IPCC, 2014). This includes all areas that meet the forest definition (including invasive species such as wattle).

"**facility**" is a plantation management unit or manufacturing facility.

"**forest**" definition from the National Forest Act (Act No. 84 of 1998) (NFA) states that:

a) "forest" includes a natural forest, a woodland and a plantation (Section 1(2)(x) of NFA).

b) "natural forest" means a group of trees whose crowns are largely contiguous, or which have been declared by the Minister to be a natural forest (Section 1(2)(xx) of NFA).

c) "plantation" means a group of trees cultivated for exploitation of the wood, bark, leaves or essential oils (Section 1(2)(xxii) of NFA).

d) "woodland" means a group of indigenous trees which are not a natural forest, but whose crowns cover more than five percent of the area bounded by the trees forming the perimeter of the group (Section 1(2)(xxxix) of NFA).

However, to facilitate a robust reporting and accounting system for forestry under the GHG Reporting Regulations, using the Marrakech Accord (2011) as a guide, a forest is defined as follows:

"**Forest**" is defined as having a minimum area of land of 1.0 hectare with tree crown cover (or equivalent stocking level) of more than 30 per cent with trees with the potential to reach a minimum height of 5 metres at maturity in situ. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown density of 30 per cent or tree height of 5 metres are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes, but which are expected to revert to forest."

SCHEDULE

"**forest activity**" refers to the activities forest management, afforestation and deforestation.

"**forest management**" is a system of practices for stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner. **Note:** The broad definition of management shall be applied, which means including planned management of silvicultural intervention even if the forest is not currently managed.

"**gross-net accounting**" is an accounting method to calculate the accounting amount which does not consider a reference period, so it is equal to the reported gross removal/emission for a forest category over the accounting period.

"**net-net accounting**" is an accounting method to calculate the accounting amount as the reported emissions/removals over the accounting period minus the annual emissions/removals for the selected reference period.

"mass-balance" is a rule where amount entering the system is equal to amounts exiting the system.

"methodological guidelines" refers to the Methodological Guidelines for Land Activities in Forest Plantations provided in Chapter C.

"**MRV tool**" refers to the Carbon Tax Sequestration MRV Tool for Forest Plantations and Timber Processing Industry.

"**not a source**" is a rule that allows to exclude from accounting a carbon pool in which the C stock change is neutral or a sink (acts as removal) rather than a source (emission).

"**reference period**" is the period which is selected as representing the baseline circumstances for emission or removals level, it can be one to several successive years. It is used for net-net accounting to estimate the mean annual net emission/removal for forest over the selected period.

"reported data" refers to the data that is reported in the MRV tool, but which are not included in the total accounted tax amount due to discounts or exclusions.

"reporting" is the provision of data by a taxpayer in a comparable, transparent, consistent, accurate and complete manner to DFFE for estimation of accountable CO_2eq emissions/removals.

"**taxpayer**" means a person or company liable for the carbon tax in terms of section 3 of the C Tax Act.

"verification" refers to the collection of activities and procedures that can be followed during the planning and development, or after completion of an inventory report that can help to establish its reliability for the intended applications of that inventory. Typically, methods external to the inventory are used to check the truth of the inventory or input parameters (Guidelines for Validation and Verification of Emissions).

SCHEDULE

Contents

Methodological Guidelines for Quantification of Greenhouse Gas Emissions – Carbon Sequestration in the Forestry Industry

SCHEDULE

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

SCHEDULE

List of Tables

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

SCHEDULE

List of Figures

Overarching purpose and document layout

Companies are to report their combustion based-, process based- and fugitive greenhouse gas emissions under the Carbon Tax Act (Act No. 15 of 2019) (referred to as "C Tax Act" in this document). In addition, National Treasury (NT) introduced a carbon sequestration ("S") component into the C Tax Act. This allows permanent carbon dioxide (CO_2) removals from the atmosphere to be used to offset against emissions from the use of fossil fuels and other fugitive emission from wood processing companies reporting and accounting under the carbon tax scheme. The C Tax Act attempts to motivate emitting entities to change practices to reduce fossil fuel emissions and to increase sequestration associated with the land use and forestry sectors.

These Guidelines aim to provide recommendations on the accounting approach to be adopted by DFFE to include carbon sequestration from plantation forests into the annual company tax accounting process. It also proposes a supporting set of rules and methods for measuring, reporting, and verifying the associated GHG emissions and removals. The document has been divided into the following four chapters:

- Chapter A: Introduction and Accounting Approach Selection
- Chapter B: Accounting Rulebook for Forest Plantations
- Chapter C: Methodological Guidelines for Land Activities in Forest Plantations
- Chapter D: Verification Guidelines for Carbon Sequestration in Forest Plantations

SCHEDULE

Chapter A: Introduction and Accounting Approach Selection

A.1. Introduction

Sequestration in the forestry sector can broadly be split into 3 major activities, namely removals in the forest carbon (C) cycle (including land use change related management), storage of C in harvested wood products (HWP) and substitution of energy intensive materials or fossil fuels with timber products (Figure A.1).

Forestry activity related C sequestration can be achieved through:

a) afforestation and reduction of deforestation;
b) extension of the rotation ages in current plantations or reduced harvest, integral harvesting and use of wood parts of the trees;
c) substitution with tree species with higher capacity of carbon uptake and storage over a rotation (e.g. faster growth, wood with higher density or increase productivity through genetic improvement);
d) manufacture of harvested wood products (HWP) from domestically produced timber;
e) production of harvested wood products with a longer lifetime or increased recycling of products in order to further delay emissions from HWP;
f) substitution of energy intensive products such as steel or cement with wood products (i.e. product substitution);
g) increase of the carbon permanently stored in the soils, deadwood and litter pools;
h) reduction of controlled biomass burning such as burning of harvest residues; and
i) reduction of greenhouse gas emissions from fertiliser application.

Sequestration in the forest ecosystem is a result of the net uptake of C during photosynthesis, accumulation in the deadwood and soil pools, decomposition losses associated with turnover of C in deadwood and emission of greenhouse gasses due to disturbances (e.g. harvest, fires) and application of fertilisers. Disturbance due to management intervention has the largest impact on the C balance resulting in either net removals or net emissions of CO_2 into the atmosphere. One of the largest impacts on managed forest plantation C balance is the level of harvest relative to growth increment (Grassi et al., 2018). It is generally accepted that afforestation results in a net removal of CO_2 from the atmosphere for the first rotation, but deforestation causes emissions of similar magnitude. It is important that accounting CO_2 removals from atmosphere under financial mechanisms or emissions reduction mitigation action are permanent.

HWP removals are a function of manufacture of long-life timber products, which are stored in the HWP pool, and emissions from the existing (historical) HWP pool back to the atmosphere due to product end life and cascading into other products or uses (e.g. bioenergy). HWP sequestration does not take place just by production of HWP but by adding more HWP to the pool than what is being released back to the atmosphere.

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

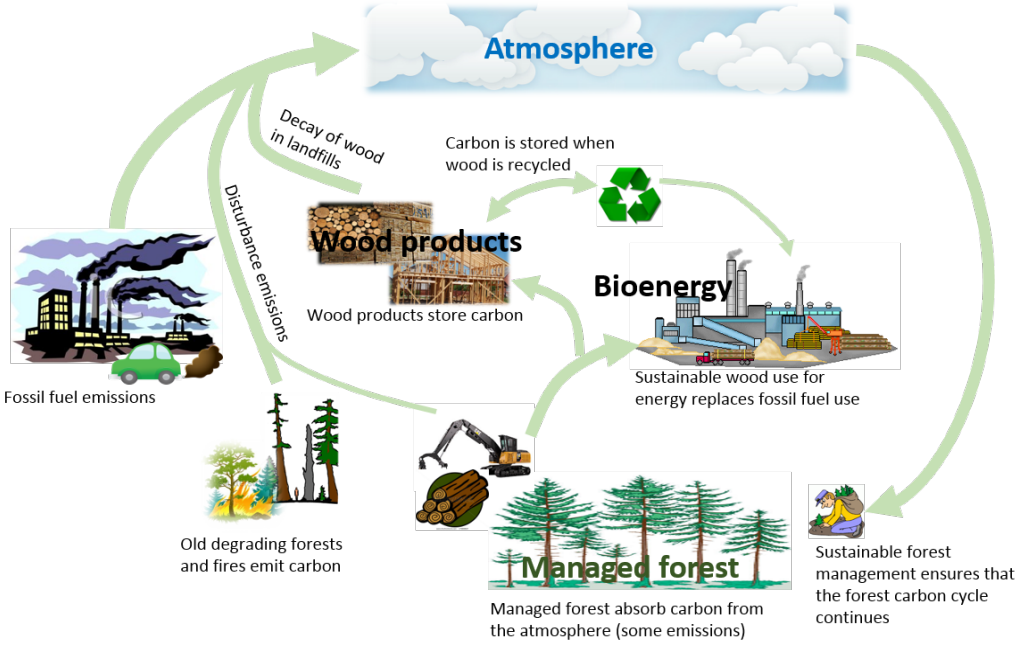


Figure A.1: A schematic representation of GHG flows between the atmosphere and forestry related activities including forest management, disturbances, wood processing emissions, net HWP storage and product substitution.

Product substitution is based on the concept of avoidance of emissions by replacement of processes or products using wood as a substitute (Sathre and O'Connor, 2010). Life cycle analysis (LCA) of wood products provides a way of measuring the CO_2 savings that can be made by use of wood products and replacement of high CO_2 emission potential products such as energy, cement etc. (Oliver, 2014). However, the accounting of product substitution is not included in C offsetting mechanisms, emission trading and C tax schemes due to methodological complexities and detailed data required to determine the extent of substitution. Potential sequestration can vary considerably depending on assumptions used and the system boundary used in the LCA (Sathre and O'Connor, 2010).

For emissions and removals to be accounted under International Climate Change Targets (e.g. Kyoto Protocol), C trading platforms or C tax schemes, certain well adopted principles should be adhered to such as permanence, additionality, leakage, robustness and avoidance of double accounting. Permanence of accounted removals is a particularly complex issue to address in the context of forest activities. All accounted forest and HWP removals should, in principle, be permanent to reflect real removals from the atmosphere. In this context, the relationship between emissions associated from harvest from forest land, the production of HWP and the decomposition of the HWP pool needs to be considered (i.e. accounting must ensure mass balance of relevant C flows).

Additionality is another principle which is difficult to deal with in the land use sector. Accounted removals should be directly human induced and additional to historical trends to ensure that effective

SCHEDULE

emission reduction to the atmosphere are real and fully attributable to the concerned activity. This requires consideration of base line, and reference level accounting frameworks, such as gross net or net-net accounting (Grassi et al., 2018; 16CMP/1[1], 2CMP/7 and 8).

A.1.1. Purpose of the chapter

The purpose of this chapter is to define "S" under the C Tax Act, assess the various approaches and challenges with setting up a robust carbon accounting system, and make recommendations to DFFE on the methods and process to be adopted for including carbon sequestration in the first carbon tax phase. In addition, the chapter aims to highlight options for improving the system in future should additional data become available, or amendments be made to the C Tax Act.

A.2. System boundary

The scope of the study only includes an accounting framework for forest and HWP related emissions and removals in the South African plantations and timber processing sector. The accounting of emissions associated with wood processing and use of fossil fuels (defined as "E" in the C Tax Act) have already been developed under the C Tax Act and are not considered here.

To account for sequestration activities accounting for plantation management and wood processing (i.e. "S"), all C pools (biomass, deadwood, litter, soils and HWP) and non-CO_2 emissions such as those form fires, management of soils, fertiliser and lime application in activities are considered based on internationally established methods (IPCC, 2006; IPCC, 2014). Specific novel approaches are, however, explored to facilitate company-based accounting under the C Tax Act.

Ownership and liability of emissions and removals is a key system boundary consideration. Although the C Tax Act lays out the criteria for eligibility, careful consideration on how timber flows from small and non-eligible plantation owners are included in the accounting framework without creating a reporting burden on owners with limited resources. This aspect has not been extensively explored in the C Tax Act. We propose new criteria for eligibility under the C Tax Act to address these issues. Rules defined here also avoid double-accounting or leakage.

[1] https://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

A.3. The Carbon Sequestration Accounting

The C Tax Act serves as an accounting framework at the company scale. The legal basis for this is the C Tax Act which came into effect from 1 June 2019. Amendments to the Act were gazetted on 31 October 2019.

Section 6 (1) of the C Tax Act sets out the formula for calculation of the tax payable by a taxpayer in respect of a tax period.

$$X = < \{[(E - S) \times (1 - C)] - [D \times (1 - M)]\} + \{P \times (1 - J)\} + \{F \times (1 - K)\} >\times \mathrm{R} \qquad \textit{Equation A.1}$$

The variables in the above formula are:

a) ''X'' represents the amount of tax to be determined that must not be less than zero
b) ''E'' represents the total fuel combustion related greenhouse gas emissions
c) ''S'' represents the greenhouse gas emissions, expressed in terms of carbon dioxide equivalent, that were sequestered
d) ''C'' represents a number equal to the sum of the percentages of allowances under section 7, 10, 11, 12 and 13 of the C Tax Act
e) ''D'' represents the petrol and diesel related greenhouse gas emissions.
f) ''M'' represents a number equal to the sum of the percentages of the allowances under section 7, 12 and 13 of the C Tax Act
g) ''P'' represents the total industrial process related greenhouse gas emissions.
h) ''J'' represents a number equal to the sum of the percentages of the allowances determined under sections 7, 8, 10, 11, 12 and 13 of the C Tax Act
i) ''F'' represents the total fugitive greenhouse gas emissions
j) ''K'' represents the sum of the percentages of the allowances determined in terms of sections 7, 9, 10, 11, 12 and 13 of the C Tax Act
k) ''R'' represents the rate of tax prescribed under section 5 of the C Tax Act

GHG emissions represented by the variable "E" in the formula are calculated in accordance with the methodology set out in the Technical Guidelines for Monitoring, Reporting and Verification of Greenhouse Gas Emissions by Industry (DEA, 2017).

The applicable allowances for listed activities that are summed to calculate variable "C" are set out in Schedule 2 of the Carbon Tax amendments.

Although the variable "S" is included in the formula, the calculation method is not defined. There are, however, a number of elements in the Act that pertain to eligibility of forest plantations and sector owners/companies and which define the system boundary of a forest accounting system. These elements can be used to define some accounting rules since they are already defined in law.

Key points included in the C Tax amendments that are relevant to the forestry sector are:

a) Schedule 1: Biogenic fuels that include wood/wood waste, sulphite lyes (black liquor), other primary solid biomass, charcoal, bio-gasoline, biodiesels, other liquid biofuels, landfill gas,

SCHEDULE

sludge gas, other biogas and municipal waste (biomass fraction) report CO_2 emissions separately and are not included in the CO_2 emission totals (namely in "E"). The calculated values for N_2O and CH_4 are included in the calculation for the variable "E".

b) Schedule 2: All activities listed under IPCC Code 3 (Agriculture, Forestry and Other Land Use) and Code 4 (Waste) are discounted with a 100% allowance.

c) The threshold for reporting by plantations is set out as >100 ha.

Guidance on the definition of "S" are provided in the next section.

A.4. Definition of the Variable "S"

The previous "Technical guidance for the reporting of GHG emissions from plantation forests, biogenic fuels and harvested wood products within the South African plantation forest and forest products sector" (Knowles and Christie, 2018) defines the net sequestration by forest and forest products ("S"), as:

$$S = S_B + S_{HWP} - \Delta C - S_{fire} - S_{fert} \qquad \textit{Equation A.2}$$

Where:

- S_B = CO_2 component of biogenic fuel emissions from the combustion of biogenic fuels sourced from South African plantations (e.g. wood, bark, black liquor) expressed in t CO_2eq. Note that this excludes non-CO_2 emissions but these are reported and accounted under 'E'
- S_{HWP} = CO_2 emissions or removals by harvested wood products (expressed in t CO_2eq)
- ΔC = Annual change in plantation carbon stocks (expressed in t CO_2eq)
- S_{fire} = Emissions from controlled burning and wildfires (N_2O and CH_4 expressed in t CO_2eq)
- S_{fert} = The fraction of emissions from applied fertiliser (N_2O expressed in t CO_2eq)

Subsequent to the compilation of the Knowles and Christie (2018) guideline document, the amendments to the C Tax Act define biogenic fuels as a net zero CO_2 emission assuming that sources are renewable. In addition, through the implementation of a mass balance methodology of S_{HWP}, biogenic fuel use and CO_2 emissions are included in this calculation.

Since the conventions for net removals of CO_2eq under the UNFCCC are that emissions are denoted as a positive value and sequestration as a negative value, both S_{HWP} and ΔC should have negative values. In the C Tax Act the equation is stated as being (E-S) (Equation A.1) which suggests that "S" is positive, therefore the signs need to be changed. Equation A.2, therefore, becomes:

$$S = -S_{HWP} - \Delta C - S_{fire} - S_{fert} \qquad \textit{Equation A.3}$$

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

Emissions from fires and fertilisation are included in the "S" equation and should be reported in the accounting system, however it is proposed that for this initial phase these components be fully discounted under the C Tax Act (see equation A.4). The rationale for reporting (under the C Tax Act) but not accounting for these emissions is that company level baseline data is required to develop more suitable accounting procedures in the future. Fertiliser emissions may be excluded from reporting (under the C Tax Act) in future if they are found to be insignificant (i.e. below the significance threshold provided in Table A.1), but the initial reporting is required to determine if these emissions are below the threshold. Fire is to be reported so that a company background level can be determined to exclude wildfire (natural disturbance) emissions in future (see Section A.10.1.2). On the other hand, fire and fertilisation emissions may also be included for accounting if determined to be significant and if the C Tax Act is reviewed. Equation A.3 is therefore rewritten as:

$$S = -S_{HWP} - \Delta C - \left[S_{fire} - \left(S_{fire} \times \frac{D}{100}\right)\right] - \left[S_{fert} - \left(S_{fert} \times \frac{D}{100}\right)\right] \qquad \textit{Equation A.4}$$

D is the current discount defined in the act (Schedule 2, C Tax Act of 2019), which is 100% for emissions from fires and fertiliser application.

Equation A.4 excludes the following emissions associated with forest lands in the IPCC guidelines, as these are considered negligible in South Africa:

a) Nitrogen mineralisation associated with loss of soil organic matter resulting from change of land use or management of mineral soils (F_{SOM}) (du Toit et al, 2016). However, F_{SOM} can be calculated directly from soil C stock changes under ΔC (Equation A.4) and included in the future if considered to be significant (Table A.1).

b) CO_2 emissions associated with lime application is not a practice of SA plantations.

c) Indirect N_2O emissions, however these should be included in future should fertiliser emissions be shown to be significant, and the discounts removed.

A.5. Principles of a Robust GHG Accounting System

The Intergovernmental Panel on Climate Change (IPCC), the International Organisation for Standardisation (ISO), the Verified Carbon Standard (VCS), the Gold Standard (GS) as well as South Africa 's GHG Emissions Reporting System (SAGERS) and National GHG Inventory Management System (NGHGIS), among others, have adopted the common principles of relevance, significance, completeness, consistency, accuracy, transparency, and comparability. These principles should be applied to entities accounting for "S" under the C Tax Act.

Table A.1: Common principles informing the scope and structure of organization GHG inventories.

SCHEDULE

Common Reporting Principles*	Description (as defined in ISO 14064-1)
Relevance	Select the GHG sources, GHG sinks, GHG reservoirs, data and methodologies appropriate to the needs of the intended user.
Completeness	Include all relevant GHG emissions and removals. Include all relevant information to support criteria and procedures.
Consistency	Estimations of GHG stocks, emissions and removals should be done consistently across time and space
Comparability	Enable meaningful comparisons in GHG-related information over time and across different data providers
Accuracy	Reduce bias and uncertainties of parameters used and accounted amounts as far as is practical
Transparency	Disclose sufficient and appropriate GHG-related information to allow intended verifiers to make decisions with reasonable confidence and reporting and accounting rules have been adhered to.
Significance	An emission for a pool or source may only be excluded from reporting and accounting if it is smaller than a significance threshold which is a fraction of the total emission and removals. Following the UNFCCC guidelines (art 37(b) of decision 24/cp19), the significance threshold is <0.05% of the total emissions for both "E" and "S" (i.e. sum of absolute emissions from "E" and "S").
Adherence to the IPCC Guidance (AFOLU 2006 and KP-supplement 2013)	The IPCC guidance provides the reporting methodology which is broadly adopted under the forestry reporting rulebook (Annex B). This is important in cases where models may be used or where company specific factors are used in calculation emissions and removals. Note: some IPCC guidance is not followed in detail, such as HWP (see section A.8.3)
*These common principles are shared by IPCC, ISO, VCS, CDM, GS, GHG Protocol as well as South Africa 's GHG Emissions Reporting System (SAGERS) and National GHG Inventory Management System (NGHGIS).	

Additional considerations on overriding principles should be adhered to when a framework for robust accounting of GHG emissions and removals is developed (Table A.2). These principles are based on international agreements, such as the Paris Agreement, agreements from other UNFCCC Conference of the Parties (particularly 16CMP/1[2], 2CMP/7 and 8), the voluntary market principles and climate change policy drivers behind the C Tax Act.

Table A.2: Common principles adopted when developing a robust carbon accounting system and considerations specific to accounting of forest land under the C Tax Act.

[2] https://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf

SCHEDULE

Accounting principles	Considerations
Eligibility	**Forest definition:** The forest definition should be consistent with the National forest definition but with additional criteria to ensure robust reporting of areas. **Ownership and liability:** C Tax Act thresholds stipulate that plantation forests eligible for registration and define liability for removals or emissions. Eligibility should ensure that the mass flow of C between HWPs and forest land C budgets are maintained.
Permanence	**Once in, always in principle:** Once emissions and removals are accounted for in a unit of forest land these areas and pools should be continued to be reported and accounted throughout the accounting period and for subsequent accounting periods. Permanence has important implications on the treatment of deforestation and decay of accounted HWP removals
Accounting periods and intervals	Reporting Periods and intervals pursuant to the C Tax Act
Robustness	The treatment of any accounted activities be based on sound science, that mass balance is conserved, and accounting should ensure emissions or removals are verifiable.
Additionality	That the mere presence of carbon stocks be excluded from accounting. That accounting excludes removals resulting from indirect human activities: (i) elevated carbon dioxide concentrations above their pre-industrial level; (ii) indirect nitrogen deposition; and (iii) the dynamic effects of age structure resulting from activities and practices before the accounting year. This is an important consideration when deciding on appropriate accounting rules, such as gross-net or net-net accounting and the rules for HWP accounting.
Incentives and policy alignment:	Accounting framework should consider other policies such as those set out under the national framework, UNFCCC and the Paris Agreement (e.g. action plans) but also incentivise companies to enhance forest sinks and reduce emissions without being unfairly penalized for current and historical management practice.

SCHEDULE

Leakage	Increased emissions of GHGs or decreased removals should not result outside the accounting framework boundary. For example: use of timber sources from outside the geographical of South Africa for production of HWPs or timber form non-reporting or unregistered entities could result in increased emission or deforestation in other regions or from forest lands non-certified for sustainable management.
Double accounting avoidance	Emissions or removals shall not be accounted twice. For example, already produced pulp, recycled pulp or paper from another production facility cannot be used as a carbon inflow into the HWP pool for the reporting entity.

A.6. Challenges faced when implementing carbon accounting system at the company level

A.6.1. Eligibility and liability

The use of an area threshold as a criterion for accounting forest and HWP emissions/removals (C Tax Act October 2019) has implications regarding inclusion of timber to HWP from non-eligible, 3rd party, forest owners. The major forest companies who will account for HWP removals can only include timber produced by eligible companies under the C Tax Act (from own wood land and leased land), estimated to be ca. 80% or less of the annual harvest. This is because the emissions associated with harvest must be linked to removals associated with HWPs to ensure balanced and robust accounting.

Another issue is that the area-based criteria also does not consider related eligibility to account for "E" under the act. It is possible in the future that a wood product manufacturer must account for emissions from "E" but cannot account for potential forest removals if the forest areas they own falls below the area threshold.

It is therefore, proposed that the area threshold currently used in the C Tax Act be removed and eligibility to account be based solely on the threshold related to processing and fossil fuel emissions "E" (Figure A.2, option A)

During the consultation, the forestry industry indicated that it would be important to include all wood flows into the HWP pool as there were concerns that the market would be biased as companies would lean towards purchasing wood from accounting companies. This may cause smaller plantations to be disadvantaged. As discussed, emissions associated with such harvest would need to be included to ensure permanence. To accommodate this an additional voluntary clause has been incorporated in the proposed framework where non-eligible 3rd party timber inflows can be included in the HWP accounting by eligible companies (Figure A.2, option B) provided that the following conditions are met:

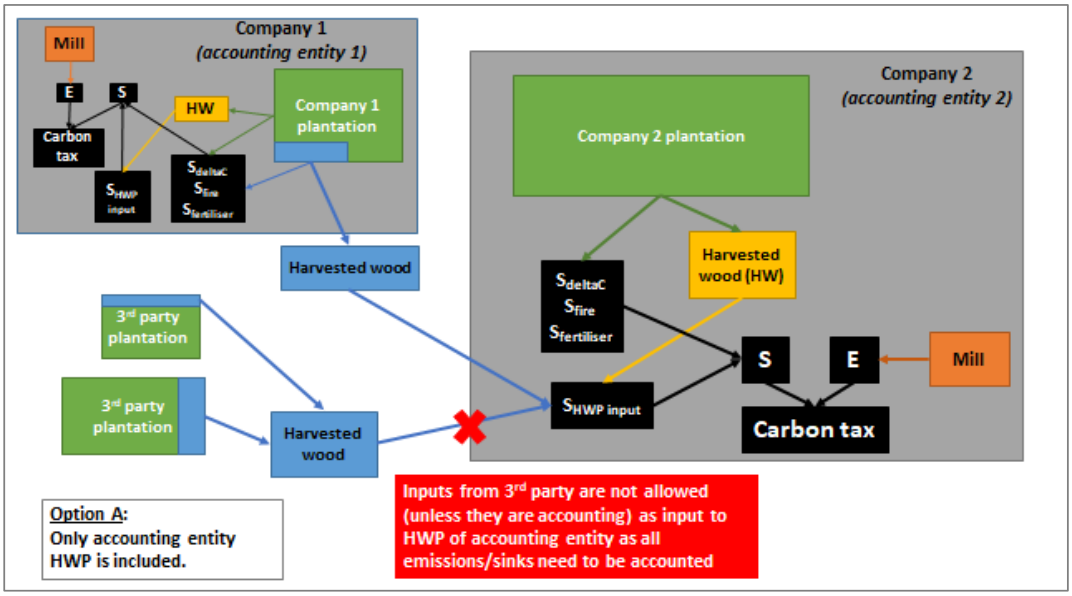
a) Ownership of HWP removals and emissions is assigned to the wood processing company.

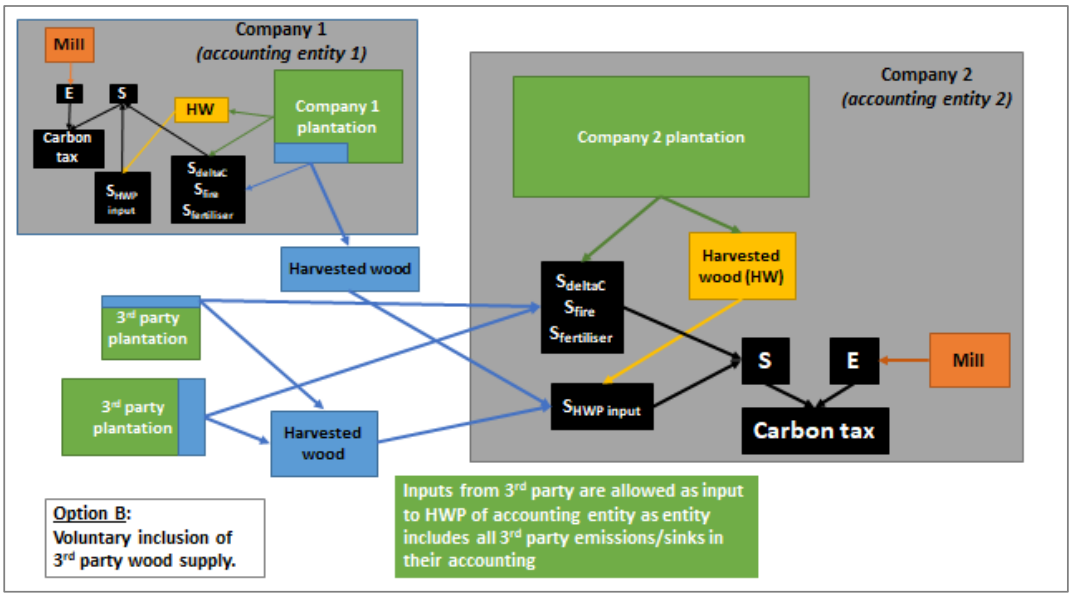
SCHEDULE

b) 3rd party forest emissions associated with the harvest timber inflows into the HWP pool are accounted.

c) There is no double accounting if timber is supplied to two or more registered companies accounting for HWP.

d) All timber from 3rd parties must be registered with COC or certified from sustainability perspective (i.e. replanting to occur after harvesting within the legal 5-year period). This ensures harmonisation between land ownership and industry related emissions.





forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

Figure A.2: Illustration of the process for accounting excluding (Option A) and including (Option B) voluntary 3rd party HWP inputs.

A.6.2. HWP accounting

The HWP first order decay approach for semi-finished HWP (IPCC, 2006) proposed by Knowles and Christie, (2018) for use under the C Tax Act, has numerous drawbacks when implemented at company scale:

a) Application of the first order decay approach means that emissions from previous historically produced HWP must be accounted in subsequent years. If there is change of ownership or where a company may exceed the eligibility threshold to the account for "E" for the first time, then newly registered companies (persons) are being debited for emissions created by previous owners or historical HWP inflows that were not accounted. Ownership is a key eligibility criterion under the C Tax Act. Therefore, annual accounting requires the accounting of removals and all emissions associated with production and use of the HWP in the year when HWPs are manufactured so to ensure that permanence principles are adhered to. The IPCC approach can be applied at the company level for annual accounting, but this would require the reporting and accounting of emissions from HWP produced in previous years (for many decades or since establishment).

b) The IPCC semi-finished product approach to allocate timber harvest to wood product does not consider company level processing efficiencies in conversion or raw timber to products. A recent South African study (Adu Poku, 2015) provides process specific mass flow approaches and conversion factors for the paper industry and similar approaches can be applied to the sawlog processing industry. Previous studies show that more detailed timber allocation models to finished products provide more accurate removal estimates when compared to the IPCC semi-finished product approach based on FAO data (Aleinikovas et al., 2018). The mass flow approach proposed by Adu Poku (2015) appears to be the best option for the South African industry.

c) The IPCC methodology (2006) does not clearly outline the assumptions used when determining the lifetime (half-life) of wood and wood products. The methodology assumes a time constant (half-life) and that the product life goes to recycling or waste or burning etc. In South Africa, it is estimated that ca. 68% of paper is recycled[3], but recycled paper should not be considered as an emission (Vácha, 2011). To account for recycling, a large proportion of paper should be reallocated to the recycled inflow pool every year or the half-life decay should be applied to 32% only. The same would apply to solid wood cascading and recycling, but there are no known national studies on detailed life cycle analysis in wood products.

[3] https://www.thepaperstory.co.za/south-africas-paper-recycling-rate-rises-to-68-4/

SCHEDULE

Consequently, the proposed accounting rules advocate to use the mass flow approach **(**Adu Poku, 2015) with product efficiencies and flow factors derived from South African studies (Adu Poku, 2015; Christie and Scholes, 1995) supplemented by international data where data is not available (UNECE/FAO, 2010). Mass flow approach means that the total amount of C entering the system (e.g. round wood and recycled paper) equals the sum of C outputs from the system (e.g. in sawn-wood, gaseous emissions from burning wood) (see Equation C.9 in Chapter C). The application of the method for accounting for emissions from HWP emissions is discussed in more detail in section C.3.3.1.

A.6.2.1. C stock and Emissions from HWPs

HWPs are included in "S" as a potential sequestration because removals are deemed to be permanent and that credits cannot be accounted simply due to the creation of C stocks (Table A.2). HWP sequestration does not take place just by production of HWP but by adding more HWP to the pool that what is being released back to the atmosphere, so accounting should be based on removals and emissions or a stock change from year to year (IPCC, 2006).

Current legislation states that ownership is the key liability for accounting of emissions for corporate/company, so the consumer should be responsible for all related emissions. However, there are numerous drawbacks and risks associated with this:

a) **Equal treatment of all sectors:** Long term retention of C in manufactured products are considered viable for annual accounting if the product life cycle is more than 1 year. Therefore, sequestration from production of charcoal, firewood, matches and other biogenic compounds in the food sector (for example) are excluded from the C Tax Act because they are considered as short-term products due to the relatively fast decay of the products after production and sale to the consumer. Emissions from these products are, therefore, implicitly accounted. Although paper and other HWP have long lifecycles, the decay of the created HWP pool should be accounted to ensure permanence and so that accounting rules are applied equally across all sectors.

b) **Removals must be permanent (so there is an actual benefit for the atmosphere, i.e. less CO_2)**. For HWP removals to be permanent emissions from the HWP pool must be considered. If the ownership principle is applied, then all future emissions from HWP should be accounted under the waste sector, however, waste emissions are not included in the C Tax Act due the methodological complexity. Therefore, if emissions cannot be accounted under the forest sector then all removals and emissions should be excluded from the act due to methodological complexity and to ensure that removals are permanent. This, again, is consistent application of rules to all sectors.

c) **Robust accounting.** If no emissions are applied to all HWPs, then the accounting framework does not acknowledge extensive scientific evidence[4] that solid wood products have longer life-cycles than paper. The discount under the act already excludes biogenic and waste emissions

[4] *Skog and Nicholson, 1998; Profft et al., 2009; Winjum et al., 1998; Brown et al., 1999; Marland et al., 2010; Miner and Perez-Garcia, 2007; Broadmeadow and Matthews, 2003; O'Connor, 2010; Lippke et al., 2011; Henschel et al., 2008; Pingoud et al., 2006; Skog, 2008; Ellison et al., 2011; UNECE, 2010; etc*

SCHEDULE

for HWP manufacturing, therefore, the paper industry will be able to claim the same amount of credits per t C of product as the sawn wood and wood-based panel manufacturing facilities. This is contrary to the scientific literature.

d) **Baseline approach**. The fact that various industrial entities produce various HWP with different climate or C storage impact is considered part of the baseline, resulted from historical contribution to the national economy.

A.6.2.2. How should HWP decay be accounted?

The suitability of the IPCC approach for accounting HWP removal and emissions was questioned by the forest industry. The use of the mass flow approach provides a partial solution for the C allocation aspect of the method, however, alternative methods to account for emissions on an annual basis are still required. A review of the literature concluded the use of one of the three options discussed below could be considered.

A.6.2.2.1. The land fill approach

The default half-life factors applied to the paper and other timber products is suggested to be over conservative and the half-life value for paper products is too generalised to capture the range of products produced by the paper industry (see Section A.6.2). An alternative approach may be to use the share of wood products converted to C emissions in landfills (Skog and Nicholson, 1998). Some studies suggest that C emissions from paper in landfill varies form 3- 38 % over 96 years (Skog & Nicholson, 1998; Table A.3), magnitudes lower than the expected C lost based on the first order decay approach. The comparable half-life of paper using the landfill approach is 220 years, compared to 1 to 6 years for paper (IPCC, 2006, Skog & Nicholson,1998). Land fill approach by Skog and Nicholson does not consider paper recycling, product life in use and combustion of paper, so could be considered as an underestimation of emissions**.**

Table A.3: Estimated maximum proportions of wood and paper converted to CO_2 or CH_4 in landfills (Skog & Nicholson, 1998) with associated life-cycle retention values (fLC96).

Product type (i)	Maximum % carbon converted	fLC_{96}
Solid wood	**3**	**0.97**
Newsprint	16	0.84
Coated paper	18	0.82
Boxboard	32	0.68
Office paper	38	0.62
Mean for paper and pulp		**0.74**

SCHEDULE

A.6.2.2.2. The 100-year approach

A proposed alternative is the use of the 100-year approach (Miner, 2006), which is designed for application to corporate accounting, considering future decay of today products of the company in contrast to the national reporting by the IPCC approach (that applies decay to historical inflows). This approach proposes three important modifications:

a) It recognised that the decay is not a first order function, i.e. the decay constant varies over time (see Kurtz et al., 1992; Row & Phelps, 1996). This acknowledges that decay constant declines over time due to the slower breakdown of more recalcitrant C (such as lignin) remaining in product after end of use and during decay. These functions also attempt to construct decay curves by considering time-in-use, an improvement on the IPCC assumptions (see section 0).
b) The 100-year time frame is based on the general IPCC approach used to defining radiative forcing potentials and this 100-year period is used in many climate change projection scenarios.
c) The approach facilitates annual accounting where all future emissions and current removals are accounted in one year.
d) Removals and emissions are all attributed to current business options of the company.

The 100-year method involves five steps:

1) Identify the types and amounts of biomass-based products (e.g. Pine or Eucalyptus) that are made in the year of interest and end up in a final product (e.g. sawlog, pallet, mining poles, paper, long life paper etc.)
2) Express this annual production in terms of the amount of biomass carbon per year for each product.
3) Divide the products into categories based on function and allocate the carbon to the functional categories. Some of the functions may be single use products. Alternatively, products can be divided into the categories used for national and international harvested wood products.
4) Use 2nd or 3rd order decay curves or other time-in-use information to estimate the fraction of the carbon in each functional category, expected to remain in use for 100 years.
5) Multiply the amount of carbon in annual production in products in each functional category by the fraction remaining at 100 years. The result is the amount of sequestered carbon in the products in each functional category attributable to this year's production.

A.6.2.2.3. The CCAR approach

All C trading platforms, besides the Californian Carbon Action Registry (CCAR), do not account for HWP because of methodological and system boundary complications. The CCAR solution is to use the IPCC approach but to exclude historical HWP C stock in the first year of reporting because it is not often

SCHEDULE

possible to derive this data at a corporate level. At the end of the first year, the net emission/removal of HWPs is equal to the amount of carbon in products-in-use associated with the company's production for that year. In each subsequent year, the company estimates additions to, and losses from, the pool of carbon attributable to its products. Additions are equal to the carbon in products-in-use attributable to new production. Losses are determined by decay curves that describe the amounts of products-in-use removed from service each year.

Under a scenario where the annual production of new products remains constant, the approach results in large annual increases in the pool of carbon in products-in-use in early years, and smaller annual increases over time. This is because the annual losses from the pool of products-in-use are small at first but increase over time as the pool gets larger and the products get older. This results in what might be termed a "start-up effect", which may be an undesirable feature in a corporate accounting context (Miner, 2006).

The disadvantage of this approach is that the use of first order decay models tend to overestimate emissions, but the multiple time decay constant approach (e.g. Row and Phelps, 1996) can be used. Another disadvantage is that the accounting of emissions of manufactured product is done in years after production and these emissions increase as the HWP pool increases. Another disadvantage is related to when a company has a new owner (which should continue the account for previous owner emissions) or starts new accounting (when "start-up effect" is strong).

A.6.2.2.4. Comparisons and conclusions

In conclusion, all the outlined methods have problems from an accounting perspective and do not accurately reflect emission reductions perspective and true atmospheric effect. If future emissions are accounted in advance (e.g. the landfill and 100-year approach), the company is in effect paying a C tax in advance. On the other hand, if emissions are accounted when they occur in subsequent years then all emissions and removals are not accounted in the year and the company may be prone to legacy risks in the future.

Comparison of the potential outcomes on implementing a HWP accounting method for the three HWP is summarised in Table A.4 below.

Table A.4: A comparison between the landfill carbon remaining approach (LCA), CCAR and 100-year approaches for accounting emissions and removals for paper production in a hypothetical mill (assuming production of 200 000tC/year based on the mass flow principle). The effect of using different half-lives and life-cycle retention values (FLC96 or FR). Retention fraction (FR) values are calculated using corresponding half-life values in the same row. The 2-year half-life (highlighted in red) is the current IPCC default for paper, and the FLC96 of 0.74 (highlighted in green) is the suggested value for paper based on an average of the data from Skog and Nicholson (1998) (see Table A.3).

S_{HWP} with landfill factor 96 year		S_{HWP} CCAR approach (using IPCC half-life) Year 1 of accounting		S_{HWP} 100-year approach Row and Phelps decay curve (FR are calculated at half-lives of 1 -10)	
FLC96	t CO_2 /yr	Half-life (yr)	t CO_2 /yr	FR	t CO_2 /yr

SCHEDULE

0.74	542 667	1	366 667	0.05	35 911
0.8	586 667	2	518 548	0.06	41 553
0.85	623 333	3	582 050	0.06	45 758
0.9	660 000	4	616 661	0.07	49 298
0.95	696 667	5	638 407	0.07	52 445
1	733 333	10	684 228	0.09	65 416

As seen in Table A.4, the application of the landfill carbon remaining approach (LCA), compared to the CCAR and 100-year method, offers a large advantage to the paper industry. It should be noted that the CCAR approach has a high "start-up value" but this will decline sharply regardless of future production outputs (Table A.5).

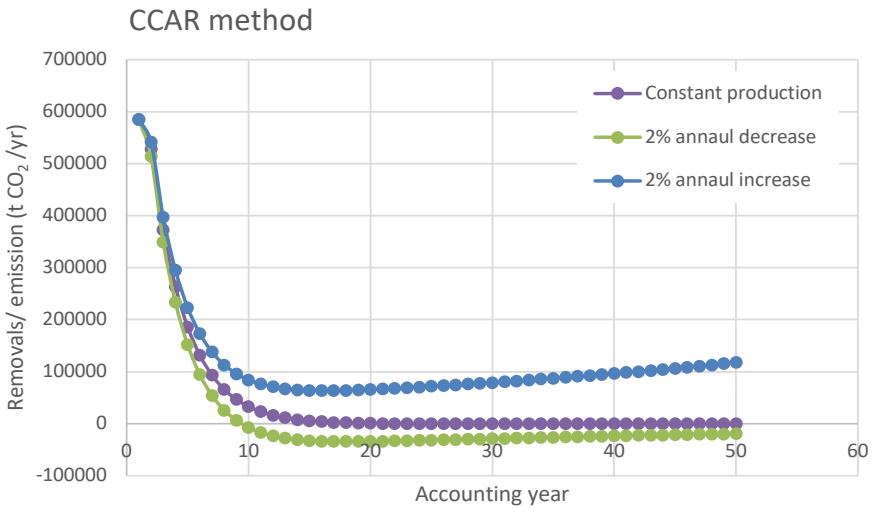


Table A.5: A projected estimate of accountable HWP removals/emissions under the CCAR scheme using a hypothetical mill with a pulp production of 225 000 tC/yr as an example assuming a constant or 2% annual increase of decrease in production output.

The 100-year approach appears to be the most robust from a scientific point of view, but this is still sensitive to assumptions on the time products are in use. The 100-year approach would be the preferred option, but only if data can be provided on product time in use for the industry.

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

The landfill or LCA approach clearly overestimates C retention in wood products. The corresponding half-life of paper using a FLC96 of 0.74 (Skog & Nicholas, 1998) is 220 years. This is greater than the half-life of lignin (150 years) in natural ecosystems (Dittmar, 2001), which is theoretically unlikely. Although it is acknowledged that the 1st order half lived are overly conservative, the 100-year approach and multiple time decay models show that differences are quite small (Miner (2006). Uncertainty analysis by Pingoud et al (2011) show that the level of uncertainty for first order decay short life products (2-4 year half-lives) is only 9-20% and most published half- life values for paper do not exceed 6 years (Miner, 2006).

Although the life-cycle retention value (FLC96) for different products (Skog and Nicholson, 1998), may largely overestimate HWP removals, the risk of claiming excessive credits due to removals is limited due to the cap applied under the C Tax Act (Appendix A). Moreover, since the annual accounting of future emissions might be argued as a payment of tax in advance, this downside may be seen to be compensated by the over estimation of removals. The landfill approach covers more HWP categories (see Skog and Nicholson 1998, Christie and Scholes, 1995) and will not have a large influence in differences in claimed credits if emissions are not accounted (Table A.6).

Table A.6: The proposed impact of using the LCA approach for annual accounting HWP removals and emissions for mills with various pulp production using the average paper FLC96 factor of 0.74.

	Annual production (Adu Poku, 2015)	S_{HWP} with FLC96	S_{HWP} without FLC96	Difference
Mill	**pulp (t C/yr)**	**t CO_2/yr**		
Mill A	400 000	1 085 333	1 466 667	381 333
Mill B	300 000	814 000	1 100 000	286 000
Mill C	200 000	542 667	733 333	190 667
Mill D	100 000	271 333	366 667	95 333
Mill E	50 000	135 667	183 333	47 667
Mill F	20 000	54 267	73 333	19 067
Mill G	10 000	27 133	36 667	9 533
Mill H	2 000	5 427	7 333	1 907

The proposed interim accounting approach is to adopt the mass flow approach with the land fill approach to account emissions. It is, however, strongly recommended that the 100-year approach

SCHEDULE

be implemented in future C tax periods as soon as industry specific studies are completed to derive suitable half-life, and product use period assumptions.

A.7. Accounting frameworks

There are various proposed accounting frameworks designed to deal with different forestry activities.

Gross-net accounting: is generally applied to afforestation and deforestation activities, where actual reported emissions or removals are accounted for each year.

Net-net accounting: is applied to managed forests, where removals or emissions need to factor out indirect human induced removals/emissions (see additionality principle) or incentives are provided to account where there are net emissions. Notably, there is a reduction in the accounted amounts of net emissions in managed areas over time. The net-net accounted value is calculated using the reported emissions/removals in an accounting period (grey zone in Figure A.3 (2008-2012) relative to a reference year (example 2000 in Figure A.3)). In all the scenarios provided in Figure A.3, credits will be accounted, even in the case where net emissions are reported in the accounting period (Scenario C). Debits will only be accounted if the slope between the reference year and accounting year is negative.

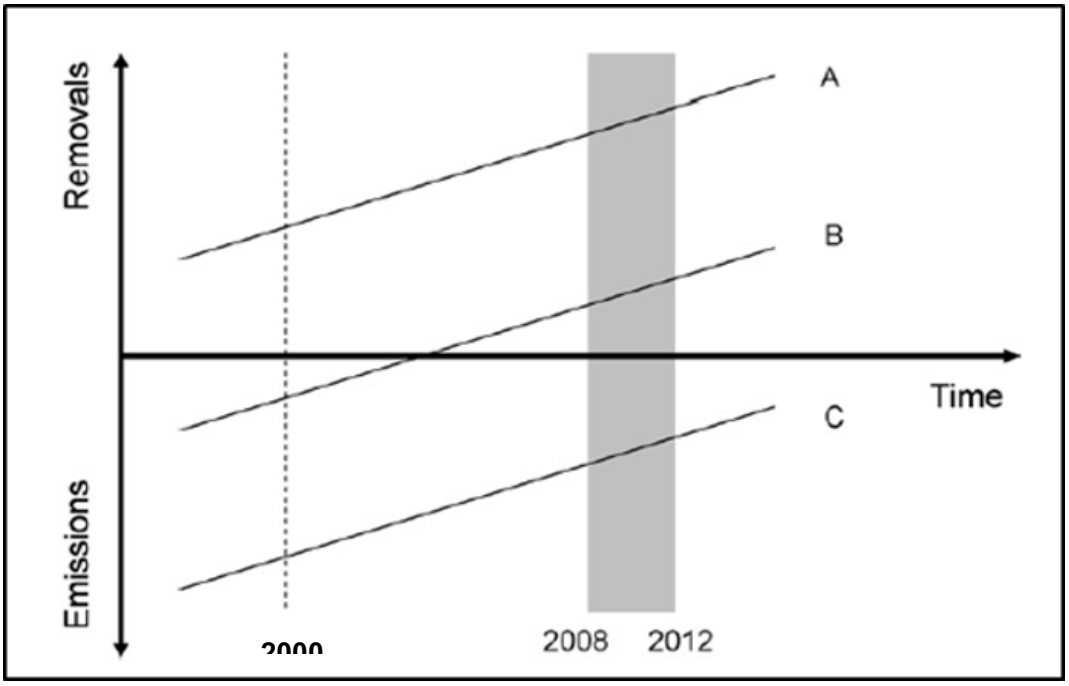


Figure A.3: Examples of net-net accounting of reported emissions and removals.

SCHEDULE

Net-net with a reference level: This is an adopted net-net approach which accounts for dynamic shifts in age class structure and historic management legacy, however, the approach requires the use of complex models (to simulate at least biomass growth under management interventions). This is dealt with in more detail in section A.10.1.1.

An accounting cap: The C Tax Act applies a cap where credits from "S" cannot exceed debits from "E", i.e. there is no tax rebate if the sum of "E" and "S" is a net removal. In order to provide a fair and balanced cap and in accordance with the discounts applied to the Land sector in schedule 2 of the C Tax Act, we proposed the same should apply to a situation where the sum of emissions and removals from forests and HWP is a net emission (i.e. additional emissions from "S" cannot be added to "E" (see Appendix A). The advantage of the cap is that it limits the amount of credits that can be claimed through forest activities whilst at the same time incentivising participation of the forestry industry in the C Tax Act where net forest and HWP activities may be a net emission, particularly under a gross net accounting framework. This may function as compensation across time given the intensity of commercial activity.

A.7.1.1. Justification for the Use of Annual Gross net Accounting

Gross-net reporting in this first phase is recommended to apply to all eligible forest activities because of the following:

a) The gross-net approach provides incentives for accounting of removals through allocation of timber for long term wood products and creation of new forest sinks through continued afforestation. Application of a net-net framework would provide no incentive for these.
b) Although a gross-net approach or the only net-net options available at present (i.e. net-net with a reference period) does not factor out any dynamic age class legacy effect on forest growth increment, particularly due to historical afforestation legacy, there is no modelling capacity to develop an alternative approach at present.
c) Application of a gross-net accounting to both the forest and HWP category ensures that the accounting system is robust and balanced. Appling different accounting framework to HWP and forest land would result in unbalanced and inconsistent accounting.
d) Application of one accounting procedure to all forest categories facilitates a simpler reporting task. Ideally the cost and effort of reporting under the C Tax Act should be minimised and simplified as much as possible.
e) Although a gross-net approach does not factor out any indirect human influences on emissions and removals, it is assumed that any windfalls are offset by debits associated with management legacy which is not factored out.
f) Liability for very large debits due to natural disturbances are excluded because emissions from fires are not accounted under the current framework.
g) "Implicit cap" from C Tax Act ensures that accounted credits are limited by the size of the "E" debit and debits cannot be incurred for "S".
h) The gross-net approach encourages participation and collecting data for future when enhanced accounting can be applied.

SCHEDULE

A.8. Links with existing Regulations and forestry frameworks

Several existing regulations, forest data resources and certification schemes were suggested to be suitable for inclusion and/or adaption for reporting and accounting requirements under the C Tax Act. These were considered during the development of these Guidelines and the reporting MRV tool.

A.8.1. National GHG Emission Reporting Regulations

The National Greenhouse Gas Emission Reporting Regulations (NGER) published under the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) were gazetted on 3 April 2017 and amended on the 11 September 2020. Annexure 1 of the amended Regulations list the activities and thresholds for which GHG emissions must be reported. The data reported through the NGER are to be utilized to improve the National GHG Inventory which is required for international reporting.

While there are similarities in the reporting for GHG inventories and accounting, there are also some differences which are highlighted in Section B.3.7. The reporting for carbon accounting has additional reporting requirements, particularly for deforestation and HWP. These differences are partly brought about because the GHG Inventory reporting follows the IPCC guidelines (IPCC, 2006), while the accounting rules follow the more detailed Kyoto Protocol (KP) IPCC guidance. Another aspect to consider is the eligibility criteria. For the NGER the eligibility is based on area (i.e. all plantations >100ha are eligible to report), while for the C Tax Accounting it is proposed that eligibility is based on the threshold related to processing and fossil fuel emissions ("E" in the tax equation) (Section A.6.1). Even though there are differences between the reporting for NGER and the C Tax Act the NGER data can be used for high level (such as total plantation volume, total area, emission factor) checks[5] and verification of the accounting data.

A.8.2. Regulation 19 under Section 6 of the National Forest Act

The Forestry Economics Services (on behalf of DFFE) collects all plantation and timber production data as legally required in terms of Regulation 19 made by the Minister of Agriculture, Forestry and Fisheries under the provisions of Section 6(1) and Section 6(3) of the National Forest Act (Government Gazette No 32185, dated 29 April 2009). This data is submitted by all company and state-owned plantations in electronic format (referred to as the "Green Mamba" form in this document and the MRV tool). This is the primary data source on forestry statistics, such as the Forestry South Africa Handbook. This data was considered during the development of the templates and guidelines and, as with NGER reporting, the data reported under the National Forest Act can serve as validation for various components included in the accounting (specifics are provided in the MRV tool, Table D.3).

A.8.3. Chain of custody standards and certification

[5] The specific checks can be determined once the format of the NGER template has been finalised.

SCHEDULE

Forest products chain of custody standards (COC) and certification (PEFC and FSC) demonstrates that registered company produces source timber from controlled, well managed forest resources. The forestry industry suggests that COC or certification should be used as a proxy for sustainable timber production, preservation of forest C stocks and that these mechanisms could be incorporated in an accounting framework. However, this approach has drawbacks:

a) Since COC or certification uses sustainability indicators to assess adherence to the schemes, this is often misinterpreted that timber is sustainably produced, while at best it could be described as responsible management with no causative link with carbon sequestration as an ecosystem service. For example, FSC criteria[6], under the S.A. standard, does not assess harvest relative to volume increment, a core sustainability indicator linked to forest C budgets (Grassi et al, 2018). Moreover, C sequestration is not listed as one of the ecosystem criteria under the FSC standard.

b) The assumption that certified plantations would not be a net emission for any reporting period does not hold. In fact, nearly 60% of the worlds certified forests and plantations are in Europe. Some member state GHG inventories report that net emissions or a decline in forest C stocks since 1990 (UNFCCC[7]). The same can be seen in the emission/removal trends for the South African forest industry (Forestry SA, 2019).

c) Not all timber suppliers to the processing facilities are certified[8]. In South Africa approximately 76% of the plantation areas are owned or managed by large companies, 95% of which are certified. Another 20 % of the plantation area is owned by commercial farmers or family companies (typically between 100 and 5,000 ha). Only 30% of these areas are covered by one of the four certification schemes and nearly no small growers are covered by a scheme. This means that even if certification was used as a proxy to ensure harvested 3rd party and non-registered forest areas (under the C Tax Act) are replanted and "responsibly" managed, most on the 3rd party timber sources supplied to manufacturing facilities may still not be certified.

d) Participation in COC or a certification scheme does not guarantee permanence of accounted removals because certification may not be renewed following subsequent audits.

Despite the above-mentioned difficulties, it is acknowledged that COC and certification could be used in cases where the risk of non-permanent accounting of removals is low, such as in the case of 3rd party forest emissions and removals and inflows into HWP storage (see Accounting Rules in Chapter B). However, 3rd parties can only be included if proof of certification is provided and that the burden of reporting and accounting is put on the company accounting for "S" under the C tax scheme.

---

[6] https://fsc.org/en/document-centre/documents/resource/319

[7] https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/national-inventory-submissions-2019

[8] Source SA Forestry Online http://saforestryonline.co.za/articles/environment/how_effective_is_forest_certification/

SCHEDULE

A.9. Carbon Tax Sequestration submission process

For C Tax reporting of sequestration, taxpayers are required to register on SAGERS. Here the MRV tool (see Section C.2.1) will be provided for completion. Once completed the tool can be uploaded to SAGERS where it will go to DFFE for review (Figure A.4). A taxpayer may be selected to undergo an independent review (see further details in the Verification Guidelines in Chapter D). Once reviewed and verified, DFFE will approve the "S" amount and submit it to SARS where it will be combined with the other emission components in the carbon tax equation to determine the overall tax liability.

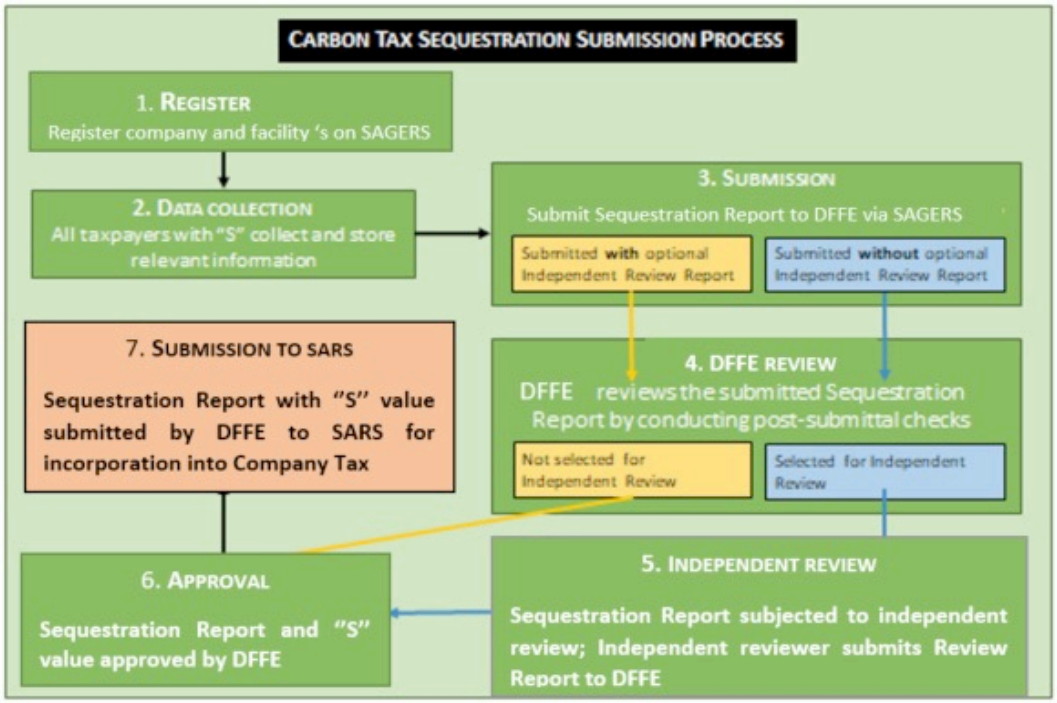


Figure A.4: Carbon Tax sequestration submission process.

A.10. Future considerations

A.10.1.1. Net-net Accounting Frameworks

The UNFCCC COP (2/CMP7) and the EU LULUCF regulation 841/EU(2018) implemented the use of a forward-looking baseline approach to define the reference level for managed forests based on dynamic forest models. This approach factors out age-class legacy and other indirect human factors whilst still providing an incentive for potential C credits, but also allowing the continuation of sustainable management practice without potential debits associated with management legacy. This

SCHEDULE

legacy has been shown to be associated with age-class shifts in forest areas due to either fluctuation in afforestation or practices that result in non-uniformly distributed ages classes in forest ecosystems (Black et. al., 2012; Botcher et al., 2008). The same trends are evident based on our analysis of the plantation on forestry industry carbon stock changes. The forward-looking baseline approach is generally accepted as credible science-based carbon accounting approach based on the projected continuation of documented historical forest management practice (Grassi et al., 2018). Meanwhile the gross-net approach is retained for afforestation and deforestation.

The advantage of this approach, in a South African forest industry perspective, is that implementation of improved management practice or deployment of genetically improved nursery stock can potentially increase any removals and hence companies can account removal credits for these activities. The suggested framework allows for the continuation of sustainable management practice and utilisation of HWP without unfairly debiting accountable emissions due to age class legacy effects (see Box A.1).

The development of forward-looking baselines requires the implementation of modelling frameworks that simulate changes in forest age class structure based on silvicultural rules defined for different species and existing stands over the defined reference period.

A.10.1.1.1. Current Forest Carbon Modelling Capacity

The development of a forward-looking baseline requires the ability to dynamically model forest C stocks based on silvicultural practice and shifts in the state of the forest (i.e. age class shifts as a result of management etc.). Based on a review of the forestry industry's capacity to develop and use complex tier 3 models for reporting or development baselines (this project and Knowles and Christie, 2018), it is suggested that the capacity is not sufficiently developed to implement such an approach.

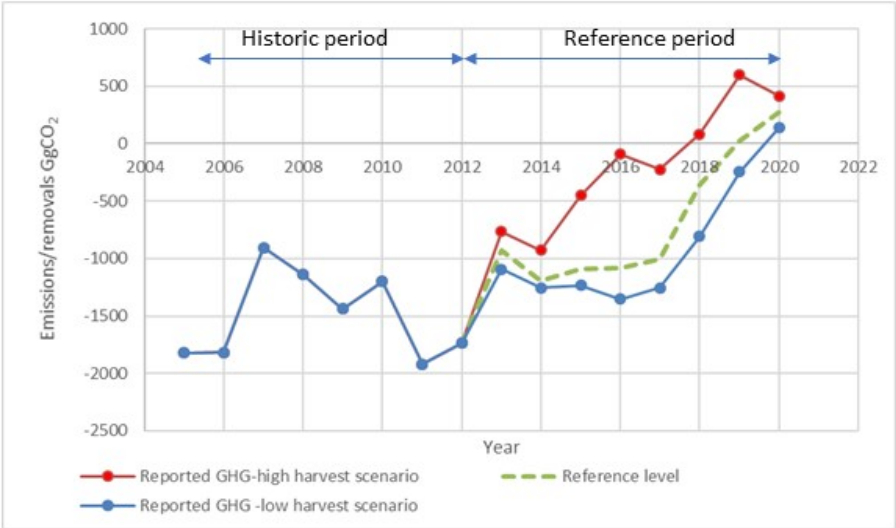
A phased approach to the implementing of reporting should be adopted allowing entities to report using Tier 1 methodology unless the information is available for an entity to submit information using higher tier calculation.

A study by Ndalowa (2014) highlighted the potential use of internationally available models, such as CBM_CFSv3 (Kurz et al., 2009) or CASMOFOR (Somogyi, 2019), for reporting and modelling future GHG profiles from South African plantations. However, it was also suggested that considerable time and resources are required to implement this at a company or national scale (Knowles and Christie, 2018). Other national platforms such as the carbon calculator are being developed to calculate carbon stocks in above- and below ground biomass pools (du Toit et al 2016, 2019). We are also aware that some companies have produced carbon stock change forecasts based on Mean Annual Increment (MAI) growth curves and inventory information.

It is noted that the basic information and allometric equations for the calculation of above ground biomass changes are available (du Toit et al., 2016) and these together with growth curves can be used to develop integrated modelling frameworks, which can simulate forest stock changes using different silvicultural assumptions but not for different climatic conditions.

SCHEDULE

Box A.1: Net-net accounting using a projected reference level (example)



The figure shows hypothetical reported GHG emission and removals for managed forest land and HWP, where the sink is declining due to age class legacy effects under two scenarios. The high level of harvest (red line) scenario is due to increase demand for timber of timber products. The low harvest scenario represents a case where forest sinks are enhanced though deployment of improved genetic material and a reduction in the level of harvest.

The projected forest reference level (FRL, green line) was constructed using historical management practices based on the historic period using a dynamic model.

The accountable emissions/removals under a gross-net accounting framework in the reference period would be equivalent to the absolute values for each year over the reference period (solid symbols). Note that there would be an accountable net emission of 413 and 137 $GgCO_2eq$. in 2020 for both the high and low scenarios, respectively.

Under a net-net forward-looking base line approach the annual accountable amount is equal to the reported amount minus the FRL in any given year in the reference period. Under the high harvest scenarios, an annual net debit of 134 to 994 Gg of CO_2eq. will be incurred, however, a net credit of -60 to -420 Gg CO_2eq. will be accounted under the low harvest scenario. In the year 2020, the low harvest scenario reports a net emission of 137 Gg CO_2, but the FRL emission is higher (275 Gg CO_2eq.), which means an accounted credit of -138 $GgCO_2$ is incurred.

SCHEDULE

A.10.1.1.2. Forward looking baseline (net-net) rules

It is recommended that the proposed accounting framework applied to managed forests be reviewed in the next 3-5 years to determine if a forward-looking baseline [reference level] approach can be adopted for managed forest lands based on the proposal by Grassi et al. (2018). Assuming that the modelling capacity has been developed by that time, the following accounting rules and criteria should be considered in constructing a reference level:

a) The projected reference level should be based on historical management practice (silvicultural practices they were *actually* applied) used for a defined historic reference period, for which period data needs to be available. Accordingly, the following information should be considered:
    i) Historic thinning practice such as thinning intensity and frequency for specified species.
    ii) Historic rotation ages and fallow periods for specific species/management cohorts.
    iii) Historic proportional inflows of timber products into HWPs.
    iv) Historic levels of deforestation and afforestation.
    v) The projected reference level should not include the following factors (after the initial year of the simulation):
        - envisaged increased levels of harvest due to increased demand or future policy;
        - the harvest to volume increment ratios observed for the reference period should not be exceeded in the projected reference level; and
        - planned changes in forest structure, management, or composition of tree species.

    Guidance on construction of reference levels are outlined by Grassi et al. (2018).
b) Models must be able to simulate age-class dynamics because of management and simulations should replicate historical carbon inventory estimates.
c) The generated reference level must be reviewed and verified by an independent third party based on defined rules before a new accounting cycle is implemented. This can be verified by a technical board set up by the Forestry industry and DFFE.
d) The South African Forestry Industry advocated the implementation of a Technical Advisory Board to guide the development of revised reporting and accounting rules. Such a body could be involved with the definition of reference periods, implementation of a 100year HWP approach (see Section A.6.2.2), review processes or even model capacity building.
e) The reference level should be able to simulate all C pools unless a pool is explicitly ruled out in the legislation revision.
f) There must be a capacity to adjust for changes in methodology over time by implementation of a technical correction when accounting for forest and HWP emissions and removals.
g) Net-net accounting with a baseline should be applied to both HWP and managed forest to ensure robust and balance accounting.

SCHEDULE

A.10.1.2. Natural disturbance

Currently it is proposed that emissions from fires be fully discounted until further data is obtained and a proper analysis of a natural disturbance baselines has been completed. A natural disturbance provision should be considered for inclusion in the next phase.

A.10.1.2.1. Accounting of natural disturbances

To minimise the impact of "force majeure" disturbance effects, such as wildfires, a natural disturbance provision, like that used for Kyoto Protocol[9] accounting and the EU LULUCF regulation[10], can be applied. This eliminates the liability of non-anthropogenic GHG emissions and emissions that are beyond the control of the taxpayer.

The forest industry could consider the use of a background level to correct for non-controlled GHG emissions (Box A.2). Due to climate change the incidence of natural disturbance events will increase (more droughts, hail, heat, etc.). Furthermore, the occurrence of natural disturbance is not similar from year to year. History shows that there are large peaks in certain years when disasters strike, such as the 2007/2008 fires (Figure A.5). Industry will not be penalised for such events that are outside their control if a natural disturbance baseline rule is defined and used.

Carbon stock changes due to natural disturbances and effects beyond human control (e.g. droughts, pests and diseases, fire, frost, snow, etc.) should be excluded from accounting. An attempt has been made to develop a method to partition between the effects (Krug, 2018). Kurz (2018) provided a conceptual framework that can be used as a starting point:

a) The natural disturbance provision allows areas effected by wildfires to be excluded from accounting if the annual emissions from wildfires in company owned forest exceeds a background level. The burnt area is removed from the accounting until biomass C stocks are equivalent to those before the disturbance event took place.
    i) The background threshold could be based on historical wildfire data for each eligible company.
    ii) If the threshold is exceeded in an accounting year, then emissions and removals for these areas are excluded from accounting until such time that the C stocks in these areas are equivalent to the biomass stock before the wildfire event.
    iii) Companies should still report C annual stock changes for the areas excluded, which must be geospatially explicitly identified (i.e. a GIS boundary, GIS co-ordinates or maps showing boundaries and describing the elements which define the boundary), as a separate item in their annual reporting.
    iv) Emission associated with salvage logging shall continue to be reported and accounted.
    v) If the excluded areas are deforested after the natural disturbance provision was applied, then emissions shall be accounted for in the current reporting year when deforestation is identified.

[9] https://unfccc.int/resource/docs/2012/cmp8/eng/13a01.pdf#page=2

[10] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.156.01.0001.01.ENG&toc=OJ:L:2018:156:TOC

SCHEDULE

vi) Emission from controlled burning, i.e. burning of harvest residues or fire breaks, should be excluded from the natural disturbance provision.

b) The natural disturbance background must be calculated for afforested and managed forest land activities separately if different accounting frameworks are use.

c) The background level cannot be adjusted after submission and verification, and it will be applied for all accounting periods (one off submission).

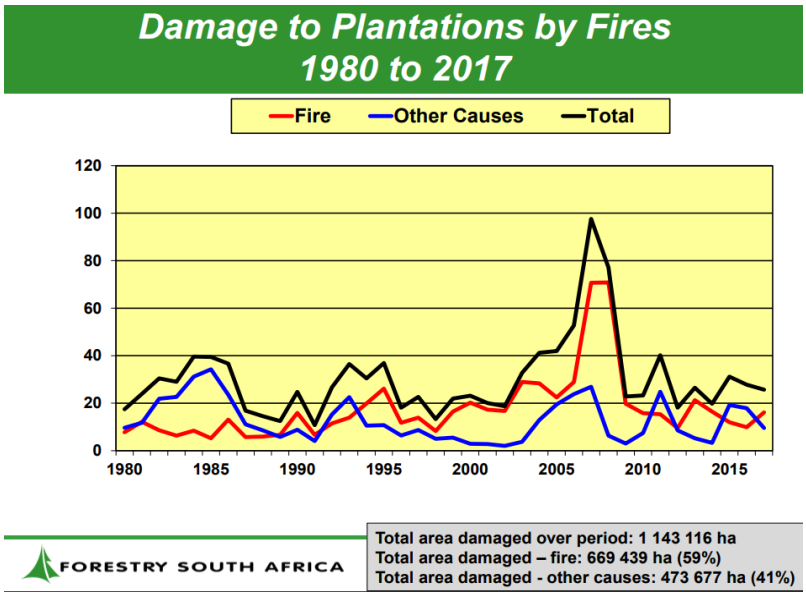
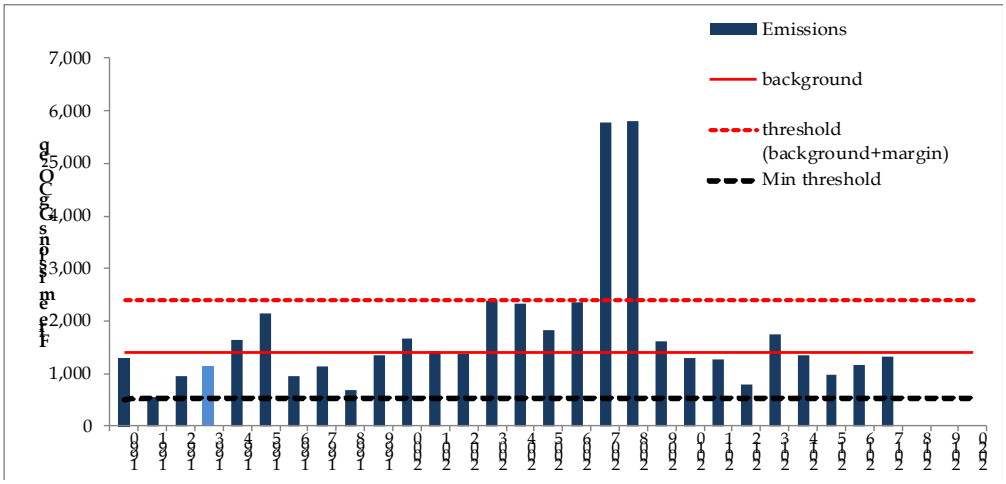


Figure A.5: Plantation area damaged between 1980 and 2017.

SCHEDULE

Box A.2: The natural disturbance example

The forest areas subject to fire (obtained from Forestry SA data (Forestry SA, 2019)) were used to calculate CO_2eq emissions for the period 1990-2017 using IPCC tier 1 methods and emission factors. The background level is calculated as the mean and the margin is the standard deviation. Outliers are removed from the data set for any given year if the annual emission is greater than the background plus 2 times the margin value (IPCC, 2014). The background and margin values are then recalculated until all outliers are removed. The reference threshold in then determined as the background plus 2 times the margin, when there are no outliers in the calibration dataset (see figure below).



In this figure 2007 and 2008 are outliers and these were removed before the final threshold (margin plus background were estimated). When emissions from fire are greater than the threshold (ca. 2513 Gg CO_2eq) emissions will be excluded from accounting under the natural disturbance provision.

An alternative approach, and one better suited for situations where calibration data is limited, is the minimum background threshold (IPCC, 2014). The threshold is determined as the minimum emission value observed over the time series. In this example the threshold will be 575 Gg CO_2eq (black dashed line in the figure above).

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

A.10.1.3. Indirect N_2O

The "S" equation includes direct N_2O emissions from fertilisers, however indirect N_2O emissions have not yet been included. This is because they are not currently in the C Tax Act and amendments have not yet been proposed to include these. In addition, direct N_2O emissions are currently fully discounted. Indirect emissions should be considered for inclusion in the second phase if fertiliser emissions are shown to be significant.

A.11. References

Adu Poku, S. (2015). Plant-Based Carbon Flow Analysis of South African Pulp Mills. MSc Thesis School of Chemical Engineering at the College of Agriculture, Engineering and Science, University of KwaZulu-Natal, Durban South Africa.

Aleinikovas, M., Jasinevičius, G., Škėma, M., Beniušienė, L., Šilinskas, B and Varnagirytė-Kabašinskienė*, I. (2018). Assessing the Effects of Accounting Methods for Carbon Storage in Harvested Wood Products on the National Carbon Budget of Lithuania. Forests 2018, 9(12), 737; https://doi.org/10.3390/f9120737

Black, K., Hendrick, E., Gallagher., G., Farrington, P. (2012). Establishment of Irelands projected reference level for Forest Management for the period 2013-2020 under Article 3.4 of the Kyoto Protocol. Irish Forestry 69: 7-32

Böttcher, H., Kurz, W.A. and Freibauer A. (2008). Accounting of forest carbon sinks and sources under a future climate protocol—factoring out past disturbance and management effects on age–class structure. Environmental Science and Policy 11: 669-686

Broadmeadow M, Matthews R. (2003). Forests, Carbon and Climate Change: the UK Contribution. Forestry Commission, Information Note 48. Crown Copywright, Edinburgh, UK (2003).

Brown S, Lim B, Schlamadinger B. (1999). Evaluating approaches for estimating net emissions of carbon dioxide for forest harvesting and wood products. In: IPCC expert workshop, Dakar, Senegal, Paris: IPCC/OECD/IEA.

Christie, S. & Scholes, R. (1995). Carbon storage in eucalyptus and pine plantations in South Africa. Environmental monitoring and assessment, 38, 231-241.

Dittmar, T. and Lara, R. J. (2001). Molecular evidence for lignin degradation in sulfate-reducing mangrove sediments (Amazonia, Brazil), Geochimica et Cosmochimica Acta, 65 (9), pp. 1417-1428 . DOI: 10.1016/S0016-7037(00)00619-0

du Toit, B., Dovey, S., Seifert, T., Muyambo, P., & Malherbe, D. (2016). Carbon sequestration in South African plantation forests Progress report number 1: Techniques to estimate net carbon sequestration carbon at the Tier 2 level using available data from local studies and international literature. Johannesburg, South Africa.

du Toit, B., Dovey, S.B., Seifert, T., Drew, D.M., Malherbe, G.F., Seifert, S., and Kunneke, A. (2019). The South African plantation forestry carbon calculator, Version 1.0. Department of Forest and Wood Science, Stellenbosch University, South Africa.

SCHEDULE

Ellison D, Lundblad M, Petersson H. (2011). Carbon accounting and the climate politics of forestry. Environmental Science and Policy. 14, 1062-1078.

Fey A. (2019). A short guide to the soils of South Africa, their distribution and correlation with World Reference Base soil groups. 19th World Congress of Soil Science, Soil Solutions for a Changing World 32, 1 – 6 August 2010, Brisbane, Australia.

Forestry SA (2019). South African Forestry and Forest Product Industry Facts 1980 – 2019, Forestry South Africa, KwaZulu-Natal.

Godsmark, R. S. L. M., & Oberholzer, F. (2019). The South African Forestry and Forest products Industry 2017. Forestry South Africa, Pietermaritzburg.

Grassi, G., Pilli, R., House, J., Federici, S., Kutz, W.A. (2018). Science-based approach for credible accounting of mitigation in managed forests. Carbon Balance Management 13:8, 4-16

Henschel C., Ward, M. Rueter, S., Ralph Ashton, R., Bird, N., Frieden, D., Lehtonen, A., Schlamadinger, B., Silvius, M., Tuerk, A. and Zanchi, G. (2008). Options for improving the treatment of LULUCF in a Copenhagen agreement: forest and wetland degradation, factoring out, harvested wood products, and approaches for fuller accounting. < http://www.climatestrategies.org/reportfiles/3_options_for_improving_the_treatment_of_lulucf_in_a_copenhagen_agreement_august_18_2008.pdf>.

IPCC. (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 4. Agriculture, Forestry and Other Land Use. Eggleston S, Buendia L, Miwa K, Ngara T and Tanabe K (eds.). The Intergovernmental Panel on Climate Change, IPCC National Greenhouse Gas Inventories Programme Technical Support Unit, Japan, Available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html

IPCC. (2014). 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol, Hiraishi T, Krug T, Tanabe K, Srivastava N, Baasansuren J, Fukuda M and Troxler TG (eds) Published: IPCC, Switzerland. Available at: https://www.ipcc.ch/publication/2013-revised-supplementary-methods-and-good-practice-guidance-arising-from-the-kyoto-protocol/

Knowles, T and Christie, S. (2018). Technical guidance for the reporting of GHG emissions from plantation forests, biogenic fuels and harvested wood products within the South African plantation forest and forest products sector. Draft report, GIZ, Pretoria

Krug JH. (2018). Accounting of GHG emissions and removals from forest management: a long road from Kyoto to Paris. Carbon balance and management 13(1):1-11

Kurz WA, Hayne S, Fellows M, MacDonald JD, Metsaranta JM, Hafer M, Blain D. (2018). Quantifying the impacts of human activities on reported greenhouse gas emissions and removals in Canada's managed forest: conceptual framework and implementation. Canadian Journal of Forest Research 48(10):1227-40.

Kurz, W.A., Apps, M.J., Webb, T.M. and McNamee, P.J. (1992). The carbon budget of the Canadian forest sector; Phase 1. Northwest Region Information Report NOR-X-326. Forestry Canada.Northwest Region, Northern Forestry Centre, Edmonton, AL.

SCHEDULE

Lippke B, Oneil E, Harrison R, Skog K, Gustavsson L, Sathre R. (2011). Life cycle impacts of forest management and wood utilization on carbon mitigation: knowns and unknowns. Carbon Management. 2(3) 303–333.

Marland ES, Stellar K, Marland GH. (2010). A distributed approach to accounting for carbon in wood products. Mitigation and Adaptation Stategies for Global Change. 15, 71-91.

Miner R, Perez-Garcia J. (2007). The greenhouse gas and carbon profile of the global forest products industry. Forest Products Journal 57, 80-90.

Miner, R. (2006). The 100-Year Method for Forecasting Carbon Sequestration In Forest Products In Use. Mitigation and Adaptation Strategies for Global Change. Springer. DOI: 10.1007/s11027-006-4496-3

Ndalowa, D. (2014) Evaluation of carbon accounting models for plantation forestry in South Africa. MSc Thesis, Department of Forest and Wood Science, University of Stellenbosch.

Pingoud K, Skog K, Martino DL, Tonosaki M, Xiaoquan Z, Ford-Robertson J. (2006). Chapter 12. Harvested wood products. IPCC Guidelines for National Greenhouse Gas Inventories, pp. 33 + HWP worksheet MS Excel. IGES, Japan.

Pingoud, K., Wagner, F. (2006). Methane Emissions from Landfills and Carbon Dynamics of Harvested Wood Products: The First-Order Decay Revisited. Mitigation and Adaptation Strategies for Global Change 11(5):961-978

Profft I, Mund M, Weber GE, Weller E, Schulze ED. (2009). Forest management and carbon sequestration in wood products. European Journal of Forest Research. 128, 399-413

Row, C. and Phelps, B. (1996). 'Wood carbon flows and storage after timber harvest', Forests and global change: Volume 2. Forest management opportunities for mitigating carbon emissions. Edited by Sampson and Hair. Published by American Forests, Washington DC.

Sathre R, O'Connor J. (2010). A synthesis of research on wood products and greenhouse gas impacts, 2nd edition, Technical Report No. TR-19R, FP Innovations, Vancouver, BC.

Skog K & Nicholson G.A. (1998). Carbon cycling through wood products: The role of wood and paper products. Forest Products Journal 48(7):75-83.

Skog K E. (2008). Sequestration of carbon in harvested wood products for the United States. Forest Products Journal, 58, 56-72.

Skog KE, Nicholson GA. (2000). Carbon sequestration in wood and paper products. USDA Forest Service General Technical Report RMRS-GTR-59 (2000).

Somogyi, Z. (2019). CASMOFOR version 6.1. NARIC Forest Research Institute, Budapest. Website: http://www.scientia.hu/casmofor

UNECE. (2010). Forest product conversion factors for the UNECE region. Geneva timber and forest discussion paper 49. United Nations publication, Geneva.

SCHEDULE

Vácha. D. (2011). Harvested wood products: approaches methodology and application, Report to IPCC under TSU, IPCC internship Available at: http://portal.chmi.cz/files/portal/docs/uoco/oez/nis/hwp/hwpstudyvacha.pdf

Winjum JK, Brown S, Schlamandinger B. (1998). Forest harvests and wood products-sources and sinks of atmospheric carbon dioxide. Forest Science 44, 272-284

SCHEDULE

Appendix A

Proposed amendments to the Carbon Tax Act

The problem statement	Place in the C Tax Act	Proposed change
Basic tax-free allowance for fossil fuel emissions – see schedule 2 related to treatment of net emissions from S	Line 25 on page 14 (expression E-S)	Add "If the sum of subcategories 3B1a, 3B1b, 3C1a, 3C4, and 3D1 is an accountable net emission then "(E-S)"=E."
Application of the threshold in schedule 2 for reporting and accounting of forestry activities	Schedule 2, 3C1a, under the threshold column	Delete N/A and replace with threshold to allow for reporting under "S".
Application of the threshold in schedule 2 for accounting of fertilisers	Schedule 2, 3C4, under the threshold column	Delete N/A and replace with threshold to allow for reporting under "S".
Application of the threshold in schedule 2 for accounting of HWP	Schedule 2, 3D1, under the threshold column	Delete N/A and replace with threshold to allow for reporting under "S".

Chapter B: Accounting Rulebook for Forest Plantations

B.1. Purpose of the Accounting Rulebook

The purpose of the Accounting Rulebook is to provide an instrument for inclusion of carbon sequestration ("S") as a component of the C Tax Act accounting framework under the relevant legislation applicable in South Africa. It provides a set of accounting rules to be adhered to by entities when accounting carbon tax liabilities.

B.2. Introduction

Although C sequestration and emissions from the South African Forestry Industry have been reported in the National Greenhouse Gas (GHG) inventory, values have been calculated at a national level using information available to Government and application of a combination of country specific and default values set out in the IPCC guidelines. With the implementation of the C Tax liability for emissions will be calculated at a company level. The IPCC has acknowledged that there are challenges associated with the application of the guidelines to areas other than national inventories, such as carbon accounting, and has held expert meetings to review these (e.g. Sofia, 1-3 July 2014). Some major challenges include difference in boundary-setting, availability, detail and quality of data, questions of appropriateness of emission factors and activity data, insufficient level of detail for specific applications and the non-prescriptive nature of guidance on some issues.

The accounting rules outlined in this document are based primarily on criteria set out in the C Tax Act and proposed modifications to the C Tax Act (see Appendix A), but also in line with international agreements, such as the Paris Agreement, agreements from other UNFCCC Conference of the Parties (particularly 16CMP/1[11], 2CMP/7 and 8), the voluntary market principles and climate change policy drivers behind the C Tax Act (2019). In addition, country specific factors based on consultation with Forestry South Africa and PAMSA were also considered.

B.2.1. Definition of "S" for carbon accounting

For the purposes of this Accounting Rulebook "S" in the C Tax Act is defined as stated in Equation A.4. of Chapter A.

B.2.2. Emission pools or sources included under the various forest activities

Forest plantations can accumulate carbon in three different pools, i.e. living biomass, dead organic matter (DOM, that includes dead wood and litter) and soil organic carbon (SOC). Conversely, if forest plantation is change to a non-forest used, this can result in GHG emissions. Management practices (e.g. application of fertiliser and controlled burning) and wildfires also results in GHG emissions. Table B.1 indicates which pools or emission sources included in the reporting and accounting of "S".

[11] https://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf

SCHEDULE

Table B.1: Sources included in the reporting and accounting of "S" for the C Tax Act.

Component in Eq B.1	C Pools or non-CO_2 emissions	Gases	Forest activity
S_{HWP}	Sawnwood, wood-based products, pulp and paper	CO_2	All except deforestation
ΔC	Aboveground biomass (AGB)	CO_2	All
	Belowground biomass (BGB)	CO_2	All
	Deadwood and litter (DOM)	CO_2	If Tier 1 and 2 are applied, changes only included for afforestation (1st rotation forests up to 20-years old) and deforestation. If Tier 3 is applied, changes included for managed forests as well.
	Mineral soils (SOC)	CO_2	If Tier 1 and 2 are applied, changes only included for afforestation (1st rotation forests up to 20-years old). If Tier 3 is applied, changes included for managed forests as well.
S_{fire}	Wildfires	$CO_2^{\#}$, CH_4, N_2O	Reported but not accounted
	Controlled burning	$CO_2^{\#}$, CH_4, N_2O	Reported but not accounted
S_{fert}	Emissions associated with application of fertilisers	N_2O	Reported but not accounted

$^{\#}CO_2$ emissions from grassland are excluded

B.3. Accounting Rules

B.3.1. Eligibility

The current eligibility criteria under the C Tax Act is an area threshold of 100ha. The eligibility criteria is redefined (see Section A.6.1) to facilitate accounting HWP removals from 3rd party timber harvests, where owned forest areas are less than 100 ha. The rationale is that eligibility to register and account should be based on the criteria to report "E" and not on the area threshold.

B.3.1.1. Ownership and liability

SCHEDULE

a) Only taxpayers that are eligible to report and account for "E", as stipulated under the C Tax Act, can account for forest and HWP emissions and removals ("S").
b) Once an area of forest owned by an eligible taxpayer (B.3.1.1.a) is included and registered for accounting, then it shall continue to be reported and accounted for subsequent tax periods.
c) To avoid double accounting, ownership of the removals by HWP resides with the processing company and not the plantation from which it is sourced.
d) Inflows of harvest from other registered taxpaying companies into HWP may be accounted by the eligible taxpayer, provided that the source and amount HWP inflows are transparently identified.
e) Eligible taxpayers may voluntarily elect to account for forest emissions/removals and inflows into HWP from 3rd party forest plantations areas subjected to, lease, harvest rights or supply contract agreements with the eligible manufacturing company. In this case:
    i. It is the eligible taxpayer's responsibility to report and account for 3rd party forestry emissions/removals associated with harvests included in HWP inflows.
    ii. All 3rd party forest emissions and removals shall be reported and accounted only in the year that harvests from the 3rd party forest area is used as inflows to HWPs.
    iii. 3rd party HWP inflows may only be accounted if proof of chain of custody certification is provided in the year relevant HWP inflows are accounted.
    iv. The 3rd party area of forest associated with harvest must be the unit (e.g. sub-compartment) that was harvested (not the total forest area owned by the 3rd Party) and this area must be identifiable and traceable (using GIS or maps).
    v. If the harvested timber from a unit of 3rd party land is sold to more than one registered taxpaying company, then the individual taxpayer shall transparently account for the equivalent proportion of emissions from harvest and inflow into the HWP pool.
f) If there is a change in ownership, lease or harvest rights, all emissions and removals are the liability of the new landowner.
g) Only domestically sourced wood from forest land registered by the taxpayer, other registered taxpayers under the act, or accounted 3rd party area are eligible to be accounted as HWP inflows (see Section B.3.1.1.a and e).

B.3.2. Accounting categories and activities

B.3.2.1. Afforestation and deforestation activities

a) Afforestation (A), deforestation (D) and associated harvested wood products (HWPs) shall be identified and reported as separate activities and accounted for annually on a gross-net basis[12].
b) Afforestation areas shall include all established 1st rotation forests for the first 20 years of the rotation. After 20-years, these areas shall be transition to the managed forest land category.

[12] Justification for gross-net accounting is provided in section 10.1 of final report.

SCHEDULE

B.3.2.2. Forest management activities

a) Managed forest areas include all managed forest activities which do not fall under the A and D activities.
b) Forest management and associated HWPs should be reported as a separate activity.
c) Accounting of managed forest areas shall be accounted for on a gross-net basis[13].

B.3.2.3. 3rd Party forest activities

a) Election of accounting emissions and removals in forest and HWP for 3rd party areas (see B.3.1.1.e) is voluntary.
b) To avoid double accounting, emissions and removals associated with the areas (i.e. see B.3.1.1.d and e) of forests owned by 3rd parties shall be reported as a separate category and transparently accounted in the year associated harvests are accounted as HWP inflows.

B.3.2.4. Controlled burning

a) Controlled burning must be reported in the accounting tool but is given a 100% discount so is not included in the accounting output.

B.3.2.5. Harvested wood products

a) Harvested wood product emissions and removals from afforested activities may be reported and accounted under forest management activities if taxpayers cannot distinguish the amount of harvest coming from afforestation or forest management activities. However, deforestation, other registered taxpayers and 3rd party HWP removals should be reported as separate categories.
b) Harvested wood products shall be estimated based on the mass balance approach (see Section 0 of Chapter A).
c) Estimation of mass flow components shall be based on mass flow fractions specific for each HWP category and industrial process (i.e. default factors and methods outlined in the methodological guidelines (see Chapter C, Section C.3.3) or higher tier methods developed by the taxpayer, providing that the methods used are demonstrated to be transparent, verifiable, applicable and accurate.
d) Annual inflows into the HWP mass balance equation (mC_{RM}) shall only include:
    i. Domestic timber harvested from company owned or leased land or timber purchased from registered taxpaying companies or 3rd parties which is used for production of HWP produced by the company owned manufacture facility.

[13] It is recommended that net-net accounting be introduced when the industry has capacity to use models and projected emissions/removals as a base line (Section 12.1 of final report).

SCHEDULE

ii. To avoid double accounting, recycled pulp or mill residues produced by the taxpayer and used for production of the HWP shall not be considered as inflows because these are already included in the mass balance calculations.

iii. All inflows shall not have previously been accounted as HWP sequestration by a registered 3rd party or the registered company.

iv. Inflows should exclude purchased processed wood products from registered and 3rd parties or cascaded wood products.

v. Purchased sawmill or pulp waste residues from other registered taxpayer can be included as inflows. For example, sawmill residues from sawn wood production can be included as inflows if purchased by a wood-based panel manufacturing facility. Similarly, if a registered taxpayer has different processing facilities, the wood-based waste from other production lines can be used of inflows only if it can be demonstrated that removals are not double accounted (i.e. verifiable information must be provided to show that waste inflows are not already included in the mass flow balance of the seller).

vi. Timber originating from deforested land must be excluded from HWP inflows in the year deforestation is detected.

e) Accountable outflows shall include:

i. Biogenic gaseous CO_2 emissions. These shall be reported but are discounted by 100% in the C Tax Act. N_2O and CH_4 emissions are reported and accounted as "E" in the C Tax Act.

ii. Solid or liquid waste emissions shall also be reported if the defined thresholds set out in the C Tax Act are exceeded. Accounting of all waste emissions are 100% discounted in the C Tax Act.

iii. CO_2eq from CH_4 and N_2O emissions from waste should be reported under HWP IPCC category 3D1 as set out in the C Tax Act.

f) The accounting of HWP removals shall acknowledge that long term storage of C is greater in sawn wood and wood-based panels than paper. It is also acknowledged that the half-life decay approach as set out under the IPCC may conservatively overestimate HWP emissions and underestimate long term storage. Therefore, to facilitate accounting of reported mC_{HWP} for each HWP category and/or subcategories will be weighted and discounted based on long-term C retention potentials (96 years, see landfill (or LCA) approach in Chapter C, Section C.3.3)[14].

g) Should mass flow factors for a particular processing facility (i.e. tier 2 or 3) not be available, a taxpayer may use default recovery fractions (see Chapter C Section C.3.3 and Appendix C) to estimate HWP removals.

h) If tier 2 mass flow and recovery factors are confidential, then this information can be provided during the verification under a non-disclosure agreement between DFFE and the taxpayer.

[14] See section A.6.2.2.1 of Chapter A for justification and arguments for application of the LCA approach and recommendation for implementation of the 100 year accounting approach when required national data is available.

SCHEDULE

i) HWP removals for use as fuels, such as firewood, charcoal and matches, are not considered as long term HWP pools and are excluded from "S" in the tax equation.

j) Additional information on annual (tax period) harvested timber owned and sold by the taxpayer and timber purchased from other companies within the tax scheme for production of HWP should be provided when accounting, including:

i. The total harvest from eligible forest areas owned by the taxpayer.

ii. Timber harvested by the taxpayer and used for production of company owned HWP production facilities.

iii. Timber purchased from other registered taxpayers for production of company owned HWP production facilities.

iv. Timber purchased for HWP from accounted forest areas owned by a 3rd party.

v. All HWPs produced by the company in the tax period, by type of HWP.

B.3.3. Permanence

a) Once emissions and removals are reported and accounted by a taxpayer, these forest areas should continue to be reported for subsequent accounting periods.

i. The permanence condition B.3.3. a will not apply if a registered taxpayers production facility is sold and/or the threshold to account to "E" under the C Tax Act is not met[15].

ii. If deforestation occurs in registered forest areas, biomass, litter, and deadwood C pools will be assumed to be immediately / instantaneously oxidised. Tier 1 emission factors can be used for deadwood pools if no company specific data exists.

iii. SOC emissions or removals on deforested land shall not be reported or accounted because other land uses are not included in the 2019 C Tax Act.

iv. If there is a change in ownership after deforestation occurs, all emissions and removals are the liability of the new landowner.

v. All eligible deforestation emissions and removals will be accounted as a debit in the year the deforestation event takes place.

vi. If the registered forest area is clear felled and not replanted before sale or lease to a new owner, whom is not eligible for registration or reporting under the scheme, the entity that reported HWP will be debited all emissions from biomass, litter, deadwood and HWP pools in the year before the clear fell event took place (i.e. from all C pools except for SOC) on land and from HWP, using the immediate oxidation assumption applied in clause B.3.3.3.(a) ii.

vii. The registered area may be withdrawn from the scheme without any penalties (and not accounted) in the event of rescinding or withdrawal of a water use licence under the National Water Act (Act No. 36 of 1998), removal of plantations from river courses (includes wetlands) as defined in the National Water Act 1998, (Act No. 36 of 1998), or as

[15] Note: liability for accounting of E and S is based on ownership as defined in the act, therefore companies cannot be liable for sold land and strict adherence to the permanence principle cannot be satisfied. However, this may lead to leakage of emissions or emission avoidance. (also applies to B.5.3 iv)

SCHEDULE

a result of successful land claims, mandatory clearing of invasive species (Conservation of Agricultural Resource Act, 1983 (Act No. 43 of 1983); National Environmental Management: Biodiversity Act: Alien and Invasive Species Regulations). However, proof of a withdrawal notice should be submitted in the year areas are withdrawn.

b) Each registered company shall account for all changes in the following carbon pools: above-ground biomass, below-ground biomass, litter, dead wood, soil organic and harvested wood products (see Table B.1). A company may choose not to account for litter, deadwood and soil pools if transparent and verifiable information is provided showing that the pool is not a source. However, once a pool is reported under an activity, then it must continue to be reported for subsequent tax periods.

c) When accounting, a taxpayer should distinguish temporary unplanted (TUP) land from deforested land. TUP areas that have not been replanted within a period of 5 years after a clear-fell, or where there is clear evidence of land use change, shall be deemed to be deforested. Emissions from these disturbed areas shall be accounted when land use change occurs or when the 5-year period between clear-fell and replanting has expired (whichever occurs first).

d) If previously accounted mandatory forest areas are sold or where the lease has expired, the following information shall be provided [in the relevant year of submission]:
   i. The name and registration identification of owner reporting to the SAGERS or the name of unregistered owner.
   ii. The carbon stock for biomass at the time the registered areas were sold.

e) To minimise liability due to force majeure disturbances such as wildfires, a natural disturbance provision may be applied in the future (see Chapter A, Section A.10.1.2). The current legislature does not, however, require the accounting of emissions from forest fires, but does require reporting (i.e. wildfire emissions are reported in the accounting tool but a 100% discount is applied).

B.3.4. Accounting periods and intervals

a) Reporting Period: The period for all reporting will be from the beginning (1 January) to the end of the tax year (31st December) preceding the reporting cycle.

b) Reporting cycle: Data for the preceding year must be reported to SAGERS by 31 March each year.

B.3.5. Robustness

a) The treatment of any accounted activities will be based on sound science.

b) All activities shall be reported using the prescribed tier 1 methods if company specific activity data does not exist. Company or manufacturing process specific methods (tier 2) or models (tier 3) methods can be used if the approach is transparently documented and justified by references.

c) The reversal of any removal due to land-use change and forestry activities will be accounted for in the year when the activities occur.

d) Taxpayers may choose not to include in their accounts changes in carbon stocks if it can be demonstrated that the carbon pool is not a source. The option shall, however, not apply to the

SCHEDULE

carbon pools of biomass and harvested wood products in the land accounting category of managed forest land and afforestation.

e) Reported emissions and removals must be verified by DFFE in accordance with the Verification Guidelines before debit or credits can be accounted (see Chapter D).

f) The pools and emission sources considered for reporting and accounting of emissions and removals are outlined in Table B.1.

B.3.6. Additionality

a) The mere presence of carbon stocks is excluded from reporting and accounting[16] (i.e. only C stock change is reported for the accounting year and activity, and not the C stocks cumulated from the past).

b) Accounting should exclude removals resulting from indirect human activities:
   i. Elevated carbon dioxide concentrations above their pre-industrial level.
   ii. Indirect nitrogen deposition.
   iii. The dynamic effects of age structure resulting from activities and practices before the accounting year, assuming robust scientific information becomes available.

Note: the gross-net accounting rule does factor out indirect human induced activities, particularly for forest management. The SA forestry industry does not currently have capacity to implement a net-net accounting system (see Chapter A, Section A.10.1.1).

c) Only managed forest land is eligible to comply. Therefore, natural forests or woodlands are excluded from accounting, but only if they are not managed.

B.3.7. Incentives and policy alignment

a) The information required to report and account for forestry related activities under the C Tax Act (2019) is consistent with the information required under the NGER with some additional elements:
   i. Different eligibility criteria to facilitate inclusion of 3rd party harvest in HWP accounting.
   ii. Additional reporting requirements for deforestation and HWP to ensure the principles of carbon accounting are adhered to (see Chapter A, Section A.5).
   iii. Reporting but not accounting for emissions from fires and fertiliser application.
   iv. Discounting of waste carbon emissions associated with wood processing under HWP.
   v. Additional verification and validation data requirement to ensure adherence to accounting rules.

b) In order to incentivise afforestation and to disincentivise deforestation, activities should be accounted on a gross-net basis.

[16] For example, produced HWP stock cannot be considered as an accountable removal amount without considering emissions due to product life cycle or harvest emissions.

SCHEDULE

c) Forest management activities should be accounted for on a gross-net basis. However, future rules should consider a net-net accounting in cases such as:
   i. Where forests with declining stock due to legacy management practice, age class structure changes or natural phenomena can be fairly accounted without penalising as an owner or entity for indirect human induced effects (see additionality principle in Chapter A, Section A.5). This may be best done using a net -net accounting approach but gross-net approach is currently recommended until such time modelling capacity is developed.
   ii. Incentivised management actions in cases where forest stocks are increasing or where improvement to stock changes are brought about by management or genetic improvement for successive rotations, managed forest land removals and emissions should be accounted for based on a net-net approach relative to a reference period. A gross-net approach is, however, recommended until such time modelling capacity is developed.

B.3.8. Leakage

a) Increased emissions of GHGs or decreased carbon removals should not result outside the accounting framework boundary. For example: use of timber sourced from outside South Africa for production of HWPs could result in increased emission or deforestation in other regions.
b) HWP inflows are only permitted from domestically produced timber harvested or purchased from registered and reporting forest owners under the C tax scheme, or from 3rd parties which implement the current rules.

B.3.9. Double accounting

a) Where carbon credits have been claimed by a manufacturer for HWPs these products cannot be included as a carbon inflow into the HWP pool for a taxpayer.
b) Emissions and removals cannot be accounted for under more than one accounting category.

B.3.10. Significance

a) To reduce the administrative burden of reporting very small emissions that do not have a significant impact on overall emission or removals, a threshold test for significance pools can be applied:
   i. Emissions may be excluded from reporting and accounting if it is smaller than a significance threshold which is a percentage of the total emissions for all, energy, processing, forest and HWP activities (i.e. sum of absolute emissions from ”E” and “S”).
   ii. The threshold for exclusion is <0.05% of the total emissions for both “E” and “S”.

B.3.11. Global Warming Potentials

SCHEDULE

In line with the updated reporting requirements of the NGER, entities will report GHGs separately (CO_2, CH_4 and N_2O). Thereafter, based on their relative Global Warming Potentials (GWPs), a CO_2eq amount is calculated and used to estimate "S" using Equation A.4. The C Tax Act specifies the use of GWP values set out in the IPCC third assessment (IPCC, 2001) report be used for calculation of CO_2 equivalent values, which is 296 CO_2eq for N_2O and 23 CO_2eq for CH_4.

B.4. References

IPCC (2001). Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 881pp.

Knowles, T and Christie, S. (2018). Technical guidance for the reporting of GHG emissions from plantation forests, biogenic fuels and harvested wood products within the South African plantation forest and forest products sector. Draft report, GIZ, Pretoria

Skog K & Nicholson G.A. (1998). Carbon cycling through wood products: The role of wood and paper products. Forest Products Journal 48(7):75-83.

SCHEDULE

Chapter C: Methodological Guidelines for Land Activities in Forest Plantations

C.1. Introduction

The Methodological Guidelines serve as a background document to facilitate the understanding and completion by companies of the Carbon Tax Sequestration MRV Tool for Forest Plantations and Timber Processing Industry (hereafter referred to as 'MRV tool') for reporting, and the verification of the information reported. The guidelines are underpinned by the Accounting Rulebook for Forest Plantations (hereafter referred to as the 'Accounting Rulebook') for the accounting of forest plantations and timber processing industry greenhouse gas emissions and removals under the C Tax Act.

C.1.1. Carbon sequestration Methodology

The net sequestration by forest and forest products ("S") is defined in Section A.4 and in the Accounting Rulebook as:

$$S = -S_{HWP} - \Delta C - S_{fire} - S_{fert}$$

Where:

- S_{HWP} = The amount of carbon located in harvested wood products (expressed in t CO_2eq). Note that it is an IPCC convention that a flux into the atmosphere (emissions) is denoted as a positive flux and sequestration (removals) as a negative flux;
- ΔC = Annual change in plantation carbon stocks, expressed in t CO_2eq. Note that it is an IPCC convention that a flux into the atmosphere (emissions) is denoted as a positive flux and sequestration (removals) as a negative flux;
- S_{fire} = Emissions from fire (N_2O and CH_4 expressed in t CO_2eq);
- S_{fert} = The fraction of emissions from applied fertiliser (N_2O expressed in t CO_2eq) growth of wood.

Note: Emissions from fires and fertilisation are to be reported, but not accounted. The reporting conversion for net sequestration is that it should be denoted as a negative value i.e. removal of CO_2eq, however, when entering S into the C Tax formulae [equation 1 main project report] it should have a positive sign.

In accordance with the Accounting Rulebook, the four activities to be reported are:

1) Forest Management;

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

2) Afforestation;
3) Deforestation; and
4) HWP production.

The emission pools or sources included under the various activities are outlined in the Accounting Rulebook (Table B.1). Deforestation has been split into "elective deforestation" and "mandatory deforestation" within the MRV tool so that reporters are not penalised for any mandatory deforestation activities. All emissions and removals from any mandatory deforestation activity will be 100 % discounted for accounting purposes. Where descriptions within these guidelines refer to "deforestation", it can be assumed that the text refers to both elective and mandatory deforestation.

C.1.2. Purpose of the Methodological Guidelines

Greenhouse gas (GHG) emissions represented by the variable "E" in the C Tax formula are calculated in accordance with the methodology set out in the Technical Guidelines for Monitoring, Reporting and Verification of Greenhouse Gas Emissions by Industry (DEA, 2017). The purpose of these guidelines is to provide guidance on the methodology for determining the sequestration or "S" factor in the C Tax formula. The guidelines aim to facilitate the understanding and completion by companies of the MRV tool for reporting, and the verification of the information reported. The guidelines are in line with the Accounting Rulebook that contain the accounting rules for the C Tax Act (Accounting Rulebook, Chapter B of this document).

C.2. Structure of the Methodological Guidelines

The following sections describe the methods for the estimate of emissions/removals from the different sources and sinks contained within the MRV tool and Accounting Rulebook. Firstly, the source is described, then the calculation method is presented followed by a list of the data required for the estimates in the MRV tool. Examples of calculations are shown within the orange boxes. Finally, there are three sections which state the data that is to be reported by the companies, the data that is to be verified and the reference to the Accounting Rulebook for the corresponding source.

C.2.1. Relation to Accounting Rulebook and MRV Tool

These methodological guidelines are complementary to the Accounting Rulebook and the MRV tool.

The corresponding section of the Accounting Rulebook is referred to throughout these methodological guidelines as:

Section [name of section] in the Accounting Rulebook

The MRV tool is a Microsoft Excel file which aims to collect information on emissions and removals from companies that are subject to reporting and/or accounting obligations. The emission/removal estimate methods implemented in the MRV tool are explained in these methodological guidelines. The corresponding sheet in the MRV tool is referred to throughout these methodological guidelines as:

SCHEDULE

Sheet [name of sheet] in the MRV tool

The MRV tool contains various sheets (Table C.1) with different purposes: introduction and instruction, textual data collection, variable/parameters used, emissions/removal estimates, accounting, and verification. Therefore, the MRV tool allows simultaneously for the Reporting, Accounting and Verification of the emission/removal estimates.

Table C.1: Content of the MRV tool: sheets and purpose.

Sheet name and colour	Description
Content and Instructions	This sheet contains information on the MRV tool content and general instructions for its use. It contains the list of sheets in the MRV tool, the colour coding used, an acronym list and a reference list.
Company Details	This sheet contains general organisation details to be filled by the user.
Facility Register	This sheet contains the main plantation details to be filled by the user.
3rd Party Register	This sheet contains the details of the 3rd parties from which the reporting facility has purchased wood. The 3rd Party ID should match the 3rd Party entered in the "Ownership" column in the 'Land Stock-Difference Method'/'Land Gain-Loss Method' tabs.
Parameters	This sheet contains default IPCC 2006 Guidance and country-specific parameters to support the estimates.
BCEF Lookups	This sheet contains factors for expansion of merchantable growing stock volume to standing above-ground biomass ($BCEF_S$), for conversion of net annual volume increment to biomass growth ($BCEF_I$) and for conversion of wood and fuelwood removal volume to above-ground biomass removal ($BCEF_R$).
Supporting Calculations	This sheet provides suggested calculations for generating activity data/emissions/removals estimates to be used in the yellow compilation sheets. Defaults are provided where available, but if alternative data which is more representative for the company circumstances and is justifiable and verifiable is available, this should be used.
Land Stock-Difference method*	This sheet provides emissions/removals estimates due to the change in Carbon Stock in living biomass using the gain-loss method.
Land Gain-Loss method*	This sheet provides emissions/removals estimates due to the change in Carbon Stock in living biomass using the stock-difference method.
HWP	This sheet provides emissions/removals estimates due to HWP.
Wildfires	This sheet provides emission estimates due to wildfires
Controlled burning	This sheet provides emission estimates due to controlled burning.
Fertilisation	This sheet provides emission estimates due to fertilisation
Reporting & Accounting	This sheet provides the summary of estimates for reporting and accounting purposes.
Verification	This sheet provides a list of checks that can be completed for verification purposes.
List	This sheet contains the values for the dropdown lists used in the MRV tool.

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

* *Either the Gain-Loss or Stock-Difference method should be used, not both. The other should be left empty.*

The MRV tool includes instructions to allow its use as a standalone file. However, further explanation on the methods implemented is presented in these Methodological Guidelines. In addition, the MRV tool utilises colour coding for the fields to facilitate its use (Table C.2).

Table C.2: Colour coding used in the MRV tool.

Input data: data required to be included by the user
Emissions/removals: calculated emissions/removals
Calculation/linked cells: cells with formulae, automatically updated. Do not change
Conversion factors & constants
Assumptions/assumed values
Checks

Note on input data: these methodological guidelines include tables to show the data that is required to complete the estimates in the MRV tool. The user has the option to use the Sheet Supporting calculations in the MRV tool to estimate some of the variables needed in other sheets in the MRV tool, these cases are highlighted throughout these guidelines.

Note on the use of different tiers: the estimation methods included in the MRV tool allows for reporting of emissions and removals using different tiers:

- **Tier 1**: using the equations for the estimates as implemented in the MRV tool and default IPCC 2006[17] or country specific values for the required parameters. These factors are included in the Sheet Parameters in the MRV tool and can found in Appendix C.3 and C.4. Tier 1 methods and country-specific parameters have been specially selected for the South African forestry sector.
- **Tier 2**: using the equations for the estimates as implemented in the MRV tool and facility-specific values for several parameters.
- **Tier 3**: when other methods, different from those implemented in the MRV tool are used. The MRV tool allows for the reporting of emissions/removals and the parameters required for verification.

[17] The only exception is the stock change factors for SOC which are taken from IPCC 2019 Refinement.

SCHEDULE

The MRV tool has formulae implemented for Tier 1 and Tier 2 estimates. When applying Tier 2 with facility-specific parameters, justification of the appropriateness of those parameters must be provided. In the case of Tier 3, less input data is needed in the MRV tool since Tier 3 estimates are only reported, not calculated, using the MRV tool. When applying Tier 3, a description of the methods used, and justification of their appropriateness must be provided as part of the annual reporting. In addition, inputs required for verification must also be provided.

Each of the columns in the MRV tool tables where data must be reported have the structure shown in Table C.3, showing the variable, instructions and tier.

Table C.3: Structure of the columns in reporting tables in the MRV tool.

e.g.: Forest ID	1st row (title row): Name of the variable
e.g.: INFORMATION ROW (do not delete)	2nd row: instructions to fill in the column
e.g.: INFORMATION ROW - TIERS (do not delete)	3rd row: Tier for which the column is to be filled

Implementation of Tiers in the MRV Tool

The MRV tool implements Tier 1 and provides default values, sourced from both IPCC 2006 and country specific values, sourced from various publications.

Companies can use their own parameters where information is available and is justified with supporting documentation.

Complete the Methodology Information Boxes included at the top of each of the yellow compilation sheets to provide a description of which tier, or combination of tiers has been applied.

Tier used for carbon stock change:	Methodology Information Box
T1	
T2	

SCHEDULE

C.3. Methodological Guidelines for Reporting and Accounting Carbon Sequestration in Forest Plantations

It should be noted that increases in carbon stocks, i.e. positive (+) stock changes, represent a removal (or 'negative' emission) from the atmosphere, while decreases in carbon stocks, i.e. negative (-) stock changes, represent a positive emission to the atmosphere.

Forest plantations represent three different carbon pools, i.e. living biomass, dead organic matter (DOM, that includes dead wood and litter) and soil organic carbon (SOC). Management practices (e.g. thinning and harvesting, application of fertiliser and controlled burning) and natural disturbances (e.g. wildfires) results in CO_2 removals enhancement and GHG emissions. Table B.1 in Chapter B of this document indicates which pools or emission sources are mandatory for reporting or accounting.

C.3.1. Area tracking for the reporting of Annual Change in Plantation Carbon Stocks, ΔC

As determined in the Accounting Rulebook, and in line with IPCC 2006, the afforestation areas shall include all forest for the first 20 years. After 20-years, these areas shall transition to the managed forest land category. The variable/column "age category" in the tables in the MRV tool allows for the tracking of areas:

- Afforestation: "age category" indicates the number of years since the afforestation occurred. This cannot be 0, it should be 1 in the year of the afforestation and up to 20 years (≤ 20 years), because starting the year 21st the land will be subject to forest management (see Box C.1 for example). The age information is considered in the estimates of carbon stock change in DOM and SOC. The first year the land is afforested (age category = 1), previous land use can be Grassland, Annual Cropland, Perennial cropland or Other. The following years, the previous land use should be Afforestation.
- Forest management: "age category" indicates the number of years of the rotation. This should be ≥ 21 years for the first rotation and can be any value for the following rotations.
- Deforestation: "age category" indicates the age of the managed forest land deforested or the age of the afforested land deforested. The age information in the deforested lands is considered in the estimates of carbon stock change in DOM. Taxpayers should have a system for distinguishing between deforestation and temporary unplanted (TUP) land.

SCHEDULE

Box C. 1: Reporting of Afforested areas

In the forest AX32, 2 ha of grassland are afforested with *Pinus patula* in 2020, 4 ha in 2021 and 3 ha in 2022. The reported data in the reporting year 2022 should be:

Forest ID	Activity	Previous land use category	Species/Genus	Age Category	Area (ha)
AX32	Afforestation	Grassland	*Pinus patula*	1	3
AX32	Afforestation	Afforestation	*Pinus patula*	2	4
AX32	Afforestation	Afforestation	*Pinus patula*	3	2

C.3.2. Annual Change in Plantation Carbon Stocks, ΔC

There are two main methods for GHG estimates in the LULUCF sector as presented in 2006 IPCC Guidelines (IPCC, 2006):

- The Gain-Loss Method estimates the net balance based on the estimation of gains and losses separately for each individual reported year.
- The Stock-Difference Method is based on carbon stocks in relevant pools measured at two points in time to assess carbon stock changes.

In the MRV tool, both methods have been implemented for the estimates of carbon stock change in living biomass. However, the gain-loss method for DOM and SOC pools requires models that simulate DOM and SOC dynamics and these are not implemented in the MRV tool. Therefore, the estimates of DOM and SOC carbon stock change in the Sheet Land Gain-loss method in the MRV tool applies stock-difference method so that all carbon stock changes in all pools can be estimated in one single sheet of the MRV tool, regardless the method used for living biomass.

For transparency, the estimation method for DOM and SOC are explained in different sections of these methodological guidelines (see Sections C.3.2.3 and C.3.2.4 below).

C.3.2.1. Living biomass pool: Gain-loss method

Sheet Land Gain-Loss Method in the MRV tool

The gain loss method, as presented in the 2006 IPCC guidelines, requires the biomass carbon loss to be subtracted from the biomass carbon gain[18].

[18] For further explanation of the gain-loss method, refer to Volume 4, Chapter 2 of 2006 IPCC Guidelines.

SCHEDULE

Calculation method in the MRV tool

The calculations for emissions/removals from the change in carbon stock in living biomass are based on the IPCC 2006 Tier 1 Biomass Gain-Loss Method (Equation 2.7 in IPCC 2006 volume 4, chapters 2 and 4). Emissions/removals are calculated based on the following equations:

$$\Delta C_B = \Delta C_G - \Delta C_L \qquad \textit{Equation C.1}$$

Where:

- ΔC_B = annual change in carbon stocks in biomass (the sum of above-ground and below-ground biomass) for each land sub-category, considering the total area, t C yr^{-1}
- ΔC_G = annual increase in carbon stocks due to biomass growth for each land sub-category, considering the total area, t C yr^{-1}
- ΔC_L = annual decrease in carbon stocks due to biomass loss for each land sub-category, considering the total area, t C yr^{-1}

Annual increase in biomass carbon stocks due to biomass increment in land remaining in the same land-use category are calculated based on the following equation (Equation 2.9 in IPCC 2006 volume 4, chapter 2) with examples provided in Box C.2 and C.3:

$$\Delta C_G = \sum_{i,j}(A_{i,j} \times G_{TOTAL_{i,j}} \times CF_{i,j}) \qquad \textit{Equation C.2}$$

Where:

- ΔC_G = annual increase in biomass carbon stocks due to biomass growth in land remaining in the same land-use category by vegetation type and climatic zone, t C yr^{-1}
- A = area of land remaining in the same land-use category or in conversion, ha
- G_{TOTAL}= mean annual biomass growth, t d.m. ha^{-1} yr^{-1}
- *i* = ecological zone (*i* = 1 to *n*)
- *j* = climate domain (*j* = 1 to *m)*
- CF = carbon fraction of dry matter, t C (t d.m.)$^{-1}$

Average annual increment in biomass is calculated based on the following equation (Equation 2.10 in IPCC 2006 Volume 4, Chapter 2):

Tier 1: $$\mathrm{G_{TOTAL}} = \Sigma\{\mathrm{G_W} \times (1 + \mathrm{R})\}$$

Biomass increment data (dry matter) are used directly.

Tiers 2 and 3: $$\mathrm{G_{TOTAL}} = \Sigma\{\mathrm{I_V} \times \mathrm{BCEF_I} \times (1 + \mathrm{R})\} \qquad \textit{Equation C.3}$$

SCHEDULE

Net annual increment data are used to estimate G_w by applying a biomass conversion and expansion factor.

Where:

- G_{TOTAL} = average annual biomass growth above and below-ground, t d.m. ha^{-1} yr^{-1}
- G_W = average annual above-ground biomass growth for a specific woody vegetation type, t d.m. ha^{-1} yr^{-1}
- R = ratio of below-ground biomass to above-ground biomass for a specific vegetation type, in t d.m. below-ground biomass (t dm above-ground biomass)$^{-1}$. R must be set to zero if assuming no changes of below-ground biomass allocation patterns (Tier 1)
- I_V = average net annual increment for specific vegetation type, m^3 ha^{-1} yr^{-1}. This is the current annual increment of standing volume, i.e. the actual increment in volume, referred as CAI

Note: Mean Annual Increment (MAI), i.e. the mean increment over the entire lifetime of the plantation, is not an adequate substitute of Current Annual Increment (CAI), as MAI only represents the net cumulated volume or biomass at the end of the rotation. The use of MAI generally leads to underestimation of the annual increment in the early ages of the plantations. However, if MAI is the only data available, it can be used, while transparent information is provided on it.

Note that if standing tons are stated as wet white tonnes (wwt), i.e. at field wet basis moisture level, then the values need to be converted from wwt to m^3. For this conversion, Standard Industry Conversion Factors (ICFs) for round wood can be used (Table C.4).

Table C.4: Standard Industry Conversion Factors (ICF) for Round wood.

Product	Species	ICF	Unit
Sawlogs	Softwood	0.94	m^3/t (wet)
Sawlogs	Eucalyptus Grandis	0.94	m^3/t (wet)
Sawlogs	Other Eucalyptus Species	0.78	m^3/t (wet)
Matchwood	Poplar	1.03	m^3/t (wet)

- $BCEF_i$ = biomass conversion and expansion factor for conversion of net annual increment in volume (including bark) to above-ground biomass growth for specific vegetation type, tonnes above-ground biomass growth (m^3 net annual increment)$^{-1}$.
- If $BCEF_i$ values are not available and if the biomass expansion factor (BEF) and basic wood density (D) values are separately estimated, then the following conversion can be used:

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

$$BCEF_i = BEF_i \times D$$

Where, Biomass Expansion Factors (BEF_i) expand merchantable volume to total above-ground biomass volume to account for non-merchantable components of increment. BEF_i is dimensionless.

To convert wood harvest data without bark, i.e. under bark, into merchantable wood removals including bark, i.e. over bark, multiply by the bark factor. Default and country-specific bark factors are included in the Sheet Parameters in the MRV tool and can be found in Appendix C.4. If the wood harvest data is already over bark, the bark fraction should be 0.

Box C.2: Information for the example for C stock change in biomass using Gain-Loss method in Box C.3.

For a forest area of 10 ha in temperate zone, it is assumed the forest species have a rotation age of 32 years and is thinned twice at 12 and 22 years (Table C.4). To calculate gains and losses, current annual increment (CAI) and losses (harvest) data are needed.

All volumes are expressed as over bark.

Table C.5: Hypothetical stand characteristics of Pinus patula showing volume data (merchantable over bark volume).

Stand age (years)	Volume m^3/ha			Increment m^3/ha/year	
	Thinning	Standing vol	Cumulative Vol	MAI	CAI
0.001			0.0001		0.001
7		82.0	82.0	11.7	11.7
12	123.0	95.0	218.0	18.2	27.2
17		265.0	388.0	22.8	34.0
22	120	428.0	548.0	24.9	32.0
27		580.0	703.0	26.0	31.0
32		714.0	837.0	26.2	26.8

SCHEDULE

Box C. 3: Annual increase in biomass carbon stocks due to biomass increment in land remaining in the same land-use category

Sheet Land Gain-Loss method in the MRV tool; column Living Biomass GAIN. Sheet Supporting calculations

It is possible to model CAI using a Chapmans growth function or another function as suggested by forest expert, using the information provided in Table C.6. CAI is the recommended increment value to use because it reflects the actual annual increment rate for volume. MAI (derived as the cumulative volume over stand age) is not suitable for growth projections. MAI is generally only used for stand management decision such as determining theoretical stand rotation age (i.e. where CAI and MAI intersect, see Figure C.1).

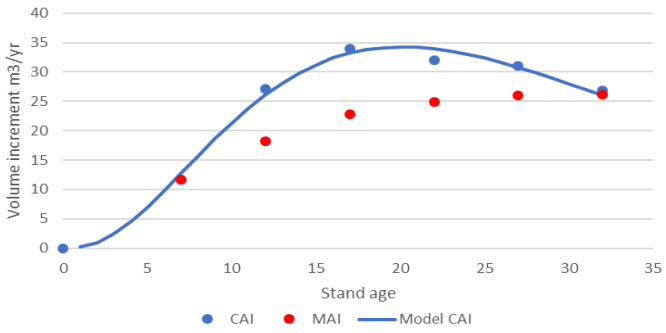


Figure C.1: Derived CAI and MAI from cumulative volume production data and the interpolated CAI using the Chapmans growth function (blue line).

The danger of using MAI is that volume increment and thus biomass growth will be underestimated and hence a lower carbon stock change will be calculated, until age 32 in Figure C.1.

Considering the example forest in Box C.2, in year 17 the CAI, BCEFi and R are:

CAI = 34.0 m^3 ha^{-1} yr^{-1}

$BCEF_I$ = 0.69 t m^{-3} (IPCC 2006, Volume 4, Chapter 4, Table 4.5, climatic zone temperate, forest type pine and growing stock level 265 m^3 ha^{-1}, i.e > 200 m^3 ha^{-1})

R = 0.28 (Du Toit B. et al. 2016).

CF = 0.47 (IPCC 2006).

Average annual increment (G_{Total}) is calculated as:

GTOTAL= 34.0 x 0.69 x (1+0.28) = 30.02 t d.m. ha-1 yr-1 (Note that if MAI is used, this would be: GTOTAL= 22.8 x 0.240 = 20.24 t d.m. ha-1 yr-1)

In the MRV tool, the Factor for conversion to C biomass growth 0.69 x (1+0.28) x 0.45 = 0.40 (can be calculated in **Sheet Supporting calculations**); and the total Gain in living biomass (t C) is calculated in **Sheet Land Gain-Loss Method** as:

Living Biomass GAIN (ABG+BGB, t C) = 34 m3 ha-1 x 0.42 t C m-3 x 10ha = **141.14 t C**

SCHEDULE

Annual biomass loss is the sum of losses from wood removal (harvest), fuelwood removal (not counting fuelwood gathered from woody debris), and other losses resulting from disturbances, such as fire, storms, and insect and diseases.

$$\Delta C_L = L_{wood-removed}$$ ***Equation C.4***

Where:

- ΔC_L = annual decrease in carbon stocks due to biomass loss in land remaining in the same land-use category, t C yr^{-1}
- $L_{wood\text{-}removed}$ = annual carbon loss due to wood removals, t C yr^{-1}, includes harvest, regardless its use as fuelwood, and tree parts removals for fuelwood.

And annual biomass carbon loss due to wood-removals is:

$$L_{wood-removed} = H \times BCEF_R \times (1 + R) \times CF + FG_{part} \times D$$ ***Equation C.5***

Where:

- $L_{wood\text{-}removed}$ = annual carbon loss due to biomass removals, t C ha^{-1} yr^{-1}
- H = annual wood removals, roundwood, m^3 yr^{-1}
- R = ratio of below-ground biomass to above-ground biomass, in t d.m. below-ground biomass (t d.m. above-ground biomass)$^{-1}$. R must be set to zero if assuming no changes of below-ground biomass allocation patterns (Tier 1)
- $BCEF_R$ = biomass conversion and expansion factor for conversion of removals in merchantable volume to total biomass removals (including bark), t biomass removal (m^3 of removals)$^{-1}$. However, if $BCEF_R$ values are not available and if the biomass expansion factor for wood removals (BEF_R) and basic wood density (D) values are separately estimated, then the following conversion can be used:

  $$BCEF_R = BEF_R \times D$$

  To convert wood harvest data without bark into merchantable wood removals including bark, multiply by bark factor. Default IPCC 2006 bark factors and country-specific bark factors are provided. These factors are included in the Sheet Parameters in the MRV tool and can found in the Appendix. If volume is already over bark, then bark fraction should be 0.
- CF = carbon fraction of dry matter, t C (t d.m.)$^{-1}$
- FG_{part} = annual volume of fuelwood removal as tree parts (where trees are not felled), m^3 yr^{-1}. Assumed 0 in Tier 1.

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

- D = basic wood density, t d.m. m^{-3}

Data required for the estimates in the MRV tool

Box C.4: Annual decrease in Carbon stocks due to Wood removals in land remaining in the same land-use category.

Sheet Land Gain-Loss method in the MRV tool; column ΔC Living Biomass.

Sheet Supporting Calculations

This example uses BEF and Wood density (D), instead of BCEF used in Box C.3.

Harvest volume – whole tree (m^3 yr^{-1}) = 500 m^3 yr^{-1} harvest. There is not fuelwood exploitation of tree parts, i.e. FG_{part} = 0.

BEF_R = 3.1 m^3 t^{-1}

Bark fraction = 0.13 (default)

Wood density = 0.354 t m^{-3} (*Pinus patula* Du Toit B. et al. (2016))

R = 0.28 (Du Toit B. et al. 2016)

CF = 0.47 (IPCC 2006)

Then, $L_{wood\text{-}removed}$ = 500 m^3 x 3.1 x (1 + 0.13) x 0.354 t m^{-3} x (1 + 0.28) x 0.47 = 373.01 t C

In the MRV tool, the Factor for conversion to C biomass loss 3.1 x (1 + 0.13) x 0.354 t m^{-3} x (1 + 0.28) x 0.47 = 0.75 (can be calculated in **Sheet Supporting Calculations**); and the total Living Biomass LOSS (ABG+BGB, t C) is calculated in **Sheet Land Gain-Loss Method** as:

Living Biomass LOSS (ABG+BGB, t C) = 500 m^3 yr^{-1}x 0.75 = 373.01 t C

Continuing with the example forest from previous boxes: Therefore, the annual change in carbon stocks in biomass in the 10 ha is:

$\Delta C_B = \Delta G_G - \Delta G_L$ = 141.14 – 373.01 = **- 231.9 t C**

This method requires activity data (e.g. area) and forest parameters (e.g. increment, harvest) at either the aggregated (e.g. plantation management units) or disaggregated (e.g. compartment) scale of the land (Table C.6).

Data needs to be disaggregated by the activity, i.e. Forest management.

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

Table C.6: Data required for estimating ΔC living biomass (gain-loss method).

Forest ID	Enter the unique forest ID
Activity	Forest Management, Afforestation Elective Deforestation or Mandatory Deforestation
Previous land use category	Forest Management, Afforestation, Elective Deforestation, Mandatory Deforestation, Grassland, Annual Cropland, Perennial Cropland or Other
Ownership	Company owned or 3rd party (please specify)
Species/Genus	Predominant species name
Age Category	Enter value, for afforested areas this should be the years since afforestation occurred
Area	Enter value in ha
Growing stock volume annual net increment	CAI or MAI* (optional for T3)
Factor for conversion to C biomass growth	Enter value or refer to **Sheet Supporting Calculations** (optional for T3)
Harvest volume, whole tree	Enter value in m^3/yr
Factor for conversion to C biomass loss	Enter value or refer to **Sheet Supporting Calculations** (optional for T3)
Living Biomass LOSS - Fuelwood Tree parts	Enter value in t C, assumed 0 in Tier 1 approach

** CAI = current annual increment, MAI = mean annual increment*

C.3.2.2. Living biomass pool: Stock-difference method

Sheet Land Stock-Difference Method in the MRV tool

The Stock-Difference method, as presented in the 2006 IPCC guidelines, requires biomass carbon stock inventories for a given land area, at two points in time[19]. Per unit of area at time t_2, the annual stock change is the difference between the carbon stock at time t_2 and time t_1, divided by the number of years between the two inventories[20].

[19] For further guidance on the stock-difference method, refer to Volume 4, Chapter 2 of 2006 IPCC Guidelines. https://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html

[20] For further guidance on the stock-difference method, refer to Chapter 2 of 2013 IPCC KP Supplement. https://www.ipcc-nggip.iges.or.jp/public/kpsg/index.html

SCHEDULE

Calculation in the MRV tool

The calculations for emissions/removals from the change in carbon stock in living biomass are based on the IPCC 2006 Tier 1 Biomass Stock-Difference Method (IPCC 2006 volume 4, chapters 2 and 4). Emissions/removals are calculated based on the following equations (Equation 2.8 in IPCC 2006 volume 4, chapters 2):

$$\Delta C_B = \frac{(C_{t_2} - C_{t1})}{(t_2 - t_1)}$$

$$C = \sum_{i,j} \{A_{i,j} \times V_{i.j} \times BCEF_{S_{i,j}} \times (1 + R_{i,j}) \times CF_{i,j}\} \quad \textit{Equation C.6}$$

Where:

- ΔC_B = annual change in carbon stocks in biomass (the sum of above-ground and below-ground biomass terms) in land remaining in the same category (e.g. *forest land remaining* forest land), tonnes C yr^{-1}
- Ct_2 = total carbon in biomass for each land sub-category at time t_2, t C
- Ct_1 = total carbon in biomass for each land sub-category at time t_1, t C
- C = total carbon in biomass for t_1 to t_2, t C
- A = area of land remaining in the same land-use category, ha
- V = merchantable growing stock volume (over bark), m^3 ha^{-1}
- i = ecological zone i (*i*=1 to n)
- j = climate domain j (*j*=1 to m)
- R = ratio of below-ground biomass to above-ground biomass, t dm below-ground biomass (t d.m. above ground biomass)$^{-1}$
- CF = carbon fraction of dry matter, tonne C (t d.m.)$^{-1}$
- $BCEF_S$ = biomass conversion and expansion factor for expansion factor for expansion of merchantable growing stock volume to above-ground biomass, t above-ground biomass (m^3 growing stock volume)$^{-1}$

As indicated in 2013 Kyoto Protocol (KP) Supplement, when using this method for a specific activity, it is important to ensure that the area of land in that activity at times t_1 and t_2 is identical, to avoid confounding changes in stock caused by area changes. Box C.6 shows the correct and incorrect way to implement the stock-change method.

SCHEDULE

At a company level the forest area may change due to the sale or purchasing of land, i.e. the reported area in time t_1 will not match the area reported in the previous year. The issue is of particular concern when areas outside the scheme enter the reporting system. In these situations, the current year area must be applied (see Box C.7).

It is good practice to implement the calculations of annual carbon stock changes in the following sequence: (1) for any carbon pool of each activity and for each area, the annual carbon stock change should be calculated for the year of interest on the area at time t_2, (2) these stock changes should be summed for all areas subject to the activity. Annual carbon stock changes and non-CO_2 GHG emissions with the area of the activity at the end of the inventory year should be calculated. The same approach should be used consistently over time. When land-use change events occur, the associated fluxes are reported in the new land-use category (e.g. afforestation or deforestation/conversion from forest plantation to non-forest lands).

Box C.5. Example of Stock-difference calculation

Sheet Land Stock-Different method in the MRV tool; column ΔC ABG+BGB in the year i

Sheet Supporting Calculations

There is 10 ha of *Pinas patula* that has been under forest management for 10 years.

Total standing volume in previous year (year t_i^{-1}) in vol merch. m^3 over bark = 425 m^3

Total standing volume in current year (year t_i) in vol merch. m^3 over bark = 500 m^3

If volume is expressed as under bark then the bark fraction needs to be added.

Wood density = 0.354 t m^{-3} (*Pinus patula* Du Toit B. et al. (2016))

BEF for CAI = 0.6861 m^3 ha^{-1} yr^{-1}

R = 0.28 (default)

Bark fraction = 0.13 (default)

CF = 0.47 (IPCC 2006)

In the MRV tool, the Factor for conversion to standing C stock 0.6861 x 0.354 t m^{-3} x (1 + 0.13) x (1 + 0.28) x 0.47 = 0.17 (can be calculated in tab Supporting calculations).

Therefore, the Standing C stock in year t_i^{-1} = 425 m^3 x 0.17 = 72.3 t C;

the Standing C stock in year t_i = 500 m^3 x 0.17 = 85.0 t C

$\Delta C_{AGB+BGB}$ = 85.0 – 72.3 = **12.7 t C**

SCHEDULE

Box C.6: Example of Stock-difference calculation. Source KP Supplement

During a year of the CP the area of land reported under FM varies because new forest land (natural forest expansion or previously unmanaged forest land that becomes subject to management) is added to the FM area and because of deforestation activities:

	At the start of year	At the end of year
Area of forest lands that was subject to FM in the previous year	1,000,000 ha	990,000 ha
Area of lands subject to FM converted to non-forest land	0 ha	10,000 ha
Area of **new** forest lands subject to FM	0 ha	10,000 ha
Total area subject to FM	1,000,000 ha	1,000,000 ha

The carbon stocks measured at times t_1 and t_2 in those lands are:

	At the start of year	At the end of year
Average per hectare biomass carbon stock of forest lands subject to FM	100 tC ha^{-1}	105 tC ha^{-1}
Average per hectare biomass carbon stock of **new** forest lands subject to FM	80 tC ha^{-1}	84 tC ha^{-1}
Average per hectare biomass carbon stock in deforested lands	100 tC ha^{-1}	20 tC ha^{-1}

A correct procedure will calculate stock changes in the three land categories:
- managed forest lands that were subject to FM since the beginning of the year,
- forest lands where the FM activity started during the year,
- managed forest lands subject to FM that were deforested and converted to cropland in the year.

Then, the sum of stock changes calculated for the two types of lands subject to FM will be reported under the FM activity, while the change in stock calculated for deforested land will be reported under D (Article 3.3).

A. Total stock-change in area subject to FM that was subject to FM in the previous year	990,000 ha * (105 – 100) tC ha^{-1} = 4,950,000 tC
B. Total stock-change in area subject to FM for the first time in this year	10,000 ha * (84 – 80) tC ha^{-1} = 40,000 tC
C. Total stock-change in deforested areas	10,000 ha * (20 – 100) tC ha^{-1} = -800,000 tC
Total stock-change in FM areas (A+B)	4,950,000 + 40,000 = 4,990,000 tC
Stock change reported in Forest Land converted to Cropland under UNFCCC and in D under Article 3.3 (C)	-800,000 t C

It would be incorrect, for instance, to calculate the total aboveground biomass carbon stock on the total land subject to FM at times t_1 and t_2 and then subtract C_1 from C_2 e.g.:

C_1 Total stock in land subject to FM at the start of year	1,000,000 ha * 100 tC ha^{-1} = 100,000,000 tC
C_2 Total stock in land subject to FM at the end of year	990,000 ha * 105 tC ha^{-1} + 10,000 ha * 84 tC ha^{-1} = 103,950,000 + 840,000 = 104,790,000 tC
C_2 - C_1 – yields the **incorrect** result	104,790,000 – 100,000,000 = 4,790,000 tC

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

Box C.7. Example of Stock-difference calculation with area adjustment

Sheet Land Stock-Different method in the MRV tool; column ΔC ABG+BGB in the year i

Sheet Supporting Calculations

There is 10 ha of Hardwoods/Eucalyptus that has been under forest management for 10 years. In the last year, 1 ha has been sold, leaving 9 ha.

The average per hectare standing volume in the previous year (year t_{i-1}) in vol merch. m³ over bark = 40 m^3/ha

The average per hectare standing volume in the current year (year t_i) in vol merch. m³ over bark = 45 m^3/ha

In order to calculate the total standing volume for the previous and current year, the current area must be used. Therefore, the total standing volume in the:

- previous year (year t_{i-1}) in vol merch. m³ over bark = 9 x 40 = 360 m^3
- current year (year t_i) in vol merch. m³ over bark = 9 x 45 = 405 m^3

If volume is expressed as under bark then the bark fraction needs to be added.

Wood density = 0.517 t m^{-3} (average for Eucalyptus Du Toit B. et al. (2016))

BEF for CAI = 0.7 m^3 ha^{-1} yr^{-1}

R = 0.24 (default)

Bark fraction = 0.13 (default)

CF = 0.47 (IPCC 2006)

In the MRV tool, the Factor for conversion to standing C stock 0.7 x 0.517 t m^{-3} x (1 + 0.13) x (1 + 0.24) x 0.47 = 0.24 (can be calculated in tab Supporting calculations).

Therefore, the Standing C stock in year t_{i-1} = 360 m^3 x 0.24 = 86.48 t C;

the Standing C stock in year t_i = 405 m^3 x 0.24 = 97.2 t C

$\Delta C_{AGB+BGB}$ = 97.2 – 86.4 = **10.8 t C**

SCHEDULE

Data required for the estimates in the MRV tool

This method requires activity data (i.e. area) and forest parameters (i.e. standing volume) at very disaggregated level, e.g. for each forest compartment of the land under administration by the entity for previous and current year subject to reporting.

Data is needed for the two calendar years, i.e. end of two years, subject to reporting.

Forest compartment would be identified in MRV tool as of records from forest management planning.

As indicated in Table C.6 above and Table C.7 below, the user has the option to use the calculations in the **Sheet Supporting Calculations in the MRV Tool** to estimate some of the data required for the estimates. At least Species and Growing stock volume level data are required.

Parameters needed for the estimate of carbon stock change in living biomass are outlined in Table C.7. Defaults are provided where available, but if alternative data which is considered more representative and is justifiable and verifiable is available, this should be used. The default parameters are included in the **Sheet Parameters in the MRV tool** and can found in Appendix C.3.

Table C.7: Data required for estimating ΔC ABG + BGB (stock-difference method).

Forest ID	Enter the unique forest ID
Activity	Forest Management, Afforestation, Elective Deforestation or Mandatory Deforestation
Previous land use category	Forest Management, Afforestation, Elective Deforestation, Mandatory Deforestation, Grassland, Annual Cropland, Perennial Cropland or Other
Ownership	Company owned or 3rd party (please specify)
Species/Genus	Predominant species name
Age Category	Enter value, for afforested areas this should be the years since afforestation occurred
Harvest volume, whole tree	Enter value in m^3/yr
Area in the previous year t_{i-1}	Enter value in ha
Area in the current year t_i	Enter value in ha
Average standing volume in previous year, year t_i^{-1} (vol merch. m^3/ha)	Enter value in merchantable volume m^3/ha, 0 = default for afforested land in age category 1 (optional for T3)
Average standing volume in current year, (year t_i (vol merch. m^3/ha)	Enter value in merchantable volumem^3/ha, 0 = default for deforestation (optional for T3)
Factor for conversion to standing C stock in the previous year t_i^{-1}	Use **Sheet Supporting Calculations** if value is not known (species and growing stock volume must be entered) (optional for T3)

SCHEDULE

Factor for conversion to standing C stock in the current year t_i	Use **Sheet Supporting Calculations** if value is not known (species and growing stock volume must be entered) (optional for T3)

C.3.2.3. Dead organic Matter, ΔDOM

In line with the Accounting Rulebook, for the estimates of carbon stock change in Dead Organic matter pool (Dead wood and litter) the following has been assumed:

a) There is no change in DOM pool on forest plantations where there is a continuous forest management as forest plantation (> 20 years as forest), therefore carbon stock change in DOM is only estimated in the case of Afforestation and Deforestation activities.

b) If deforestation occurs litter and deadwood C pools are assumed to be immediately / instantaneously oxidised, therefore carbon stock change in DOM is estimated and reported in the year when the Deforestation occurs (Box C.8). If afforested land is deforested before 20-years then only the amount of DOM accumulated over the afforestation period is oxidised (Box C.9).

c) If afforestation occurs, afforested areas accumulate DOM for the first 20 years of the established 1st rotation. After 20-years or the rotation, DOM reaches an equilibrium value specific to continuous forest plantations.

d) Because plantations are under very intensive management and there is no Dead Wood present only carbon stock in Litter is considered.

Calculation method in the MRV tool

Since it is assumed that the carbon stock in DOM pool only changes in the case of Afforestation or Deforestation activities, the IPCC 2006 method for Land conversions is used.

Two methods can be used: either track inputs and outputs (the Gain-Loss Method) or estimate the difference in DOM pools at two points in time (Stock-Difference Method). These estimates require either detailed inventories that include repeated measurements of dead wood and litter pools, or models that simulate dead wood and litter dynamics (IPCC, 2006, volume 4 chapter 2).

The MRV tool allows for the estimates using the stock-difference. The Tier 1 assumption is that DOM pools in non-forest land categories after the conversion are zero, i.e., they contain no litter or dead wood. The Tier 1 assumption for land converted from forest to another land-use category is that all DOM carbon losses occur in the year of land-use conversion. Conversely, conversion to Forest Land results in build-up of litter and dead wood carbon pools starting from zero carbon in those pools. DOM carbon gains on land converted to forest occur linearly, starting from zero, over a transition period (IPCC, 2006, volume 4 chapter 2).

Equation C.7 is the stock-difference method applied in the MRV tool and examples are provided in Boxes 8 - 10:

SCHEDULE

$$\Delta C_{DOM} = \frac{(C_n - C_o) \times A_{on}}{T_{on}}$$ ***Equation C.7***

Where:

- ΔC_{DOM} = annual change in carbon stocks in dead wood or litter, t C yr^{-1}
- C_o = dead wood/litter stock, under the old land-use category, t C ha^{-1}
- C_n = dead wood/litter stock, under the new land-use category, t C ha^{-1}, for forest land the default stock is 20 t C ha^{-1} at 20 years
- A_{on} = area undergoing conversion from old to new land-use category, ha
- T_{on} = time period of the transition from old to new land-use category, yr. The Tier 1 default is 20 years for carbon stock increases and 1 year for carbon losses.

Data required for the estimates in the MRV tool

Table C.8: Data required for estimating ΔC Dead Organic Matter (DOM).

Forest ID	Enter the unique forest ID
Activity	Forest Management, Afforestation, Elective Deforestation or Mandatory Deforestation
Previous land use category	Forest Management, Afforestation, Elective Deforestation, Mandatory Deforestation, Grassland, Annual Cropland, Perennial Cropland or Other
Ownership	Company owned or 3rd party (please specify)
Age Category	Enter value, for afforested areas this should be the years since afforestation occurred
Area in the current year t_i	Enter value in ha
DOM	DOM in t C/ha, use of **Sheet Supporting Calculations** is possible if value is not known. Note that the calculated ΔC DOM should be positive (+) in the case of Forest Management and Afforestation; and negative (-) in the case of Deforestation
DOM in previous land use	DOM in non-forest use t C/ha, the default value is 0. This field is optional.

SCHEDULE

As a minimum, forest type needs to be known for the use of **Sheet Supporting Calculations in the MRV Tool**. Default values of DOM by forest types are sourced from IPCC 2006 Guidelines, these factors are included in the **Sheet Parameters in the MRV tool** and can found in Appendix C.4.

Box C.8. Annual change in Carbon stocks in DOM due to land use conversion: Afforestation

Sheet Land Gain-Loss method in the MRV tool; column ΔC DOM

Sheet Supporting Calculations

The default method applied in the MRV tool uses a steady state stock of C in DOM at 20 years.

The stock change for 10 ha of afforested areas of *Pinus patula* in climatic zone warm temperate for the first 20 years is:

C in DOM (equilibrium value for specific continuous forest plantation): 20.3 t C ha^{-1} (for Needleleaf evergreen, IPCC 2006, volume 4, chapter 2, Table 2.2, Climate: Warm temperate)

C in DOM in non-forest land: 0 t C ha^{-1} (IPCC 2006 Tier 1 assumption)

Then, ΔC_{DOM}= (20.3 t C ha^{-1} - 0 t C ha^{-1}) x 10 ha/20 years = **10.15 t C vr^{-1}**

SCHEDULE

Box C.9. Annual change in Carbon stocks in DOM due to land use conversion: Elective Deforestation of previous Forest management

Sheet Land Gain-Loss method in the MRV tool; column ΔC DOM

Sheet Supporting Calculations

For deforestation, all DOM is assumed to be immediately oxidised. The stock change for 10 ha of elective deforested area of *Pinus patula* in climatic zone warm temperate is:

C in DOM (equilibrium value for specific continuous forest plantation): 20.3 t C ha^{-1} (for Needle leaf evergreen, IPCC 2006, volume 4, chapter 2, Table 2.2, Climate: Warm temperate)

C in DOM in non-forest land: 0 t C ha^{-1} (IPCC 2006 Tier 1 assumption)

Then, ΔC_{DOM}= (0 t C ha^{-1} - 20.3 t C ha^{-1}) x 10 = **- 203 t C yr^{-1}** to be reported only in the event year

Box C.10. Annual change in Carbon stocks in DOM due to land use conversion: from Afforestation to Elective Deforestation

Sheet Land Stock-Difference method in the MRV tool; column ΔC DOM

Sheet Supporting Calculations

If 10 ha of *Pinus patula* in climatic zone warm temperate in afforested lands are electively deforested before reaching 10 years after establishment of the 1st rotation (e.g. at 3 years) then the DOM stock change is:

C in DOM (equilibrium value for specific continuous forest plantation): 20.3 t C ha^{-1} (for Needle leaf evergreen, IPCC 2006, volume 4, chapter 2, Table 2.2, Climate: Warm temperate)

C in DOM in non-forest land: 0 t C ha^{-1} (IPCC 2006 Tier 1 assumption)

ΔC_{DOM}= ((0 t C ha^{-1} - 20.03 t C ha^{-1})/20 years) x 3 years x 10 ha = **- 30.45 t C yr^{-1}**

SCHEDULE

C.3.2.4. Soil Organic Carbon, ΔSOC

In line with the Accounting Rulebook, for the estimates of carbon stock change in DOM pool (dead wood and litter) the following has been assumed:

a) There is no change in SOC pool in Forest management, therefore carbon stock change in SOC is only estimated in the case of Afforestation and Deforestation.

b) SOC stock changes associated with Deforestation generally occurs for a period after deforested. However, SOC emissions or removals shall not be reported or accounted because other land uses are not included in the 2019 Carbon Tax Act.

c) Therefore, carbon stock change in SOC is only reported when Afforestation occurs and for Forest Management, if Tier 2 or Tier 3 methodologies are applied.

d) If afforestation occurs, the default Tier 1 assumption is that afforested areas accumulate SOC for the first 20 years. After 20-years of the rotation, SOC reaches an equilibrium value.

Calculation method in the MRV tool

Since it is assumed that the carbon stock in the SOC pool only changes in the case of Afforestation or Deforestation activities, the IPCC 2006 method for Land conversions is used.

$$\Delta C_{Mineral} = \frac{(SOC_0 - SOC_{(0-t)})}{D}$$

$$SOC = \sum_{c.i.j} (SOC_{REF_{c,s,j}} \times F_{LU_{c,s,j}} \times F_{MG_{c,s,j}} \times F_{I_{c,s,j}}) \qquad \textit{Equation C.8}$$

Note: T is used in place of D in this equation if T is ≥ 20 years

Where:

- $\Delta C_{Mineral}$ = annual change in carbon stocks in mineral soils, t C yr^{-1}
- SOC_0 = soil organic carbon stock in the last year of an inventory time period, t C
- $SOC_{(0-t)}$ = soil organic carbon stock at the beginning of the inventory time period, t C
- SOC_0 and $SOC_{(0-T)}$ are calculated using the SOC equation in the box where the reference carbon stocks and stock change factors are assigned according to the land-use and management activities and corresponding areas at each of the points in time (time = 0 and time = 0-T)
- T = number of years over a single inventory time period, yr
- D = Time dependence of stock change factors which is the default time period for transition between equilibrium SOC values, yr. Commonly 20 years, but depends on assumptions made in computing the factors F_{LU}, F_{MG} and F_I. If T exceeds D, use the value for T to obtain an annual rate of change over the inventory time period (0-T years)

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

- c = represents the climate zones, s the soil types, and i the set of management systems that are present in a country
- SOC_{REF} = the reference carbon stock, t C ha^{-1}
- F_{LU} = stock change factor for land-use systems or sub-system for a particular land-use, dimensionless
- F_{MG} = stock change factor for management regime, dimensionless
- F_I = stock change factor for input of organic matter, dimensionless
- A = land area of the stratum being estimated, ha. All land in the stratum should have common biophysical conditions (i.e. climate and soil type) and management history over the inventory time period to be treated together for analytical purposes

Refer to Box C.11 and Box C.12 for examples.

Data required for estimates in the MRV tool

Table C.9: Data required for the estimates, Soil Organic Carbon (SOC).

Forest ID	Enter the unique forest ID
Activity	Forest management, Afforestation, Elective Deforestation or Mandatory Deforestation
Previous land use category	Forest Management, Afforestation, Elective Deforestation, Mandatory Deforestation, Grassland, Annual Cropland, Perennial Cropland or Other
Ownership	Company owned or 3rd party (please specify)
Area in the current year ti	Enter value in ha
SOC	SOC in t C/ha, use of **Sheet Supporting Calculations** is possible if value is not known. Note that the calculated ΔC SOC should be positive (+) in the case of Forest Management and Afforestation; and negative (-) in the case of Deforestation
SOC in previous land use	Change in SOC in non-forest use in t C/ha. Use of **Sheet Supporting Calculations** is possible if value is not known.

SCHEDULE

As a minimum, climate zone and soil type needs to be known for the use of **Sheet Supporting Calculations in the MRV Tool**. Default values of SOC for forest, cropland and grassland are sourced from South Africa NIR 2017. These values are included in the **Sheet Parameters in the MRV tool** and can found in Appendix C.4.

Box C.11. Annual change in Carbon stocks in SOC due to land use conversion: Afforestation

Sheet Land Gain-Loss Method in the MRV tool; column ΔC SOC

Sheet Supporting Calculations

The default method applied in the MRV tool uses a steady state stock of C in SOC by ha at 20 years. Carbon stock in SOC in non-forest land uses is assumed to be in equilibrium before the first afforestation.

The stock change for 10 ha of afforested areas of *Pinus patula* converted from annual crop in climatic zone warm temperate – moist and sandy soils, for the first 20 years is:

C in SOC in forest after 20 years: 34 t C ha^{-1} (SA NIR 2017)

C in SOC in annual cropland: 22.59 t C ha^{-1} (SA NIR 2017)

Then, ΔC_{SOC}= (34 t C ha^{-1} – 22.59 t C ha^{-1})/ 20 years x 10 ha = 5.7 t C yr^{-1}

Box C.12. Annual change in Carbon stocks in SOC due to accumulation of SOC: Forest management

Sheet Land Stock-Difference Method in the MRV tool; column ΔC SOC

The default Tier 1 method applied in the MRV tool uses a steady state stock of C in SOC by ha in Forest Management areas. However, if facility-specific data is available i.e. a Tier 2 or 3 method is applied, then SOC from Forest Management areas can be estimated.

To estimate the stock change for 10 ha area *Eucalyptus grandis* which has been under forest management for 5 years, it is assumed that:

C in SOC in forest reached equilibrium at 48 t C ha^{-1} after 15 years

C in SOC in non-forest use: NA (not applicable)

Then, ΔC_{SOC}= (48 t C ha^{-1} / 15 years) x 10 ha =32 t C yr^{-1}

Note: the values used in this example do not represent real data.

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

Accounting of Annual Change in Plantation Carbon Stocks, ΔC

All emissions and removals from annual changes in plantation carbon stocks that are reported are accounted within the MRV Tool. **Refer to the Accounting Rulebook** (see Chapter B, Section B.2) for further information.

C.3.3. Harvested Wood Products, S_{HWP}

C.3.3.1. The mass balance approach

Calculation method in the MRV tool

A mass balance approach (Ado_Paku, 2015) can be used to determine the mass of carbon in the HWP emanating from a mill as follows:

$$mC_{HWP} = mC_{RM} - mC_{E} - mC_{SW} - mC_{LW} \qquad \textit{Equation C.9}$$

Where:

- mC_{HWP} = mass of biogenic carbon in HWP leaving the mill. This should include pulp, paper, solid wood products, saw milling waste sold for pulping if applicable, fines or lignin by products, t C
- mC_{RM} = mass of biogenic carbon entering the mill in the timber raw materials, t C
    - Biogenic carbon mC_{RM} can be calculated based on the mass of timber processed and default conversion. It also includes the mass of recycled wood/pulp

      $$mC_{RM} = V_{(OB)} \times \mathrm{D} \times \mathrm{CF} + mC_{recycled} \qquad \textit{Equation C.10}$$

    - Country specific values for bark fraction[21], wood density and carbon fraction are included in the MRV tool. Same factors should be used for species in calculating C stock change in forest land and HWP
    - $V_{(OB)}$ = overbark volume, m^3. If under bark values are used, then V x (1+Bark fraction) should be used. This parameter is needed in order to apply consistently the default factors (e.g. fractions, mass flow factors) provided in this guideline
    - $mC_{recycled}$ is the mass (tC) of inflow from other timber processing facilities. To avoid double counting, recycled inflows are reported but not accounted for

[21] Bark fraction is the factor for converting under bark to total merchantable wood i.e. the inclusion of the mixture of bark, wood, branches etc, which is separated from the pulp wood during the process of barking. A bark fraction of 0 is applied where the wood entering the mill is underbark.

SCHEDULE

- mC_E = mass of biogenic carbon leaving the mill as gaseous emissions, determined as a fraction of mC_{RM} entering the mill based on the mass flow into biogenic energy, expressed as a fraction of mC_{RM} (FmC_E), t C

$$mC_E = mC_{RM} \times FmC_E \qquad \textit{Equation C.11}$$

- mC_{SW} = mass of biogenic carbon exiting the mill as solid waste determined as a fraction of mC_{RM} entering the mill based on the mass flow into biogenic energy, expressed as a fraction of mC_{RM} (FmC_{SW}), t C

$$mC_{SW} = mC_{RM} \times FmC_{SW} \qquad \textit{Equation C.12}$$

- mC_{LW} = mass of biogenic carbon exiting the mill as liquid waste (effluent) determined as a fraction of mC_{RM} entering the mill based on the mass flow into biogenic energy, expressed as a fraction of mC_{RM} (FmC_{LW}), t C

$$mC_{LW} = mC_{RM} \times FmC_{LW} \qquad \textit{Equation C.13}$$

Note that waste discharge threshold applies to mC_{SW} and mC_{LW} and emissions are only reported if these thresholds are exceeded (see IPCC code 4 schedule 2 of the 2019 Carbon Tax Act).

Since biogenic and waste emissions are discounted (D) when accounting under the 2019 Carbon Tax Act Equation C.9 can be rewritten as Equation C.14. Recycled inflows are deducted from accounting to avoid double counting but are included in reporting.

$$mC_{HWP} = mC_{RM} - mC_{recycled} - (mC_E \times \frac{D}{100}) - (mC_{SW} \times \frac{D}{100}) - \left(mC_{LW} \times \frac{D}{100}\right) \qquad \textit{Equation C.14}$$

The discount is currently set at 100% in the 2019 Carbon Tax Act, but these emissions will still be reported. The derived mC_{HWP} value from equation 10 can be used as the S_{HWP} variable in the S of the C tax equation outlined in the 2019 Carbon Tax Act.

The mass flow approach can be used for all production facilities including the pulp/paper, lignin-based compounds, sawn products or primary wood-based products, or other products well defined as entering or exiting the mill gate. However, certain accounting rules regarding the eligibility of m_{CRM} need to be considered to avoid double accounting, leakage and conserved mass balance with harvest coming from forest areas included in the scheme (see Chapter B, Section B.3.2.5.d).

The final removal or emissions from HWP pool (S_{HWP}) for different HWP categories (i) is derived as a fraction of HWP remaining based on the landfill approach whereby the fraction of C decayed over 96 years (fLC_{96}) by different HWPs (i) is applied to the reported mC_{HWP} value submitted by companies:

$$S_{HWP(i)} = mC_{HWP(i)} \times fLC_{96(i)} \qquad \textit{Equation C.15}$$

SCHEDULE

The retention potential is expressed as default fLC_{96} value for different products and is based on the estimated maximum proportions of wood and paper converted to CO_2 or CH_4 in landfills over 96 years (Skog & Nicholson, 1998). The value for pulp is based on the average for all paper products (see **Sheet Parameters in the MRV tool** and Appendix C.1.).

The industry can use their own Tier 2 values, but this should be demonstrated to be applicable, verifiable, and based on sound science, with references included in the annual report.

C.3.3.2. Paper mills

System boundaries, in line with the over-riding concepts outlined above:

a) Any pulp bought in or recovered pulp from other companies as wood products (mC_{HWP}) cannot be included in mC_{RM}, since this would represent double accounting as the credits would have already been claimed as mC_{HWP} by the company selling the pulp or recovered pulp.

b) Sawmill residues or recovered pulp used in production of product cannot be included in mC_RM, as these are already included in the mass flow balance as waste of the reporting company.

c) Therefore, there is no need to distinguish between integrated and non-integrated mills.

d) However, bought in recovered pulp or wood waste residues provided by other parties (i.e. waste bought in by a registered non-integrated mill) is considered as mC_{RM} and reported because they are not included in the mass flow approach. However, the contribution of recycled waste from other facilities to HWP removals should not be accounted for since these are already discounted under the C Tax Act (Figure C.2).

e) Gaseous (mC_E), liquid (mC_{LW}) and solid waste (mC_{SW}) are fully discounted under the C tax rules so this falls outside the system boundary (Figure C.2). These emissions could include lime kiln emissions which are considered as a biogenic source of C as part of the recovery in the Kraft process (Adu Poku, 2015).

SCHEDULE

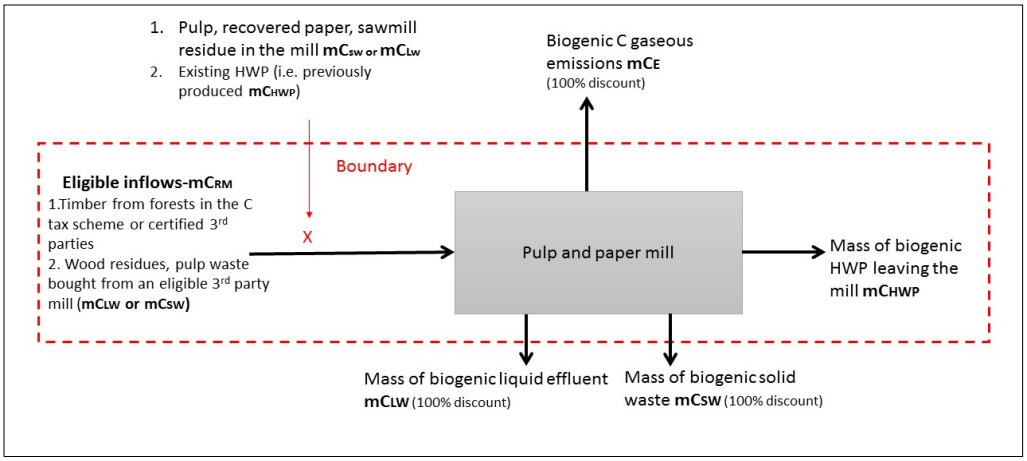


Figure C.2: A mass flow accounting for paper mills.

Mass flow factors for paper mills are derived from the thesis of Adu Poku (2015), where factors can be categorised based on different milling processes. These factors are included in the **Sheet Parameters in the MRV tool** and can found in Appendix C.4. Individual companies can calculate their own mass flow fractions for carbon leaving the mill based on the latest data available where information is available and can be verified with supporting documentation.

C.3.3.3. Sawmills

Tier 1 option: Mass flow factors for all sawn wood. Appropriate mass flow factors have not been identified, so tier 1 estimates are based on the fraction recovery of product based on raw timber inputs by HWP category (F_{HWPrec}).

SCHEDULE

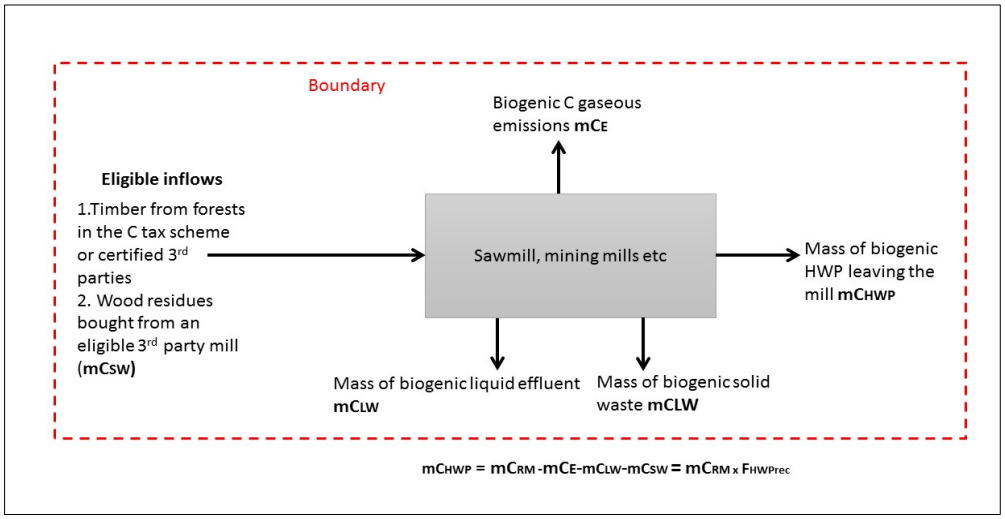


Figure C.3: Mass flow accounting tier 1 (default) option for the sawmill, panels, mining, and pole production.

In the absence of any country specific data for F_{HWPrec}, it is recommended to use the UNECE/FAO conversion factors for the timber industry as a default. Hence Equation C.9 can be restructured for this sector if no specific mC_E, mC_{SW}, mC_{LW} data is available:

$$mC_{HWP} = mC_{RM(i)} \times F_{HWP\ rec(i)} \qquad \textit{Equation C.16}$$

Where:

- F_{HWPrec} is the recovery of product based on raw timber inputs and i is the HWP category.

In the default approach mC_{RM} only includes timber inflow from forest areas within the C tax scheme and recovered waste wood or pulp purchased form 3rd parties within the C tax scheme. Although the presented recovery ratios do not consider use of by products such as wood chips, saw dust used in other processes such as wood-based panels from particles (WBP) and pulp, processing residues are considered as eligible inflows (Figure C.3).

The approach also means that biogenic and waste emissions are reported but these are fully discounted for this sector (Figure C.3).

Default values for F_{HWPrec} by HWP category are included in the **Sheet Parameters in the MRV tool** and can found in Appendix C.4.

Higher tier methodologies can use complete C mass flow or models if they are available and verifiable. Hence, individual companies may use their own recovery factors or data relating to biogenic emissions, other wood by-products and C lost in waste from the plant as outlined in Figure C.3, based on the latest available information. Use of such an approach must be verified by supporting production

SCHEDULE

data for each product. It is recommended that the South African milling sector develops specific mass flow factors for each type of mill process. This may be particularly useful if the discount on waste and energy emissions are changed in future amendments to the C Tax Act.

Individual processing facilities should use their own mass flow factors based on the latest available information, which should be verified with supporting documentation.

Tier 2 option. The mass flow principle can also be applied to the milling and solid wood processing sector (Figure C.4). Carbon mass balance studies are at present only available for production of sawn wood (unpublished data, Kerr 2019). But there are no known publications on mass flow balances for mining poles, wood based panels, plywood or pole production in South Africa. If companies have specific information to calculate sawmill HWP mass balance then the same approach can be used as outlined for the paper and pulp sector using equation C.10, with the relevant discounts and waste thresholds (Figure C.4).

Note that if standing tons are stated as wet white tons (wwt), i.e. at field wet basis moisture level, then the values need to be converted from wwt to m^3. For this conversion, Standard Industry Conversion Factors (ICFs) for round wood can be used (see Table C.4).

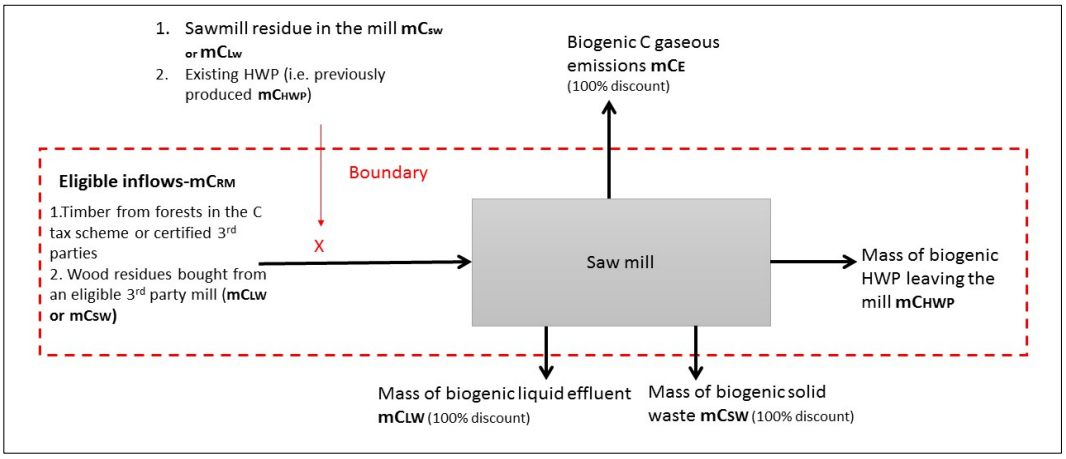


Figure C.4: Mass flow tier 2 accounting option for the sawmill, panels, mining and pole production

Data required for estimates in the MRV tool

In line with the Accounting Rulebook (see Chapter B, Section B.3.2), the MRV tool allows for the estimation of the HWP contribution differentiated by Activity (forest management, afforestation, or deforestation). However, the HWP estimates in afforested areas can be reported under forest management. HWP estimates in deforested areas are to be reported separately (see column Fraction of harvest from registered forests that is from deforested land), because these are not to be accounted.

SCHEDULE

The method used requires the following data for Paper mills and Sawmills. Data on the total mass of carbon entering the mills is also required (see Table C.10). The Tier 2 methodology for Sawmills matches the Paper mill methodology with the exception that HWP type rather than the process must be reported (see Table C.13 below). The Tier 1 methodology for Sawmills is presented in Table C.12.

Table C.10: Data required for estimating HWP, mass carbon entering the mill.

Ownership	Company owned, 3rd party (please specify) or other registered company
Species/ Genus	Predominant species name
Volume entering the mill	Enter a value in m^3, or leave blank is 'Biomass entering the mill (t d.m.)' is provided
Biomass entering the mill (t d.m.)	Enter a value in t d.m, or leave blank is 'Volume entering the mill (m^3)' is provided.
Is the volume entering the mill under or over bark?	Leave blank if entering the biomass entering the mill.

Mass C Entering the mill (t m^3) can be estimated using the MRV tool within Table C.10 based on:

a) Volume Entering the Mill (m^3) by species.
b) Mean wood density (t m^{-3}) (default by species provided).
c) Carbon fraction, CF (default by species provided).
d) Bark fraction (default provided).

Note that when using the MRV tool the volume entering the mill should express under bark, since the bark fraction is then applied. If the volume entering the mill is over bark, then the bark fraction should be 0. Examples for estimating the HWP contribution from a pulp mill (Box C.13) and a sawmill (Box C.14) is provided below.

Table C.11: Data required for estimating HWP, pulp/ paper mills.

Mill name	Enter mill name
Activity	Forest management, Afforestation, Elective Deforestation or Mandatory Deforestation If it is not possible to split the data by activity, then select Forest management.

SCHEDULE

Process	Kraft, Sulphite, Soda (Bagasse), Thermomechanical, NSSC, Mechanical & Kraft, NSSC & Kraft or User defined
Solid waste per year	Enter value, t d.m.
Liquid waste per day	Enter value, m^3/day
mC recycled inflow	Enter value, t C, the default value is 0
Mass C Entering the Mill	Enter value, t C. Reported separately for 3rd party and other register company inflows
Fraction of harvest from registered and/or 3rd party forest under the C tax act 2019	Enter fraction

SCHEDULE

Box C.13. Estimates for HWP contribution: Pulp mill example

Sheet HWP in the MRV tool

In a pulp mill produces thermomechanical pulp from wood of *Eucalyptus grandis*. The annual volume under bark entering the mill is 337 240 m^3. Pulp rejects are minimized by continuously recycling fibres back into the process.

It is not possible to differentiate the origin of the wood by activity (i.e. Forest management, Afforestation or Deforestation). Solid waste per year is 24 400 t d.m. and Liquid waste output per day is 50 m^3 day^{-1}.

Applying Tier 1, the Total inflow: Mass C Entering the Mill (t C) is

Species = *Eucalyptus grandis*

Volume Entering the Mill (m^3) under bark = 337 240 m^3

Mean wood density (t m^3) = 0.42

Carbon fraction (CF) = 0.47 (default)

Bark fraction = 0.13 (default)

Activity = Forest management.

Total inflow: Mass C Entering the Mill (t C) = 337 240 x 0.42 x (1+0.13) x 0.47 = 75 225 t C

mC recycled wood/pulp inflow (t C) = 0, because it is already included in the mass flow balance.

mC_{RM} (t C) = 75 225 t C

FmC_E = 0.11; FmC_{SW} = 0.04; FmC_{LW} = 0.1

mC_E = 9 152 t C

Does solid waste threshold exceed amount specified in C tax act? No

Does waste water threshold exceed amount specified in C tax act? No

mC_{SW} (t C) = NO

mC_{LW} (t C) = NO

mC_{HWP} from milling processing facility (t C) = 66 951 t C

fLC_{96} = 0.74 (default provided)

S_{HWPi} Reporting = **- 181 659 t CO_2**

S_{HWPi} Accounting = **-204 112 t CO_2**

Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

Table C.12: Data required for the estimating HWP, sawmill Tier 1

Mill name	Enter mill name
Activity	Forest management, Afforestation, Elective Deforestation or Mandatory Deforestation If it is not possible to split the data by activity, then select Forest management.
HWP type	User defined, e.g. Sawn wood, Sawn wood (Pine), Sawn wood (Eucs), Veneer and plywood, Particle board, OSB and wafer board, Fibreboard (all), Mining timber, Poles or User defined
mC recycled wood/pulp inflow	Enter value, t C, the default is 0
Mass C Entering the mill	Enter value, t C. Report separately for 3rd party and other register company inflows
Fraction of harvest from registered and/or 3rd party forests under the C tax act 2019	Enter fraction

SCHEDULE

Table C.13: Data required for estimating HWP, sawmill Tier 2

Mill name	Enter mill name
Activity	Forest Management, Afforestation, Elective Deforestation or Mandatory Deforestation If it is not possible to split the data by activity, then select Forest management.
Solid waste per year	Enter value, t
Liquid waste per day	Enter value, m3 day^{-1}
HWP type	User defined, e.g. Sawn wood, Sawn wood (Pine), Sawn wood (Eucs), Veneer and plywood, Particle board, OSB and wafer board, Fibreboard (all), Mining timber, Poles or User defined
mC recycled wood/pulp inflow	Enter value, t C, the default is 0
Mass C Entering the mill	Enter value, t C. Report separately for 3rd party and other register company inflows
Fraction of harvest from registered and/or 3rd party forests under the C tax act 2019	Enter fraction
FmC_E	Enter value, no defaults available
FmC_{SW}	Enter value, no defaults available
FmC_{LW}	Enter value, no defaults available

SCHEDULE

Box C.14. Estimates for HWP contribution: Sawmill example

Sheet HWP in the MRV tool

A sawmill produces poles from wood of *Eucalyptus grandis*. The annual volume under bark entering the mill is 337 240 m^3. No recycled wood is used.

It is not possible to differentiate the origin of the wood by activity (i.e. Forest management, Afforestation or Deforestation). Solid waste per year is 24 400 t d.m. and Liquid waste output per day is 50 m^3 day^{-1}.

Applying Tier 1, the Total inflow: Mass C Entering the Mill (t C) is

Species = *Eucalyptus grandis*

Volume Entering the Mill (m^3) under bark = 337 240 m^3

Mean wood density (t m^3) = 0.42 (default)

Carbon fraction (CF) = 0.47 (default)

Bark fraction = 0.13 (default)

Activity = Forest management.

Total inflow: Mass C Entering the Mill (t C) = 337 240 x 0.42 x (1+0.13) x 0.47 = 75 225 t C

mC recycled wood/pulp inflow (t C) = 0, because it is already included in the mass flow balance.

mC_{RM} (t C) = 75 225 t C

f_{HWPrec}= 0.83;

mC_{HWP} from milling processing facility (t C) = **62 437** t C

fLC_{96} = 0.97 (default provided)

S_{HWPi} Reporting = **-222 068 t CO_2**

S_{HWPi} Accounting = **-267 552 t CO_2**

SCHEDULE

C.3.4. Emissions from Fire, S_{fire}

Biomass burning entails the emissions of CO_2, CH_4 and N_2O gases. Two types of fires are described in this section: wildfires and controlled burning. The MRV tool includes separate sheets for each of them:

a) Controlled burning covers the burning of the remaining residue and litter following the removal of wood to mills and the burning of vegetation in firebreaks. This vegetation is considered to be savanna grassland.

b) Wildfires are limited to the affected forest area within the plantation, i.e. wildfires occurring in grassland areas within the plantation are not estimated nor reported.

It should be noted that if the land stock-difference method has been used, then it is assumed that CO_2 emissions have already been accounted for and CO_2 emissions should therefore be reported as IE (included elsewhere) under fires. When calculating emissions from grassland, CO_2 emissions should be reported as NA (not applicable) as carbon stocks are assumed to be in equivalence.

Calculation method in the MRV tool

The calculations for emissions from fires (S_{fires}) are based on the IPCC 2006 methodology (volume 4, chapter 2, equation 2.27). Emissions from fires are calculated based on the following equations:

$$L_{fire} = A_{disturbed} \times M_B \times Cf \times G_{ef} \times 10^{-3} \qquad \textit{Equation C.17}$$

Where:

- L_{fire} = amount of greenhouse gas emissions from fire, t's of each GHG e.g., t CH_4, t N_2O, etc.
- A = area burnt, hectares
- M_B= mass of fuel available for combustion, t d.m. ha^{-1}. This includes all biomass, ground litter and dead wood. When Tier 1 methods are used then litter and dead wood pools are assumed to be zero, except where there is a land-use change, therefore:
    - If the activity is Forest management, the total emissions from DOM burnt is assumed to be 0 for tier 1[22]. For higher tier total DOM C stock needs to be provided
    - If Activity is Afforestation, then total C in DOM depends on the age of the afforestation
    - If the activity is Deforestation, total C in DOM depends on the age of the afforestation or forest.

[22] Because the C stock change in DOM in Forest management is 0, i.e. loss should not be reported because gains are not reported.

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

- C_f = combustion factor, dimensionless. Tier 1 assumption uses the fraction biomass lost based on the type of disturbance and assume the same fraction for AGB and DOM
- G_{ef} = emission factor, grams per kilogram of dry matter burnt (default values in Appendix C.4).

Wildfires - Data required for estimates in the MRV tool

The method requires data on the biomass burnt (Table C.14).

Table C.14: Data required for estimating emissions from wildfires.

Forest ID	Enter the unique forest ID
Activity	Forest Management, Afforestation, Elective Deforestation or Mandatory Deforestation
Total area	Enter value in ha
Mass of fuel available for combustion,	It can be estimated based on total biomass and fraction damaged.
Area disturbed	Enter value in ha
Type of damage	Slight loss, Serious damage or Total loss. This is used to provide default values for the fraction of biomass lost, facility-specific values can be used instead of defaults.

In the case of Wildfires, the amount of biomass burnt can be estimated based on:

a) Total biomass: input by the user

b) fraction damaged: input by the user or default provided based on type of damage (slight loss - 1% lost; serious damage - 60% lost, and total loss - 100% lost according to SA NIR 2017).

c) Biomass burnt (t C) = M_B (t d.m.) x Fraction biomass lost.

Emissions of CH_4 and N_2O are converted to CO_2eq applying GWP of IPCC third assessment report (TAR). An example calculation for emissions due to wildfires is presented in Box C.15.

SCHEDULE

Box C.15. Emission estimates due biomass burning:

wildfires, forest fires

Sheet Wildfires in the MRV tool

Applying tier 1, the emissions due to a wildfire affecting 5 ha, producing serious damage in a forest management of Extra tropical forest with a total biomass (living biomass and DOM) per ha of 19.8 t d.m. ha^{-1} are:

Area disturbed = 5 ha

M_B = 19.8 t d.m. ha^{-1}

Fraction damaged = 0.6 (serious damage, SA NIR 2019)

G_{ef}-CO_2 = 1569 g (kg d.m. burnt)$^{-1}$ (default IPCC 2006)

$L_{fire\text{-}CO2}$ = 5 ha× 19.8 t d.m. ha^{-1} × 0.6 × 1569 x 10^{-3} = **93.20 t CO_2**

G_{ef}-CH_4= 4.7 g (kg d.m. burnt)$^{-1}$ (default IPCC 2006)

$L_{fire\text{-}CH4}$ = 5 ha × 19.8 t d.m. ha^{-1} × 0.6 × 4.7 x 10^{-3} = **0.28 t CH_4**

G_{ef}-N_2O= 0.26 g (kg d.m. burnt)$^{-1}$ (default IPCC 2006)

$L_{fire\text{-}N2O}$ = 5 ha× 19.8 t d.m. ha^{-1} × 0.6 × 0.26 × 10^{-3} = **0.02 t N_2O**

$L_{fire\text{-}CO2eq}$ = 93.20 + 0.28 x 23 + 0.02 x 296 = **104.9 t CO_{2eq}**

Note that emission factors are expressed in g/kg, therefore 10^{-3} needs to be included in the calculation of emissions.

CO_2, CH_4 and N_2O are first estimated and reported separately. The emissions are then converted to CO_2eq and reported as a summed total. CO_2 emissions must be reported in case of deforestation, while it is assuming short term recovery of C in all C pool in the case of forest Management and Afforestation, and therefore CO_2 emissions are not reported.

The estimates must be reported by wildfire.

Wildfires – Accounting of emissions from Fire, S_{fire}

This source is reported but a 100% discount is applied in the accounting. **See Chapter B, Section 3 (Accounting Rulebook).**

SCHEDULE

Controlled burning - Data required for estimates in the MRV tool

The method requires data on the biomass burnt (Table C.15).

Table C.15: Data required for estimating emissions from controlled burning.

Forestt ID	Enter the unique forest ID
Activity	Forest management, Afforestation Elective Deforestation or Mandatory Deforestation
Species/Genus	Predominant species name
Area burnt	Enter value in ha
Controlled burning category	Select from the dropdown (11 options available)

In the case of controlled burning, the amount of biomass burnt could can be estimated (see Box C.16 for example) using **Sheet Controlled burning in the MRV Tool**:

- For the controlled burning category post-harvest burning, the amount of biomass burnt is the product of biomass in litter and harvest residues, that is input by the user or default provided, and the combustion fraction, that is input by user or default provided.
- For the controlled burning category Firebreaks, the amount of biomass burnt is input by the user or the default provided sourced from IPCC 2006, vol 4, ch. 2, table 2.4 and the combustion factor sourced from IPCC 2006, vol 4, ch. 2, table 2.6, type of vegetation savanna grasslands (mid/late dry season burns), surface layer combustion only.

Emissions of CH_4 and N_2O are converted to CO_2eq applying GWP of IPCC third assessment report (TAR).

SCHEDULE

Box C.16. Emission estimates due biomass burning: controlled burning

Sheet Controlled burning in the MRV tool

Applying tier 1, the emissions due to controlled burning post-harvest in 100 ha of *Eucalyptus grandis* under forest management is:

Area disturbed = 100 ha

Biomass in litter and harvest residues (t d.m. ha^{-1}) = 31.4 t d.m. ha^{-1} (default provided)

Cf = 0.62 (default IPCC 2019b)

G_{ef}-CO_2 = 1569 g (kg d.m. burnt)$^{-1}$ (default IPCC 2006)

$L_{fire\text{-}CO2}$ = 100 ha × 31.4 t d.m. ha^{-1} × 0.2 × 1569 x 10^{-3} = **3054.53 t CO_2**

G_{ef}-CH_4= 4.7 g (kg d.m. burnt)$^{-1}$ (default IPCC 2006)

$L_{fire\text{-}CH4}$ = 100 ha× 31.4 t d.m. ha^{-1} × 0.62 x 4.7 × 10^{-3} = **9.15 t CH_4**

G_{ef}-N_2O= 0.26 g/kg d.m. burnt (default IPCC 2006)

$L_{fire\text{-}N2O}$ = 100 ha× 31.4 t d.m. ha^{-1} × 0.62 x 0.26 × 10^{-3} = **0.51 t N_2O**

$L_{fire\text{-}CO2eq}$ = 3054.53 + (9.15 * 23) + (0.51 * 296) = **43414.89 t CO_2eq**

** Note that if Land Stock-Difference Method is being applied, CO_2 emissions should be reported as "IE" here as it is assumed that the loss has already been included within the calculations.*

CO_2, CH_4 and N_2O are first estimated and reported separately. The emissions are then converted to CO_2eq and reported as a summed total.

The estimates must be reported by controlled burning (harvest residues and litter or firebreaks).

Controlled burning – Accounting of emissions from fire, S_{fire}

This source is reported but a 100% discount is applied in the accounting. **See Chapter B, Section 3 (Accounting Rulebook).**

C.3.5. Applied Fertiliser, S_{fert}

The application of fertilisers results in human-induced net N additions to soils (e.g. organic fertilisers such as deposited manure, crop residues, sewage sludge and synthetic fertilisers) and consequentially N_2O emissions. Commercial fertilizers may contain a fraction of nitrogen which represents the activity data for estimation (N inputs). Formally termed “direct emissions from the application of fertiliser”, it

SCHEDULE

does not include the emissions generated through the production and supply of the fertiliser, only the N_2O emissions generated where they are applied. Only synthetic N fertilisers are assumed to be used, i.e. methodology to estimate emissions due to the use of organic fertilisers is not included in the MRV tool or this document.

Calculation method in the MRV tool

The calculations for emissions from applied fertiliser (S_{fert}) are based on the IPCC 2006 Tier 1 methodology (volume 4, chapter 11). Emissions from fertiliser are calculated based on the following equations for example:

$$N_2O_{Direct}\text{-}N = N_2O\text{-}N_{N\,inputs} \qquad \textit{Equation C.18}$$

$$N_2O\text{-}N_{N\,inputs} = F_{SN} \times EF_N \qquad \textit{Equation C.19}$$

Where:

N_2O Direct –N = annual direct N_2O–N emissions produced from managed soils, kg N_2O–N yr^{-1} (N which is available for conversion to N_2O)

- N_2O–N inputs = annual direct N_2O–N emissions from N inputs to managed soils, kg N_2O–N yr^{-1}
- F_{SN} = annual amount of synthetic fertiliser N applied to soils, kg N yr^{-1}
  - $F_{SN} = F_{TOTAL} \times Fraction_N$,
  - where F_{TOTAL} = Total fertiliser applied (kg), Fraction N = the fraction of N in fertiliser
- EF_N = emission factor for N_2O emissions from N inputs (default 0.01 t N_2O-N tN^{-1})

Conversion of N_2O–N emissions to N_2O emissions for reporting purposes is performed by using the following equation:

$$N_2O = N_2O - N \times \frac{44}{28}$$

Emissions of CH_4 and N_2O are converted to CO_2eq applying GWP of IPCC third assessment report (TAR).

SCHEDULE

Box C.17. Emission estimates due to Synthetic fertiliser application

Sheet Fertilisation in the MRV tool

N_2O emissions due to the application of 10,000 kg of N synthetic fertilisers in a forest plantation are:

F_{SN} = 10,000 kg N

EF_N = 0.01 kg N_2O –N (kg N)$^{-1}$ (default IPCC 2006)

N_2O–$N_{N\ inputs}$ = 10,000 kg N x 0.01 kg N_2O–N (kg N)$^{-1}$ = 100 kg

N_2O emissions = 100 *44/28 x 10^{-3} = 0.16 t

CO_2eq emissions = 0.16*296 = **46.5 t CO_2eq**

Data required for estimates in the MRV tool

Registered companies must provide their annual total fertiliser application in kg of N. Default values are provided for other parameters required to calculate the total N applied and N_2O.

Table C.16: Data required for estimating emissions from applied fertiliser.

Fertiliser type	Enter fertiliser type
Activity	Forest Management, Afforestation Elective Deforestation or Mandatory Deforestation
N in fertiliser applied (kg)	The total N In nitrogen applied

Companies should report the total emissions both in t N_2O and t CO_2eq from fertiliser application.

Accounting of applied Fertiliser, S_{fert}

This source is reported but a 100% discount is applied in the accounting. **Refer to Annex B, Section 5 (Accounting Rulebook).**

C.3.6. Land Tracking

SCHEDULE

There is a need for land tracking under the C tax that is covered in the **sheet Facility Register in the MRV tool.** This is required to ensure accounted emissions/removals are permanent and that once an area is accounted it will continue to be accounted for subsequent years. General information is requested by Facility unit.

Table C.17: General information by Facility unit.

Forest ID	Enter unique forest ID
Province	Select from dropdown/ provide text
Region	Select from dropdown/ provide text
Geospatial verification	Provide file reference e.g. paper maps, or geospatial reference
Species/genus	Predominate species name, this should be consistent with the calculation sheets
Area	Enter the area in ha, this should be consistent with the areas entered in either the **Land Gain-Loss Method** or **Land Stock-Difference Method** sheets
TUP area	Enter temporary unplanted area in ha.

C.3.7. 3rd Party register

There is a need to track the 3rd parities from which the taxpayer is purchasing wood. This is done within the **sheet 3rd Party Register in the MRV tool.** This is required to ensure accounted emissions/removals are eligible, "3rd party forests" is defined a forest land area or ownership that is not eligible under the C Tax Act. Its participation in the scheme is only possible through eligible entities which report emissions from fossil fuels "E" under the C tax. In accordance with the conservative principle, emissions from 3rd party growers must be reported. It is optional to report removals. Refer to the Accounting Guidelines for more information. General information is requested by 3rd Party Name.

SCHEDULE

Table C.18: General information by Forest unit.

3rd Party Name	Enter 3rd party name
Forest ID	Enter unique forest ID
Area harvested	Enter the area of the Forest that is harvested
Proportion of harvest bought	Enter value
Harvest amount	Enter value
Units of harvest	Provide the units of the harvest amount
Geospatial verification	Provide file reference e.g. paper maps, or geospatial reference
Is there an agreement with the 3rd Party?	Yes or no
Has a certificate been provided?	Yes or no
Are forest emissions/reported?	Yes or no

C.3.8. Verification

A separate document has been prepared to provide detailed information for the verification process (see Chapter D of this report). In the **sheet Verification in the MRV tool** some information relating to verification is provided. It is not mandatory to complete this sheet, but taxpayers are encouraged to do so as it would assist the verification process and could shorten the time for the approval process.

C.3.9. Guidance for the Use of Models

Companies can develop their own tier 3 methods for estimating carbon sources and sinks. Tier 3 methods make use of measurements and/or modelling, with the goal of improving the estimation of GHG emissions and removals. The IPCC Refinement Volume 4, chapter 2, section 2.5. provides guidance on the development of such models.

If tier 3 models are applied in C tax accounting, it is essential to have detailed and transparent documentation to accompany the model. The following details are required in the documentation:

a) Model selection or development:
   i. A description of the model.
   ii. Reasons for choosing the model (e.g. suitability to C tax reporting and accounting).
   iii. Discussion on any likely consequences if the model is used outside of the domain that the model is parameterised to simulate.

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

b) Model calibration:
   i. Description of the process undertaken to calibrate the model.
   ii. Documentation of the data sources informing the manual or automatic calibration.
c) Model behaviour evaluation:
   i. Results of the analysis verifying model behaviour using independent measurements to confirm that the model is capable of estimating carbon stocks, stock changes and/or emissions and removals in the source/sink categories of interest.
   ii. Source of independent data.
d) Model implementation:
   i. Overview of procedures that are used to apply the model.
e) Quantifying uncertainties:
   i. Description of the approach taken to estimate uncertainty in the model outputs.
f) Verification of estimates:
   i. Summary of the verification results for the model.
g) Reporting and documentation:
   i. Information on the quality assurance and quality control step taken throughout the process.

This documentation would need to be submitted along with the C Tax sequestration submission to DFFE.

C.4. References

Adu Poku, S. (2015). Plant-based carbon flow analysis of South African pulp mills. MSc Thesis School of Chemical Engineering at the College of Agriculture, Engineering and Science, University of KwaZulu-Natal, Durban South Africa.

Christie, S. & Scholes, R. (1995). Carbon storage in eucalyptus and pine plantations in South Africa. *Environmental monitoring and assessment,* 38**,** 231-241.

IPCC (2001). Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 881pp.

IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan. Available at: https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html

IPCC (2014). 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol, Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M.

SCHEDULE

and Troxler, T.G. (eds) Published: IPCC, Switzerland. Available at: https://www.ipcc-nggip.iges.or.jp/public/kpsg/index.html

IPCC (2019). 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Calvo Buendia, E., Tanabe, K., Kranjc, A., Baasansuren, J., Fukuda, M., Ngarize S., Osako, A., Pyrozhenko, Y., Shermanau, P. and Federici, S. (eds). Published: IPCC, Switzerland. Available at: https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html

Skog K & Nicholson G.A (1998). Carbon cycling through wood products: The role of wood and paper products. Forest Products Journal 48(7):75-83.

UNECE/FAO (2010). Forest Product Conversion Factors for the UNECE Region. GENEVA TIMBER AND FOREST DISCUSSION PAPER 49. UN, Geneva.

SCHEDULE

Appendix C

Appendix C.1: Functionalities in the MRV Tool & User Tips

It is recommended that users familiarise themselves with the Methodology Guidelines before using the MRV Tool. The key functionalities or the MRV Tool and user tips are provided below. This information is also provided within the **Sheet Content and Instructions in the MRV tool.**

a) Detailed information is provided within each sheet as well as within the Methodological Guidance. Read this information carefully before entering any data into the tool.
b) Complete all green cells (input data cells) which are relevant for the tier being applied, note that users should:
    i) Use either the gain-loss or the stock-difference method for calculating the carbon stock change in living biomass.
    ii) Use either the tier 1 or tier 2 tables provided for Sawmills in the 'HWP' sheet.
c) Complete the methodology boxes at the top of each sheet.
d) Add new rows under the tables as needed, the formula will be copied automatically.
e) Some tables are pre-filled with data for demonstration purposes, references are provided to the Methodological Guidelines. This data should be overridden/ removed before submitting this file.
f) The formulae within the compilation tables are provided to help with the calculations but can be overridden, it is recommended that users first review the examples provided within the MRV Tool.
g) Default parameters are provided for some categories, users may use their own parameters as long as justification is provided. Detailed information is provided within the methodology.
h) Some activity data/emissions/removals estimates required for the yellow compilation sheets can be generated in the **Sheet Supporting Calculations in the MRV Tool**.
i) The **Sheet Reporting & Accounting in the MRV Tool** is filled automatically, ensure that the appropriate methods are selected in the dropdowns.

Where no emissions/removals are generated from a source/pool the appropriate notation keys should be applied (see below).

SCHEDULE

Appendix C.2: Country specific Mass flow factors for sawn wood

Mass flow factors for all sawn wood production systems based on inflows of round wood. The only available mass flow factors for the sawn wood products are provided by Kerr (unpublished thesis, 2019) as shown in Table C.19. These are based on mass flow for all sawn wood products in South Africa, so these estimates are not suitable for use by individual mills because recovery rates could vary from 28 to 100 % (Christie and Scholes, 1995). These are not considered to be suitable for reporting of HWP flow for individual companies.

Table C.19: Mass flow factors for sawn wood. Not to be used for Tier 1

Mass flow factor	Value (t C/t C of roundwood inflows)
fmC_E	0.061
fmC_{LW}*	NA
fmC_{sw}	0.092

** There are no liquid waste emission C flows in the sawn wood processing sector (NA= not applicable)*

Appendix C.3: BCEF default values (see "BCEF lookups" In MRV tool)

Lookup	Climatic Zone	Species	Growing stock level (m^3)	$BCEF_I$ (t/m^3)	$BCEF_R$ (t/m^3)	$BCEF_S$ (t/m^3)
Hardwoods/Eucalyptus< 20	Temperate	Hardwoods/Eucalyptus	< 20	1.5	3.33	3
Hardwoods/Eucalyptus21 - 40	Temperate	Hardwoods/Eucalyptus	21 - 40	1.3	1.89	1.7
Hardwoods/Eucalyptus41 - 100	Temperate	Hardwoods/Eucalyptus	41 - 100	0.9	1.55	1.4
Hardwoods/Eucalyptus101 - 200	Temperate	Hardwoods/Eucalyptus	101 - 200	0.6	1.17	1.05
Hardwoods/Eucalyptus> 200	Temperate	Hardwoods/Eucalyptus	> 200	0.48	0.89	0.8
Pines< 20	Temperate	Pines	< 20	1.5	2	1.8
Pines21 - 40	Temperate	Pines	21 - 40	0.75	1.11	1
Pines41 - 100	Temperate	Pines	41 - 100	0.6	0.83	0.75
Pines101 - 200	Temperate	Pines	101 - 200	0.67	0.77	0.7
Pines> 200	Temperate	Pines	> 200	0.69	0.77	0.7
Acacia< 20	Temperate	Acacia	< 20	1	3.33	3
Acacia21 - 40	Temperate	Acacia	21 - 40	0.83	1.55	1.4
Acacia41 - 100	Temperate	Acacia	41 - 100	0.57	1.11	1
Acacia101 - 200	Temperate	Acacia	101 - 200	0.53	0.83	0.75

SCHEDULE

Acacia> 200	Temperate	Acacia	> 200	0.6	0.77	0.7

Source: IPCC (2006) Volume 4, Chapter 4, Table 4.5

Appendix C.4: Default and country-specific parameters included in the MRV tool

Type	Parameter	Value	Units	Data Source
General factors	C to CO2	-3.67	-	IPCC 2006
named ranges set	N to N2O	1.57	-	IPCC 2006
	GWP CH4	23	-	IPCC third assessment report (TAR)
	GWP N2O	296	-	IPCC third assessment report (TAR)
	kg to t / g to kg	0.001	-	-
Carbon Fraction				
	CF: Default	0.47	t C/ d.m.	IPCC 2006, V4, Chp4, Table 4.3 Default value
Combustion factors				
	Eucalyptus grandis - Both treatments, spread- and piled- slash	0.92	fraction	Nadel (2005) (Knowles & Christie, 2018, p.55, table 6.2)
	Other temperate forests - post logging slash burn (Eucalyptus)	0.62	fraction	IPCC, 2019b Table 2.6 (Updated) "Other temperate forests – Post logging slash burn"

SCHEDULE

Type	Parameter	Value	Units	Data Source
	Eucalyptus grandis - 36.4 t.ha-1 pre-fire, 4.2 t.ha-1 post-fire	0.9	fraction	Dovey (2012) (Knowles & Christie, 2018, p.55, table 6.2)
	Firebreaks: grassland	1	fraction	IPCC (2006)
R: above-ground to below-ground ratio				
	R: Eucalyptus grandis	0.24	ratio	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	R: Eucalyptus dunnii	0.24	ratio	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	R: Eucalyptus macarthurii	0.24	ratio	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	R: Eucalyptus nitens	0.24	ratio	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	R: Eucalyptus smithii	0.24	ratio	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	R: E.grandis x E.urophylla	0.24	ratio	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	R: E.grandis x E.nitens	0.24	ratio	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016

SCHEDULE

Type	Parameter	Value	Units	Data Source
	R: E.grandis x E.camaldulensis	0.24	ratio	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	R: Pinus patula	0.28	ratio	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	R: Pinus elliottii (13 yrs)	0.28	ratio	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	R: Pinus radiata	0.28	ratio	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	R: Pinus taeda (12 yrs)	0.28	ratio	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	R: Pinus pinaster	0.28	ratio	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	R: Acacia mearnsii	0.28	ratio	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
D: Mean wood density				
	D: Eucalyptus grandis	0.42	t/m³	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	D: Eucalyptus dunnii	0.534	t/m³	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016

SCHEDULE

Type	Parameter	Value	Units	Data Source
	D: Eucalyptus macarthurii	0.541	t/m³	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	D: Eucalyptus nitens	0.483	t/m³	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	D: Eucalyptus smithii	0.569	t/m³	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	D: E.grandis x E.urophylla	0.487	t/m³	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	D: E.grandis x E.nitens	0.512	t/m³	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	D: E.grandis x E.camaldulensis	0.588	t/m³	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	D: Pinus patula	0.354	t/m³	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	D: Pinus elliottii (13 yrs)	0.42	t/m³	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	D: Pinus radiata	0.382	t/m³	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	D: Pinus taeda (12 yrs)	0.416	t/m³	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016

SCHEDULE

Type	Parameter	Value	Units	Data Source
	D: Pinus pinaster	0.44	t/m³	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
	D: Acacia mearnsii	0.655	t/m³	Du Toit B. et al. (2016) Carbon sequestration in South Africa plantation forests, Progress report number 1. Prepared for PAMSA, February 2016
Bark fraction				
	Bark fraction: default	0.13	fraction	IPCC 2006, V4, Ch12, Table 12.5, default value from notes
Default living biomass in other land uses				
	Total biomass: Grassland	6.1	t C/ d.m.	IPCC 2006, V4, Ch6, Table 6.4, Climate: Warm temperate, dry
	Total biomass: Annual Cropland	5	t C/ d.m.	IPCC 2006, V4, Ch5, Table 5.9
	Total biomass: Perennial Cropland	2.1	t C/ d.m.	IPCC 2006, V4, Ch5, Table 5.9, Climate: Temperate
	Total biomass: Other	0		
Default DOM carbon stocks				
	DOM: Broadleaf deciduous	28.2	t C/ha	IPCC 2006, V4, Ch2, Table 2.2, Climate: Warm temperate, dry
	DOM: Needleleaf evergreen	20.3	t C/ha	IPCC 2006, V4, Ch2, Table 2.2, Climate: Warm temperate, dry
Default mass flow fraction for C leaving the mill as a proportion of timber entering the mill under different milling processes. Paper/pulp mill				

SCHEDULE

Type	Parameter	Value	Units	Data Source
	FmCE: Kraft	0.49	fraction	Adu Poku, 2015; Published yield range %: 40-50
	FmCE: Sulphite	0.42	fraction	Adu Poku, 2015; Published yield range %: 29
	FmCE: Soda (Bagasse)	0.62	fraction	Adu Poku, 2015; Published yield range %: 28-42
	FmCE: Thermomechanical	0.11	fraction	Adu Poku, 2015; Published yield range %: 72-95
	FmCE: NSSC	0.13	fraction	Adu Poku, 2015; Published yield range %: 63-76
	FmCE: Mechanical & Kraft	0.36	fraction	Adu Poku, 2015; Published yield range %: 46
	FmCE: NSSC & Kraft	0.28	fraction	Adu Poku, 2015; Published yield range %: 57
	FmCSW: Kraft	0.03	fraction	Adu Poku, 2015; Published yield range %: 40-50
	FmCSW: Sulphite	0.01	fraction	Adu Poku, 2015; Published yield range %: 29
	FmCSW: Soda (Bagasse)	0.05	fraction	Adu Poku, 2015; Published yield range %: 28-42
	FmCSW: Thermomechanical	0.04	fraction	Adu Poku, 2015; Published yield range %: 72-95
	FmCSW: NSSC	0.15	fraction	Adu Poku, 2015; Published yield range %: 63-76
	FmCSW: Mechanical & Kraft	0.09	fraction	Adu Poku, 2015; Published yield range %: 46
	FmCSW: NSSC & Kraft	0.09	fraction	Adu Poku, 2015; Published yield range %: 57
	FmCLW: Kraft	0	fraction	Adu Poku, 2015; Published yield range %: 40-50

Type	Parameter	Value	Units	Data Source
	FmCLW: Sulphite	0.27	fraction	Adu Poku, 2015; Published yield range %: 29
	FmCLW: Soda (Bagasse)	0.015	fraction	Adu Poku, 2015; Published yield range %: 28-42
	FmCLW: Thermomechanical	0.1	fraction	Adu Poku, 2015; Published yield range %: 72-95
	FmCLW: NSSC	0	fraction	Adu Poku, 2015; Published yield range %: 63-76
	FmCLW: Mechanical & Kraft	0	fraction	Adu Poku, 2015; Published yield range %: 46
	FmCLW: NSSC & Kraft	0.04	fraction	Adu Poku, 2015; Published yield range %: 57
FHWPrec values for different categories and sources of data for the saw mill default approach.				
	FHWPrec: Sawn wood	0.43	fraction	Mean value. South African Forestry and Forest Industry Facts 1980-2017
	FHWPrec: Sawn wood (Pine)	0.5	fraction	CHRISTIE, S. & SCHOLES, R. 1995
	FHWPrec: Sawn wood (Eucs)	0.28	fraction	CHRISTIE, S. & SCHOLES, R. 1995
	FHWPrec: Veneer and plywood	0.46	fraction	UNECE/FAO, 2010
	FHWPrec: Particle board	0.82	fraction	UNECE/FAO, 2010
	FHWPrec: OSB and waferboard	0.9	fraction	UNECE/FAO, 2010
	FHWPrec: Fibreboard (all)	0.85	fraction	UNECE/FAO, 2010

SCHEDULE

Type	Parameter	Value	Units	Data Source
	FHWPrec: Mining timber	0.74	fraction	Median value (data not normally distributed). South African Forestry and Forest Industry Facts 1980-2017
	FHWPrec: Poles	0.83	fraction	Median value (data not normally distributed). South African Forestry and Forest Industry Facts 1980-2017
fLC96 values for different mill inputs				
	fLC96: Solid wood	0.97	fraction	Skog & Nicholson, 1998
	fLC96: Newsprint	0.84	fraction	Skog & Nicholson, 1998
	fLC96: Coated paper	0.82	fraction	Skog & Nicholson, 1998
	fLC97: Boxboard	0.68	fraction	Skog & Nicholson, 1998
	fLC97: Office paper	0.62	fraction	Skog & Nicholson, 1998
	fLC97: Mean paper used for pulp	0.74	fraction	Skog & Nicholson, 1998
Fires				
	Extra tropical forest CO2 EF	1569	g/kg d.m. burnt	Andreae and Merlet (2001). IPCC 2006, V4, Ch2, Table 2.5
	Extra tropical forest CH4 EF	4.7	g/kg d.m. burnt	Andreae and Merlet (2001). IPCC 2006, V4, Ch2, Table 2.5
	Extra tropical forest N2O EF	0.26	g/kg d.m. burnt	Andreae and Merlet (2001). IPCC 2006, V4, Ch2, Table 2.5
	Savanna and grassland CO2 EF	1613	g/kg d.m. burnt	Andreae and Merlet (2001). IPCC 2006, V4, Ch2, Table 2.6

Type	Parameter	Value	Units	Data Source
	Savanna and grassland CH4 EF	2.3	g/kg d.m. burnt	Andreae and Merlet (2001). IPCC 2006, V4, Ch2, Table 2.7
	Savanna and grassland N2O EF	0.21	g/kg d.m. burnt	Andreae and Merlet (2001). IPCC 2006, V4, Ch2, Table 2.8
	Slight loss	0.01	fraction	South Africa 2017 GHI inventory
	Serious damage	0.6	fraction	South Africa 2017 GHI inventory
	Total loss	1	fraction	South Africa 2017 GHI inventory
Controlled burning				
	Biomass burning Post-harvest: Eucalyptus grandis	31.4	t d.m/ha	du Toit et al. (2004) (Knowles & Christie, 2018)
	Biomass burning Post-harvest-spread slash: Eucalyptus grandis	15	t d.m/ha	Nadel (2005) (Knowles & Christie, 2018)
	Biomass burning Post-harvest-piled slash: Eucalyptus grandis	79	t d.m/ha	Nadel (2005) (Knowles & Christie, 2018)
	Biomass burning Post-harvest-mean: Eucalyptus grandis	15.4	t d.m/ha	Nadel (2005) (Knowles & Christie, 2018)
	Biomass burning Post-harvest-harvest residue: Eucalyptus grandis	26	t d.m/ha	Dovey (2012) (Knowles & Christie, 2018)
	Biomass burning Post-harvest-litter: Eucalyptus grandis	24.6	t d.m/ha	

SCHEDULE

Type	Parameter	Value	Units	Data Source
	Biomass burning Post-harvest-litter-sawn timber regime: Pinus patula	15 - 138	t d.m/ha	Ross 2004 (Knowles & Christie, 2018)
	Biomass burning Post-harvest-litter-pulp wood regime: Pinus patula	23 - 53	t d.m/ha	Ross 2004 (Knowles & Christie, 2018)
	Biomass burning Post-harvest-harvest residue-sawn timber regime: Pinus patula	54.6	t d.m/ha	Ross 2004 (Knowles & Christie, 2018)
	Biomass burning Post-harvest-harvest residue - pulpwood regime: Pinus patula	55.6	t d.m/ha	Ross 2004 (Knowles & Christie, 2018)
	Biomass burning grassland: firebreaks	10	t d.m/ha	IPCC 2006, V4, Ch2, Table 2.4, All savanna grasslands (mid/late dry season burns)*
	Biomass burning savanna: firebreaks	7	t d.m/ha	IPCC 2006, V4, Ch2, Table 2.4, All savanna grasslands (mid/late dry season burns)*
Fertilisers				
	EF for N additions from mineral fertilisers, organic amendments and crop residues, and N mineralised from mineral soil as a result of loss of soil carbon	0.01	kg N2O–N (kg N)-1	IPCC 2006 V4, Ch11, Table 11.1. Uncertainty range 0.003 - 0.03
Discount for emissions				

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

Type	Parameter	Value	Units	Data Source
	Fires	100		Accounting Rulebook and C tax Bill 2019
schedule 2 of the act	Fertilisation	100		Accounting Rulebook and C tax Bill 2019
SOC values				
	Managed forest - Cold, temperate, dry - High activity clay	50	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Cold, temperate, dry - Low activity clay	33	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Cold, temperate, dry - Sandy soils	34	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Cold, temperate, dry - Volcanic soils	20	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Cold, temperate, dry - Wetland soils	87	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Cold temperate, moist - High activity clay	95	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Cold temperate, moist - Low activity clay	85	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)

SCHEDULE

Type	Parameter	Value	Units	Data Source
	Managed forest - Cold temperate, moist - Sandy soils	71	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Cold temperate, moist - Spodic soils	115	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Cold temperate, moist - Volcanic soils	130	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Cold temperate, moist - Wetland soils	87	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Warm temperate, dry - High activity clay	38	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Warm temperate, dry - Low activity clay	24	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Warm temperate, dry - Sandy soils	19	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Warm temperate, dry - Volcanic soils	70	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Warm temperate, dry - Wetland soils	88	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Warm temperate, moist - High activity clay	88	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)

SCHEDULE

Type	Parameter	Value	Units	Data Source
	Managed forest - Warm temperate, moist - Low activity clay	63	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Warm temperate, moist - Sandy soils	34	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Warm temperate, moist - Spodic soils	NA	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Warm temperate, moist - Volcanic soils	80	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Managed forest - Warm temperate, moist - Wetland soils	88	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Cold, temperate, dry - High activity clay	33.56	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Cold, temperate, dry - Low activity clay	22.15	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Cold, temperate, dry - Sandy soils	22.83	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Cold, temperate, dry - Volcanic soils	3	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Cold, temperate, dry - Wetland soils	58.41	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)

SCHEDULE

Type	Parameter	Value	Units	Data Source
	Perennial crop - Cold temperate, moist - High activity clay	63.77	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Cold temperate, moist - Low activity clay	57.06	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Cold temperate, moist - Sandy soils	47.66	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Cold temperate, moist - Spodic soils	77.2	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Cold temperate, moist - Volcanic soils	87.27	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Cold temperate, moist - Wetland soils	58.41	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Warm temperate, dry - High activity clay	25.51	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Warm temperate, dry - Low activity clay	16.11	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Warm temperate, dry - Sandy soils	12.76	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Warm temperate, dry - Volcanic soils	46.99	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)

SCHEDULE

Type	Parameter	Value	Units	Data Source
	Perennial crop - Warm temperate, dry - Wetland soils	59.08	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Warm temperate, moist - High activity clay	59.084	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Warm temperate, moist - Low activity clay	42.29	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Warm temperate, moist - Sandy soils	22.83	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Warm temperate, moist - Spodic soils	NA	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Warm temperate, moist - Volcanic soils	53.71	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Perennial crop - Warm temperate, moist - Wetland soils	59.07	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Cold, temperate, dry - High activity clay	36.73	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Cold, temperate, dry - Low activity clay	24.24	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Cold, temperate, dry - Sandy soils	24.98	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)

SCHEDULE

Type	Parameter	Value	Units	Data Source
	Annual crop - Cold, temperate, dry - Volcanic soils	14.69	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Cold, temperate, dry - Wetland soils	63.91	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Cold temperate, moist - High activity clay	63.97	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Cold temperate, moist - Low activity clay	57.24	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Cold temperate, moist - Sandy soils	47.81	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Cold temperate, moist - Spodic soils	77.44	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Cold temperate, moist - Volcanic soils	87.54	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Cold temperate, moist - Wetland soils	58.58	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Warm temperate, dry - High activity clay	27.58	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Warm temperate, dry - Low activity clay	17.42	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)

SCHEDULE

Type	Parameter	Value	Units	Data Source
	Annual crop - Warm temperate, dry - Sandy soils	13.79	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Warm temperate, dry - Volcanic soils	50.81	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Warm temperate, dry - Wetland soils	63.87	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Warm temperate, moist - High activity clay	58.47	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Warm temperate, moist - Low activity clay	41.86	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Warm temperate, moist - Sandy soils	22.59	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Warm temperate, moist - Spodic soils	NA	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Warm temperate, moist - Volcanic soils	53.15	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Annual crop - Warm temperate, moist - Wetland soils	58.47	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Cold, temperate, dry - High activity clay	50	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)

SCHEDULE

Type	Parameter	Value	Units	Data Source
	Natural grassland - Cold, temperate, dry - Low activity clay	33	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Cold, temperate, dry - Sandy soils	34	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Cold, temperate, dry - Volcanic soils	20	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Cold, temperate, dry - Wetland soils	87	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Cold temperate, moist - High activity clay	95	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Cold temperate, moist - Low activity clay	85	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Cold temperate, moist - Sandy soils	71	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Cold temperate, moist - Spodic soils	115	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Cold temperate, moist - Volcanic soils	130	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Cold temperate, moist - Wetland soils	87	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)

SCHEDULE

Type	Parameter	Value	Units	Data Source
	Natural grassland - Warm temperate, dry - High activity clay	38	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Warm temperate, dry - Low activity clay	24	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Warm temperate, dry - Sandy soils	19	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Warm temperate, dry - Volcanic soils	70	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Warm temperate, dry - Wetland soils	88	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Warm temperate, moist - High activity clay	88	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Warm temperate, moist - Low activity clay	63	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Warm temperate, moist - Sandy soils	34	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Warm temperate, moist - Spodic soils	NA	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Natural grassland - Warm temperate, moist - Volcanic soils	80	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)

SCHEDULE

Type	Parameter	Value	Units	Data Source
	Natural grassland - Warm temperate, moist - Wetland soils	88	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Cold, temperate, dry - High activity clay	46.4	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Cold, temperate, dry - Low activity clay	30.64	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Cold, temperate, dry - Sandy soils	31.55	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Cold, temperate, dry - Volcanic soils	18.56	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Cold, temperate, dry - Wetland soils	80.74	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Cold temperate, moist - High activity clay	88.16	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Cold temperate, moist - Low activity clay	78.89	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Cold temperate, moist - Sandy soils	65.89	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Cold temperate, moist - Spodic soils	106.72	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)

SCHEDULE

Type	Parameter	Value	Units	Data Source
	Moderately degraded grassland - Cold temperate, moist - Volcanic soils	120.64	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Cold temperate, moist - Wetland soils	80.74	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Warm temperate, dry - High activity clay	35.492	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Warm temperate, dry - Low activity clay	22.42	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Warm temperate, dry - Sandy soils	17.75	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Warm temperate, dry - Volcanic soils	65.38	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Warm temperate, dry - Wetland soils	82.192	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Warm temperate, moist - High activity clay	82.72	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Warm temperate, moist - Low activity clay	59.22	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Warm temperate, moist - Sandy soils	31.96	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)

SCHEDULE

Type	Parameter	Value	Units	Data Source
	Moderately degraded grassland - Warm temperate, moist - Spodic soils	NA	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Warm temperate, moist - Volcanic soils	75.2	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)
	Moderately degraded grassland - Warm temperate, moist - Wetland soils	82.72	t C/ha	SA NIR 2017 (IPCC 2006 SOC Ref and IPCC 2019 stock change factors)

Chapter D: Verification Guidelines for Carbon Sequestration in Forest Plantations

D.1. Overview

An overview of the verification process is shown in Table D.1. The Carbon Tax Sequestration MRV Tool (referred to as "MRV Tool" throughout this document) is the tool which should be submitted via the SAGERS system. The collection of data and calculation of emissions/removals should follow the rules provided in the Accounting Rulebook (Chapter B) and the methods provided in the Methodological Guidelines for Land Activities in Forest Plantations (Chapter C). The competent authority to undertake the review in this case is the Department of Forestry, Fisheries and Environment (DFFE).

Table D.1: Overview of verification process.

Process stage	Details of the validation and verification guideline section	Applicable guideline section
1 Data collection	The taxpayer is required to collect and store relevant data and supporting evidence related to its sequestration. It is regarded as good practice that the facility establishes a Monitoring Plan.	Section D.2
2 Submission of data	The taxpayer is required to complete the self-declaration and MRV Tool and submit the requested documentation on the SAGERS. Taxpayers who have voluntarily submitted an acceptable verification statement on the SAGERS from an accredited or approved Independent Verifier (in accordance with process stages 4 and 5) alongside their MRV Tool, may have their data immediately approved by the DFFE for that facility, provided the requirements of Section D.2 have been met.	Section D.3
3 DFFE review	Once the taxpayer has submitted the required data to the SAGERS, the DFFE will conduct a series of post submittal data and risk assessment checks (see Section D.4.1). The results of the post-submittal checks will be used by the DFFE to determine which taxpayers should undergo inspection or independent verification and which taxpayers should have their MRV Tools approved.	Section D.4
4 Independent verification	If a taxpayer is selected for independent verification, they will be required to select an Independent Verifier approved by the DFFE prior to undertaking the verification assessment based on their competence being aligned to the SANAS accreditation requirements as outlined in Section D.5. This is a transitionary arrangement and Independent Verifiers will need to be SANAS accredited from 2023 to undertake independent verification. Additional detail on this is provided in Section D.5. The verification process must be completed within 90 days of notification. Once a	Section D.5

SCHEDULE

	signed Verification Opinion and final Verification Report has been issued by the Independent Verifier and the DFFE has conducted final checks on the MRV Tool and Verification Report and is satisfied with the outcome, the MRV Tool outputs will be approved.	
5 **Data approved**	The taxpayers' MRV Tool is deemed accepted if the DFFE does not respond to the taxpayer with questions for clarification or corrections within 60 days of having received the Verification Report. If a taxpayer is required to undergo independent verification as outlined in Step 4, the DFFE will notify the taxpayer once the MRV Tool has been checked.	Section D.6

D.2. Data collection

Taxpayers must ensure transparency of the MRV Tool by archiving all data, calculations, algorithms, procedures and technical references used to estimate GHG emissions/removals. This information relates to the calculations performed for the listed activities in line with the requirements of the Accounting Rulebook (Chapter B) and the Methodological Guidelines for Land Activities in Forest Plantations (Chapter C). This is done to ensure that verification of submissions made in terms of the C Tax Act can take place. Data Providers must keep a record of the information submitted to the DFFE for at least five years, and at least between two successive independent verifications, and such records must, on request, be made available for inspection by the DFFE.

Documents to be kept are:

a) Archiving all reports submitted for at least 5 years or since last independent verification.
b) Documents to support the extent of the plantations area and wood/biomass productivity.
c) Documentation of assessments made over excluded emission sources (e.g. annual amount of liquid and solid waste).
d) Data management system documentation, including descriptions of the processes for data collection, input, calculation, and management.
e) Results of any relevant internal audit or third-party verification activities.
f) Facility level breakdowns of data used to generate the sequestration estimated in the MRV Tool for forest land and HWP.
g) Records of incidents or events on site that may impact on production or other emission/sequestration drivers (e.g. disease or fires).
h) Justification of the quantification methodology and emission factors used, including documented references and citations, and root data upon which any site-specific factors were derived.
i) Documentation of any key assumptions and uncertainties associated with the sequestration data.

SCHEDULE

j) Description of GHG reduction projects.
k) Description of operational incidents that impact GHG performance.
l) Explanation of trends in sequestration emissions from historical data and forecasts.
m) Supporting MRV Tool detailing source data.
n) Green Mamba spreadsheets.
o) Submission files and documentation of reporting under the NGER.
p) GIS or paper maps identifying the plantation areas.
q) Documentation on system for distinguishing TUP from deforested areas, including remote sensing data to track TUP and deforestation.
r) Certification records.
s) Correspondence with suppliers of harvested wood and 3rd party suppliers (e.g., invoices).
t) Manufacturing data, weigh bridge data, forest production data.
u) Correspondence with suppliers of fertilisers (e.g., invoices).
v) Self-implemented monitoring plan (optional).

D.3. Submission of data

In accordance with C Tax Act, all taxpayers are required to submit their Sequestration Report on the SAGERS for the preceding calendar year, to the DFFE by 31 March of each year. Taxpayers who have submitted a Verification Report, in accordance with Section D.5 of this guideline, with the submission of their MRV Tool report via the SAGERS, may have their data immediately approved by the DFFE provided that:

a) The independent verifier has issued a positive Verification Opinion (see Section D.5 for further detail) and any material misstatements detected in the independent verification process have been rectified.
b) The DFFE is satisfied that the Verification Report and opinion produced by the independent verifier is in line with the requirements of the Validation and Verification Guideline.
c) A final check of the MRV Tool by the DFFE is completed.

Taxpayers who have been selected for independent verification, as an outcome of the process outlined in Section D.4.2, should submit the Verification Report to the DFFE within 90 days of being notified of the requirement to undertake independent verification by the DFFE.

D.3.1. Submission reports

Data Providers are required to submit the following information on the SAGERS by 31 March:

a) MRV Tool: Taxpayers are required to complete the MRV Tool for each of its facilities.
b) Self-declaration: As a part of the submission, taxpayers will be required to self-declare on the SAGERS that they have reviewed their MRV Tool for accuracy before submitting onto the

SCHEDULE

SAGERS, and that all information submitted on the SAGERS is truthful, accurate, complete and in compliance with the C Tax Act, to the best of their knowledge.

c) Verification Reports (Optional): Taxpayers who have voluntarily completed an independent verification exercise in accordance with the Validation and Verification Guideline, may submit their facility level Verification Report and Verification Opinion at this stage of submission. Taxpayers may have their data immediately approved by the Competent Authority for that facility, if they have opted to have their emissions verified, provided the requirements of Section D.3.1 have been met.

d) Monitoring Plan (Optional): While it is not mandatory for taxpayers to submit monitoring plans to the competent authority in Phase 1 of the Verification Programme, taxpayers who have monitoring plans in place may do so.

D.4. Review by DFFE

D.4.1. Post submittal checks

Once the MRV Tool has been formally submitted on the SAGERS, the DFFE will run a number of post-submittal checks to evaluate the validity of submitted data and identify areas where risk of inconsistencies or inaccuracies exist. The post-submittal checks will entail a combination of automated system and manual checks. The outcome of the post-submittal checks will determine whether independent verification required. Examples of the types of checks that will be conducted are outlined in Table D.2 below. Examples of other suggested checks which DFFE can undertake to ensure the value ranges are in the correct range are provided in Appendix D.

Table D.2: Examples of checks that will be completed as part of the review by competent authority.

Type of check	Description	MRV tool reference
Rulebook checks	Check that all rules in the Rulebook have been adhered to.	
Range checks	Determine if Sequestration report data is within the expected range. Make comparisons with IPCC default values.	All sheets
Statistical checks	Evaluate data from similar taxpayers to identify outliers.	
Calculation checks	Check that columns have been added correctly.	All sheets
	Check balance between various input and output parameters	
	Check all appropriate data columns are completed	All sheets

SCHEDULE

	3rd party checks	
	Check that the discount factors are correctly applied.	Accounting sheet
Mass balance checks	Check the mass of carbon entering the mill is balanced with what is leaving the mills. Sum of inputs (tC) - sum of outputs (tC) = 0	HWP sheet
Afforestation checks	Check that afforested areas are not older than 20 years.	Land gain-loss method
Deforestation and TUP checks	Check the consistency in reporting of TUP and Deforestation areas	
HWP checks	Check the production data supplied in SA forestry statistics is not less than the sum of all inflows reported.	
Biomass burning checks	Check ratio of estimated gas emissions are equal to the GWP of that gas	Wildfires; Controlled burning
Methodological checks	Check changes in tier levels, and ensure methods are following IPCC methodology.	
	Ensure correct columns are completed for the selected Tier method	
Unit checks	Ensure consistency in units and check unit conversions.	
Change in ownership and registration checks	Determine if there have been any changes in ownership and whether this has affected outputs.	Verification sheet
Outside data checks	Data checks against an outside source, specifically Green Mamba forms (see Table D.3) and NGER submissions.	Verification sheet
Missing data checks	Identify gaps in emission/sequestration sources compared to the taxpayer activities.	
Cross checks	Cross-check with new data or common parameters used across sectors against that of other entities in the same sector or sector averages.	
	Cross-check with NGER submissions.	Verification sheet
Boundary checks	Assess whether data captured is in the correct reporting period, and that the data should be included as a part of the facilities data or not.	

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

SCHEDULE

	Ensure that roundwood stocks from previous years are not reported twice as input into HWP.	
Trend analysis	Identify unusual or unexpected trends or outliers which may be indicative of errors between years.	
Land area checks	Complete a land change matrix and check all land area is accounted for.	
	Check land change matrix for previous submission to check correspondence between previous and current stratification.	
Verification checks	Checks of the results of a previous verification completed in line with the validation and verification guideline.	

In the MRV Tool a Verification sheet has been included (Table D.3). The completion of this sheet is optional but would assist in the verification process and may reduce the change of being selected for an independent review.

Where areas of unexplained risk are detected, the DFFE may contact the taxpayer to resolve failed checks or explain why the failed checks do not indicate an error. This may entail a process of documentation requests by the DFFE for additional evidence to explain sources of error in the Sequestration Report. Where necessary, the DFFE may request an on-site visit to the taxpayer's facility if the documentation provided still does not satisfy the DFFE that the error has been resolved. Taxpayers are given a period of 60 days to address errors otherwise a compliance issue is raised.

Table D.3: Verification table included in the Sequestration tool.

Element	Method	Reported Value	Units	Green Mamba Reference	Notes
Any land acquired or leased?		Yes	-	B.2 Page 3	
Area of land acquired/ leased from a 3rd party	G-L	0	ha	B.2.1 Page 3	Only area associated with purchases HWPs should be reported here
Total area at the beginning or the reporting period	S-D	30	ha	B.6 Page 5	
Area of plantation		0	t	Section C and D, Page 6 - 11	Consider total area by genus/species if possible
Total area by species: Softwood	S-D	[calculate manually]	ha	Section E Page 12	Aggregate softwood areas for comparison with Green Mamba
Total area by species: Eucalyptus grandis	S-D	0	ha	Section E Page 12	Aggregate Eucalyptus grandis areas for comparison with Green Mamba
Total area by species: Other eucalyptus	S-D	[calculate manually]	ha	Section E Page 12	Aggregate other eucalyptus areas for comparison with Green Mamba
Total area by species: Wattle	S-D	[calculate manually]	ha	Section E Page 12	Aggregate wattle areas for comparison with Green Mamba
Total area by species: Poplars	S-D	[calculate manually]	ha	Section E Page 12	Aggregate poplar areas for comparison with Green Mamba
Total area by species: Other hardwood	S-D	[calculate manually]	ha	Section E Page 12	Aggregate other hardwood areas for comparison with Green Mamba

SCHEDULE

Total volume Consumed and / or Processed from own forest management units		[calculate manually]	m3	Table F2.2 F.2.2 - Own Consumption and / or Processing	Only consider Total inflow: Mass C Entering the Mill (t) from company owned plantations
Total area affected by wildfires		5	ha	Section H.1 Page 15	Assumed that only wild/accidental fires are reported under Green Mamba

D.5. Independent verification

D.5.1. Selection of facilities for independent verification

D.5.1.1. Criteria for selection of independent verification

There are several factors that the DFFE will consider that may trigger the need for a taxpayer to undergo independent verification of their facility. The main criteria that will be used in this determination includes the following:

a) The results of the post-submittal checks completed in Table D.2.
b) The completion of the Verification tab in the MRV Tool (Table D.3).
c) The total sequestration - taxpayers with high total sequestration are more likely to be required to undergo independent verification.

D.5.1.2. Notification of independent verification

Should the taxpayer MRV Tool be selected to undergo independent verification, the DFFE will notify the taxpayer. The notification for independent verification will at a minimum contain the following details:

a) Indication of the reason for being selected for independent verification.
b) Detail on the timelines for the finalisation of the independent verification process
c) The scope of the independent verification. Independent verification may in certain circumstance focus on specific elements of the Sequestration Reports submitted.
d) Additional administrative guidance on the independent verification process.

D.5.2. Independent verification principles and requirements

D.5.2.1. Principles of verification

The principles of verification described below are taken from section 3.1.2 of the Guidelines for Validation and Verification of Emissions (DFFE, 2020). The Independent Verifier shall adhere to the following principles of verification throughout any independent verification engagement:

a) Independence and objectivity –The Independent Verifier and its verification team shall remain independent of the facility and activity being verified, and free from bias and conflict of interest. The verification teams shall maintain objectivity throughout the verification to ensure that the findings and conclusions will be based on objective evidence generated during the verification.
b) Ethical conduct - Demonstrate ethical conduct through trust, integrity, confidentiality, and discretion throughout the verification process.
c) Fair presentation - Reflect truthfully and accurately verification activities, findings, conclusions, and reports. Report significant obstacles encountered during the verification process, as well as unresolved, diverging opinions among verification team members, the Independent Verifier, and the Data Provider.

SCHEDULE

d) Due professional care - Exercise due professional care and judgment in accordance with the importance of the task performed and the confidence placed by the Data Provider and Independent Verifier. Have the necessary skills and competencies to undertake the verification.

D.5.2.2. Scope of verification

The verification team shall plan and perform the verification to state with a reasonable level of assurance that the aggregated error in the total GHG emissions for the reporting period does not exceed the materiality limit.

These verification guidelines outline the type of verification procedures that shall be conducted (i.e. substantive testing, controls testing, site visit) to achieve a reasonable level of assurance. However, they are not intended to be prescriptive about the exact verification activities to be performed during verification. The exact verification activities shall be conducted based on the lead verifier's professional judgment.

D.5.2.3. Reasonable level of assurance

The level of assurance refers to the degree of assurance the intended user requires in a verification and this is defined in Section D.3.1.3 of the Guidelines for Validation and Verification of Emissions (DFFE, 2020).

D.5.2.4. Materiality

The prescribed materiality limit for independent verification engagements under these guidelines is 5% based on international standards and norms (DFFE, 2020). The total emissions and removals, i.e. the total "S" value, determined by the independent verifier should not deviate by more than 5% of the taxpayers reported value in order for the verification team to issue a positive Verification Opinion statement).

D.5.3. Independent verification process

The independent verification process will follow that described in Section D.3.2 of the Guidelines for Validation and Verification of Emissions (DFFE, 2020).

D.6. Data approval

A taxpayer's MRV Tool is deemed accepted if the DFFE does not respond to the taxpayer with questions for clarification, corrections or instruction for verification within 90 days of the submission. In the instance that a taxpayer is required to undergo independent verification, the DFFE will communicate with the taxpayer on the verification requirements and any necessary instructions and will provide confirmation once the verification process has concluded and the data has been approved by the DFFE.

SCHEDULE

Once the Sequestration Report is approved it will be submitted to SARS where it will be combined with the company's total fuel combustion related greenhouse gas emissions ("E" in the Carbon Tax Act). SARS will be responsible for checking that if the sequestration ("S") is actually a net emission (i.e. S<0) then "E-S=E".

D.7. References

DFFE, 2020. Technical Guidelines for Validation and Verification of Greenhouse Gas Emissions: A companion to the South African National Greenhouse Gas Emission Reporting Regulations, Department of Forestry, Fisheries and Environment, Pretoria, South Africa.

SCHEDULE

Appendix D

Type of check	Description	MRV tool sheet reference
Area checks	Total area checked against reported area for FM, AR, D (i.e. Total = FM+AR-D).	Facility register; 3rd party register; Land gain-loss method; Land stock-difference method
Afforestation checks	Check that Afforestation area is not older than 20yrs	Land gain-loss method; Land stock-difference method
TUP check	Check that TUP is not more than 5 years	Land gain-loss method; Land stock-difference method, check MRV tool if emission is deducted
Deforestation check	TUP area that was 5 years in previous submission and was not replanted should be now deforestation.	Land gain-loss method; Land stock-difference method
Stratification checks	Check previous submission to check correspondence between previous and current stratification (for C stock change method).	Facility register
Gain-loss method checks	Living Biomass GAIN (ABG+BGB, tC) / Living Biomass LOSS (ABG+BGB, tC) ±1 (or very close to 1, ideally smaller in sustainable forestry)	Land gain-loss method
	Total of [Total net removal (t CO_2eq/yr)] / Total of [Total area (of AR, FM)] < approx. 5 (so in practice it should be equivalent to net biomass growth per 1 ha per year, as long as 1tCO_2 = 1 mc of wood), if annual roundwood increment is 10 m^3 that is 10tCO_2, or slightly higher is entire ABG is included (foliage, roots) 12 tCO_2	Land gain-loss method
	Total of [Harvest volume (m^3/yr)] = Total of [Harvest volume (m^3/yr)] from Afforestation and Forest Management	Land gain-loss method, Green Mamba

SCHEDULE

Stock difference method checks	Total of [Total net removal (t CO_2eq/yr)] / Total of [Total area (of AR, FM)] < MAI	Land stock-difference method
	Total of [Harvest volume (m^3/yr)] = Total of [Harvest volume (m^3/yr)] from Afforestation and Forest Management	Land stock-difference method, Green Mamba
Reporting and accounting checks	Total accounted amount / Total of [Total area (of AR, FM)] < approx. 5	Reporting & accounting
DOM checks	20 * DOM ΔC (tC) = DOM (tC/ha) in afforestation	Land gain-loss method; Land stock-difference method
Removals from forest	to be consistent with harvest from CSC biomass (expected approx. Rem >0.9 Harvest). Inflow cannot be bigger than removals	Land gain-loss method; Land stock-difference method
Volume entering the mill	to be consistent with Removal (expected approx. Entering >0.9 Removal)	Land gain-loss method; Land stock-difference method; HWP
National level checks	At national level, the sum of harvested from eligible must be the sum of inflow reported by all companies	
HWP checks	Total of [Volume Entering the Mill (m^3)] (HWP sheet) = Total of [Harvest volume Whole tree (m^3/yr)] from Afforestation and Forest management	HWP
HWP mass balance checks	Sum of inputs (tC) - sum of outputs (tC) = 0	HWP
Biomass burning verification	Ratio of estimated N_2O emissions/ CO_2 emissions = GWP N_2O	Wildfires; Controlled burning
	Ratio of estimated CH_4 emissions/ CO_2 emissions = GWP CH_4	Wildfires; Controlled burning
	Ratio of estimated N_2O emissions/ CH_4 emissions = GWP N_2O/ GWP CH_4	Wildfires; Controlled burning

SCHEDULE

Fertiliser checks	Verify quantity purchased correspond to usage	Fertilisers