Resources

*Production Forest Methodologies for the Emissions Reduction **Fund***

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Forest & Wood Products Australia

Production Forest Methodologies for the Emissions Reduction Fund

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by

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Executive Summary

In 2014 the Federal Government established the Emissions Reduction Fund (ERF) which created a potential opportunity for the forest and wood products sectors to generate revenue through participation in greenhouse gas emissions (GHG) abatement projects. To realise this opportunity methods for project activities must be developed, meet legislated standards and be approved by the government.

This project investigated opportunities for methods that could be developed under the ERF for forest managers and wood processors in both the native forest and plantation sectors, including through:

1. Carbon sequestration in long-rotation plantations;
2. Carbon sequestration through the retention of plantations established on economically marginal sites which are under threat of conversion into agricultural lands;
3. Carbon storage in harvested wood products (HWPs);
4. Use of biomass from forest harvest operations and wood processing facilities to generate bioenergy;
5. Increasing carbon stocks in forests through enhanced forest management; and
6. Reduced emissions through bushfire prevention.

Under the ERF the government instituted an approach to method development that is driven by the Department of Environment and Energy (DoEE) with support from industry through technical working groups and with oversight from an Emissions Reduction Assurance committee (ERAC). Methods are developed on a priority basis, taking into account:

- Business support for the method and the likely volume of GHG abatement;
- The ease, certainty and cost of estimating emissions reductions;
- Whether the technology involved is proven and commercially ready;
- If the activity is likely to have adverse social, environmental or economic impacts; and
- Whether the activity could be more efficiently promoted through alternative measures.

Methods must also meet a number of legislated offsets integrity standards.

It was under this framework that this project researched and proposed to the DoEE a number of methods that would enable participation in the ERF by the forest and wood products sector and which would result in genuine and substantial GHG emissions abatement. These proposals were based on review of current literature and research and consultation with industry partners. Consultation with DoEE and industry was an iterative process which enabled the development and refinement of method options.

By the completion of this project one new ERF method for Plantation Forestry had been made into a legislative instrument enabling the plantation sector to participate in the ERF and ten projects had been registered. That method incorporates several elements of other methods considered under this project. Additional opportunities for the wood industry to participate in the ERF were identified in a number of other existing methods with scope for these to be enhanced through future amendments.

With respect to the Plantation Forestry Method there are opportunities to improve the method during a formal review exercise. There is scope for modelled abatement estimates to become more closely aligned with actual abatement by expediting updates to FullCAM that allow project proponents to use reliable project-specific inventory data as one of the inputs to FullCAM.

In addition, there are opportunities to explore:

a) the potential of a zero baseline for short-rotation plantations at risk of conversion to non-forest and use.

b) new research supporting the inclusion of HWPs in landfill.

c) revising the Ministerial Assessment of impacts on Agricultural land to ensure consistency across all relevant ERF methods.

d) the application of the 600mm rainfall limitation for relevance and consistency across relevant ERF methods.

e) revisions to the NPI boundaries to ensure that they capture all suitable plantation areas.

With respect to expanding opportunities within other methods, consideration should be given to:

a) allowing greenfield activities (such as replacing a coal powered station with a biomass powers station).

b) revising the limits on energy generation in the IEFE method, to allow for activities that generate electricity greater than the current restriction of 30 megawatts to increase demand for biomass feed stock from plantation forests.

c) reviewing the scope of the Renewable Energy Act rules with respect to energy crops, and how this could be revised to bring it in line with the CFI Regulation.

d) opportunities to generate abatement through enhanced management of native forests, taking a landscape approach.

e) opportunities associated with the use of biomass for bioenergy.

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Introduction

This project on Production Forest Methodologies for the Emissions Reduction Fund (ERF) was designed to research and develop methods for greenhouse gas (GHG) abatement through a range of forestry related activities. The concept was developed in response to past research that had shown that there is a significant contribution that production forests and wood can make to GHG emissions abatement (Ximenes et al. 2016 and the concurrent lack of available methods that are applicable to project activities that could be undertaken in or arising from production forests and wood industries.

The project considered a number of possible GHG abatement opportunities:

- Carbon sequestration in long-rotation plantations.
- Carbon sequestration through retention of plantations established on economically marginal sites which are under threat of conversion into agricultural lands.
- Carbon storage in harvested wood products (HWPs) in service and in landfill.
- Increasing carbon stocks in native forests due to increased productivity arising from specific forest management interventions such as native forest silvicultural practices (e.g. ecological thinning; extended rotation length) and actions to improve forest health (e.g. more effective lantana control and regenerating forests impacted by Bell miner associated dieback).
- The use of residual biomass from forest harvest operations and wood processing to generate bioenergy.
- Approaches for reduced emissions through bushfire control.

Research Context

This project was undertaken within the context of the Federal Government’s policies for climate change, specifically the framework that has been established for the generation and sale of carbon credits (Australian Carbon Credit Units or ‘ACCUs’) – initially the Carbon Farming Initiative (CFI) and subsequently the ERF. The opportunity to develop methods that credit GHG emissions abatement and implement these at the project level arises largely through Australia’s participation in international climate change initiatives such as the Kyoto Protocol[1] and the Paris Agreement.[2] Any emissions reductions that are credited under an ERF methodology must be able to be counted towards Australia‘s international climate change targets, in accordance with Australia‘s obligations under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol or a successor agreement.

The Kyoto Protocol

The Kyoto Protocol is an international agreement linked to the UNFCCC, which commits its Parties by setting internationally binding emission reduction targets. The Kyoto Protocol was adopted in 1997 and entered into force in 2005. The detailed rules for the implementation of the Protocol were adopted at COP 7 in Marrakesh, Morocco, in 2001, and are referred to as ‘the Marrakesh Accords’.

[1] https://unfccc.int/process/the-kyoto-protocol

[2] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

The Kyoto Protocol's first commitment period ran from 2008 to 2012 and aimed to reduce the collective greenhouse gas emissions of developed country Parties by at least five per cent below 1990 levels. Australia ratified the Kyoto Protocol on 3rd December 2007, adopting a Quantified Emissions Limitation or Reduction Obligation (QELRO) limiting Australia's emissions growth over the first commitment period to 108 per cent of 1990 levels. The Kyoto rules focussed on defining certain human activities which draw land into the accounting framework. Some of the land sector activities are mandatory, meaning that all countries with Kyoto Protocol commitments must include them in calculating their annual GHG emissions and removals. For the first commitment period, 2008-2012, this included the forestry activities of afforestation, reforestation and deforestation (Article 3.3).

In 2012, the Kyoto Protocol was amended to establish a second commitment period from 2013 to 2020. Australia submitted a second commitment period QELRO of 99.5 per cent, consistent with the Government's unconditional target to reduce emissions by five per cent below 2000 levels by 2020. Forest management (Article 3.4) was added to the list of mandatory activities for this period. Other land sector activities remained voluntary. The Australian Government subsequently announced it would include cropland management, grazing land management and revegetation activities.

As a result, the land sector activities that currently contribute to Australia's international commitments are:

- Deforestation- the direct, human-induced removal of forest cover and replacement with pasture, crops or other non-forest uses since 1 January, 1990.
- Reforestation/afforestation - the establishment of new forests by direct human action on land not forested as at 1 January, 1990.
- Forest management - a system of practices for stewardship and use of forestland aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner. Forest management lands have been defined as those forests that are managed under a system of practices that include forest harvesting, silvicultural practices and the protection of natural resources within the areas of land available for harvest. Forests included under this definition are[3]:
    - Multiple Use Forest;
    - Plantations established prior to 1990 (that is, those plantations that do not qualify for afforestation/reforestation);
    - other forest lands, including privately managed native forest and lands in formal conservation reserve as at December 2009, where harvesting or sink enhancement activities occur.

Forest Management activities also occur on privately managed native forest land and to ensure balanced and complete accounting for emissions and removals from forest management activities, harvesting on these lands since 1990 has been identified and included under Forest Management. Forest Management therefore includes all timber production areas[4].

[3] Australia's National Greenhouse Gas Inventory September 2014 Quarterly Update.

[4] Australian Government (2011). Submission to the AWG-KP: September 2011 — Forest Management Reference Level Submission.

Some new accounting rules were also agreed for the second commitment period, which helped parties to reach agreement on the mandatory inclusion of forest management.

- Firstly, net emissions from forests are compared with net emissions from a forest management reference level, which takes into account the underlying growth dynamics of forests and policies in place at 2009.
- Secondly, countries can exclude from their accounting the emissions, and subsequent sequestration, from significant natural disturbances beyond human control such as bushfire.
- Thirdly, parties are required to account for six carbon pools on forest lands: above-ground biomass (AGB), below-ground biomass (BGB), litter, dead wood, soil organic carbon (SOC) and HWP emissions. The HWP pool from forests is included and estimated to reflect the use and degradation of products over time.

The Paris Agreement

The Paris Agreement under the UNFCCC was made at the 21st Conference of the Parties (‘COP21’) in Paris in 2015. The agreement sets in place a framework for all countries to take climate action from 2020, building on existing international efforts in the period up to 2020. Key outcomes include:

- A global goal to hold increase in average temperature to well below 2°C and pursue efforts to keep warming below 1.5°C above pre-industrial levels.
- All countries to set mitigation targets from 2020 and review targets every 5 years informed by a global stocktake.
- Robust transparency and accountability rules to provide confidence in countries' actions and track progress towards targets.
- Promoting action to adapt and build resilience to climate impacts.
- Financial, technological and capacity building support to help developing countries implement the Agreement.

Ahead of the Paris Conference, countries submitted indicative post-2020 targets, known as Intended Nationally Determined Contributions (INDCs). Australia set a target to reduce emissions by 26-28 per cent below 2005 levels by 2030, which builds on the 2020 target of reducing emissions by five per cent below 2000 levels[5].

Australia's National Greenhouse Gas Inventory

Australia's national greenhouse gas inventory is prepared according to the framework of rules supporting the UNFCCC and the Kyoto Protocol. All parties to these agreements must use the UNFCCC Reporting Guidelines on Annual Inventories[6] and the supplementary reporting requirements under the Kyoto Protocol to prepare their national inventories. These guidelines establish standardised reporting formats and require detailed information on all aspects of each party's national inventory system, including measurement systems, data collection systems, estimation methodologies, reporting and data management.

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[5] http://www.environment.gov.au/climate-change/government/international/paris-agreement

[6] https://unfccc.int/process/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/reporting-requirements

The principle sub-classifications of the Land Use, Land Use Change and Forestry (LULUCF) sector under the Kyoto Protocol classification system include Deforestation, Forest Management, Afforestation/Reforestation, Grazing land management and Crop land management. The corresponding classifications under the UNFCCC include Forest conversion, Forest lands, Land converted to forest land, Grasslands and Croplands. Emissions and removals on forest management land are estimated using the same estimation methods and data used to estimate emissions and removals for the forest remaining forest land category for the national inventory reported under the UNFCCC.

To ensure consistency and comparability between the inventories of different countries, emissions must be estimated using the methods described by the Intergovernmental Panel on Climate Change (IPCC). Currently emission estimates are compiled in accordance with the IPCC Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 1997); IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC 2000); and the Good Practice Guidance on Land Use, Land Use Change and Forestry (IPCC 2003, IPCC 2014). Parties may also use country-specific methodologies where these are consistent with the IPCC guidelines and improve the accuracy of emissions estimates. Australia predominantly uses country-specific methodologies and emissions factors, described in detail in the National Inventory Report.

Carbon Farming Initiative

The Carbon Farming Initiative was a voluntary carbon abatement scheme that commenced in 2011 through the introduction of the *Carbon Credit (Carbon Farming Initiative) Act 2011* ('CFI Act'). The CFI Act established a project-based, baseline-and-credit offset certification scheme. It was designed to work in conjunction with a carbon pricing mechanism which was a cap-and-trade emissions trading scheme. The scheme required entities with an emissions liability to purchase and surrender 'eligible emissions units' ('carbon credits') to cover their liability and enabled the participation of farmers and land managers to generate and sell eligible emissions units by storing carbon or reducing greenhouse gas emissions on the land. Participation in projects to earn carbon credits through GHG abatement activities was enabled through the development of methodologies.

Under the CFI, method development was largely an industry led activity, with the support of government, including through grant funding. Method proponents developed methods and then submitted these to the Domestic Offsets Integrity Committee (DOIC) according to a set format together with supporting evidence.

The DOIC was an independent expert committee that supported the environmental integrity of carbon offsets generated under the CFI. It assessed proposals for methods and advised the then Minister for the Environment on the making of methods. The DOIC was supported by technical experts to undertake methodology assessments, and a secretariat to provide administrative support, through the then Department of Climate Change and Energy Efficiency (DCCEE). The DCCEE undertook the steps to make the methods approved by the DOIC into legislative instruments known as methodology determinations.

Methodology determinations ('methods') contain a set of rules and conditions for the implementation of a project activity that results in the emission abatement (for example tree planting). The methods establish the eligibility rules for projects – such as where a project can be implemented, the types of activities that are accepted as increasing sequestration or reducing emissions, and the carbon accounting and monitoring and verification process. All methods are also subject to a broad set of rules that are set out in the CFI Act, *Carbon Credits (Carbon Farming Initiative) Regulations 2011* and legislative rules.

Opportunities to develop methods were guided by a 'positive list' which was a register of abatement activities eligible to earn carbon credits. A 'negative list' of activities, for which methods could not be developed, was also established, which identified types of projects likely to cause adverse impacts to one or more of the following:

- the availability of water
- the conservation of biodiversity
- employment
- the local community, and
- land access for agricultural production.

The aspects of the negative list relevant to this project are described in further detail below.

Emissions Reduction Fund (ERF)

In 2014 the ERF replaced the CFI and provided a new governance structure, process and framework for the development of methods (Figure 1) and for selling ACCUs through a government reverse auction rather than the pre-existing 'cap and trade' market-based approach. The ERF auction is a voluntary mechanism for projects to sell their carbon credits to the Government which then uses them to help meet its international obligations. Other policy-led opportunities for the sale of carbon credits are through a 'safeguard mechanism' and voluntary carbon offsetting. The safeguard mechanism was introduced to 'protect taxpayers' funds by ensuring that emissions reductions paid for through the crediting and purchasing elements of the ERF are not displaced by significant increases in emissions above business-as-usual levels elsewhere in the economy'[7]. The safeguard mechanism applies to facilities with direct emissions above 100,000 tCO_2-e per year and that are required to manage their emissions against a baseline including through the purchase of ACCUs. Voluntary carbon offsetting is based on sales of ACCUs to companies, organisations and individuals wishing to manage their GHG emissions and to achieve carbon neutrality. The government developed a National Carbon Offsets Standard to support this industry[8].

<u>ERF Method Development</u>

Under the ERF, the CFI positive list was abolished and replaced a by a process of prioritising method development with a view to progressing those methods that offer the greatest opportunity for uptake and generating genuine abatement at lowest cost. The method prioritisation process applies the following criteria:

- Whether there is broad business support for the method and what the likely volume of abatement would be;
- Whether emissions reductions can be easily estimated with a reasonable degree of certainty and cost;
- Whether the technology involved is proven and commercially ready;

[7]http://www.environment.gov.au/climate-change/government/emissions-reduction-fund/publications/factsheet-erf-safeguard-mechanism

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

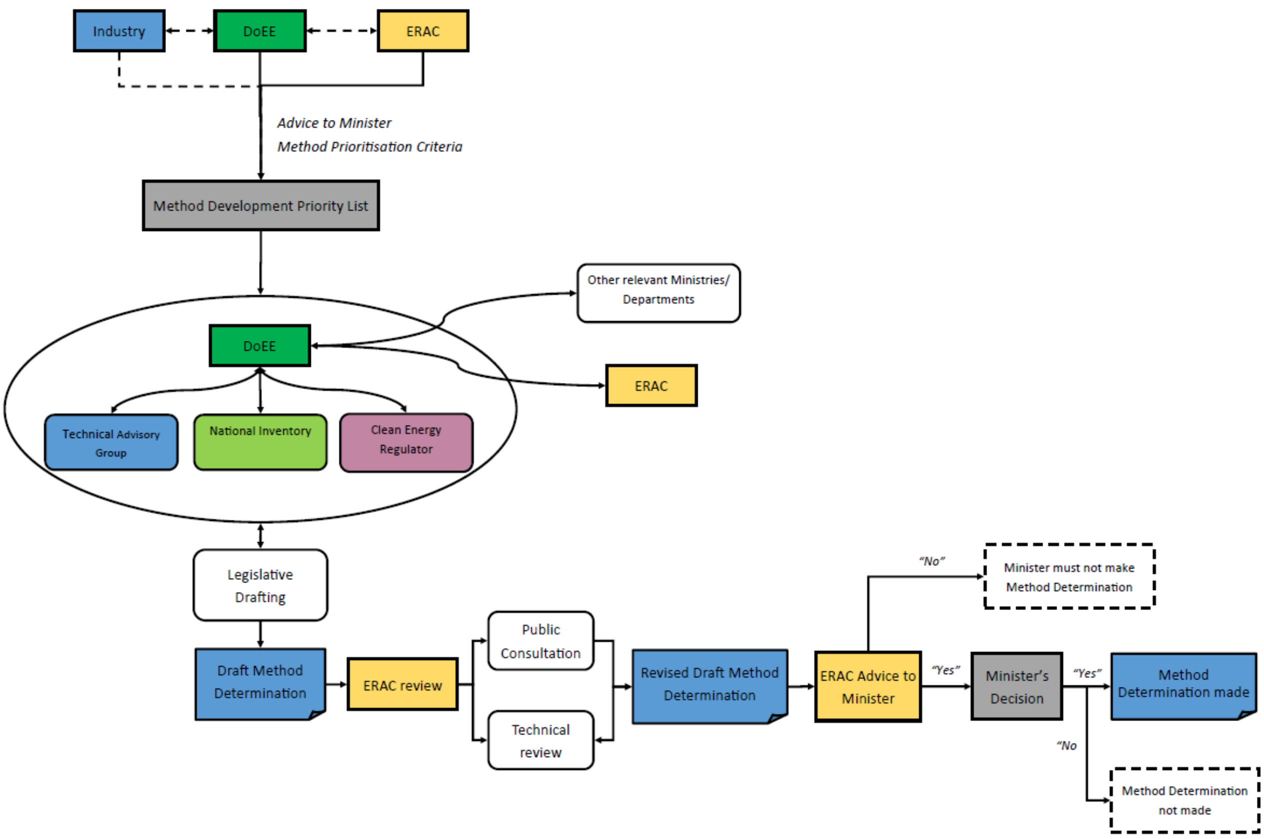
- If the activity is likely to have any adverse social, environmental or economic impacts; and
- Whether the activity could be promoted more efficiently through alternative measures.

Once prioritised the Department of Environment and Energy (DoEE) coordinates the development of methods, with assistance from Technical Working Groups (TWGs) comprising scientific and industry experts, and stakeholders as well as with the Clean Energy Regulator (CER) and other relevant government departments.

Once developed, draft methods are submitted to the ERAC which assesses whether methods meet the Offsets Integrity Standards (described below) and other requirements of the ERF. The ERAC provides advice to the Minister who then decides whether to make methodology determinations. To ensure that methods are practical and cost-effective, the ERAC also considers advice from the CER on implementation of proposed methods and may also seek external expert technical review.

All methods are subject to period review, usually every four years or reviews may be undertaken on an as-needed basis.

Figure 1: ERF Method Development Process



The Offsets Integrity Standards

The Offsets Integrity Standards are a set of legislated[9] principles that the ERAC must take into account when assessing methods and considering how to advise the Minister with respect to the making of methods. The Offsets Integrity Standards are:

- Methods should should result in carbon abatement that is unlikely to occur in the ordinary course of events ('additionality')
- Estimations of removals, reductions or emissions are measurable and capable of being verified ('measurable and verifiable')
- Carbon abatement used in ascertaining the net carbon dioxide abatement amount for a project must able to be used to meet Australia's climate change targets under the Kyoto protocol or an international agreement that is a successor to the Kyoto protocol ('eligible').
- The method is supported by clear and convincing evidence ('evidence-based')
- Material amounts, in carbon dioxide equivalent, of greenhouse gases that are emitted as a direct consequence of carrying out the project are deducted ('material'); and
- Estimates, projections or assumptions included in the methodology are conservative ('conservative').

The Minister must not make a methodology determination if the ERAC has advised the Minister that the determination does not comply with one of more of the Offsets Integrity Standards[10].

Other Regulatory Criteria

Additionality Criteria

Additionality criteria have been established to ensure that the first offsets integrity standard is achieved. In order for a project to be eligible for registration under the ERF (unless the method covering the project specifies otherwise), it must:

- not have begun to be implemented before it has been registered with the CER, (the 'newness' requirement),
- not be required to be carried out by or under a Commonwealth, State or Territory law (the 'regulatory additionality' requirement), and
- not be likely to be carried out under another Commonwealth, state or territory government programme in the absence of registration under the ERF (the 'government program' requirement). These are listed as:
    - funding under the 20 Million Trees Programme
    - activities under the:
        - *Renewable Energy (Electricity) Act 2000 (Cth)*
        - *Electricity Supply Act 1995 (NSW)*

[9] CFI Act Part 9, Division 3, Section 133.

[10] CFI Act 2011, Part 9, Division 2, subdivision A, Article 106 (4B)

- *Victorian Energy Efficiency Target Act 2007 (VIC)*
- *Electricity (General) Regulations 2012 (SA)*
- *Gas Regulations 2012 (SA)*
- *Energy Efficiency (Cost of Living) Improvement Act 2012 (ACT)*

However, methods may include provisions *in lieu* of these criteria.

The Negative List

There are elements of the negative list, described above, that are particularly relevant to projects for production forests.

The CFI Regulations (S 3.37) exclude '*specified tree plantings'* as an offsets project type. 'Specified tree planting' means the planting of trees in an area that, according to the CFI rainfall map[11], receives more than 600 mm long-term average annual rainfall unless:

- the planting is a permanent environmental planting (S 3.37 (2)).
- the planting contributes to the mitigation of dryland salinity in accordance with the Salinity Guidelines (S 3.37 (3)).
- the project area is in a region in relation to which the National Water Commission has determined that the commitments by the relevant State or Territory government under the National Water Initiative (NWI) to manage water interception by plantations have been adequately implemented (S 3.37 (4)).
- the project proponent holds a water access entitlement (S 3.37 (5)).
- the tree planting is project area is (S 3.37 (8)):

  a) in a region in which it is not possible to obtain a water access entitlement; and

  b) the Regulator, after seeking the advice of the relevant State or Territory agency that manages the water resource and other expert advice as necessary, is satisfied that there is no material impact on water availability, or on the reliability of existing water access entitlements, in or near the project area, for the duration of the project;

With respect to S 3.37 (4), the NWI prescribes measures to manage the impact of interception as a result of land use change such as plantation establishment, to protect the integrity of the water access entitlements system and deliver on environmental objectives. The Commission's role is to assess the interception management arrangements for all areas in the greater than 600 mm average annual rainfall zone (CFI eligible planting zone) to determine if they are consistent with the NWI and therefore considered to be adequate.

An Assessment Framework has been developed to assess all the water plan areas in the ERF eligible planting zone.

The CFI Regulations also exclude:

- the establishment of a *forest under a forestry managed investment* scheme defined under Division 394 of Part 3-45 of the *Income Tax Assessment Act* 1997 (CFI Act S 3.36 (c)). Although plantations that were established under a MIS but are no longer part of an MIS are not excluded.

[11]http://www.environment.gov.au/climate-change/government/emissions-reduction-fund/publications/cfi-rainfall-map

- activities that which involve the cessation or avoidance of the harvest of a plantation (S 3.36 (d)). The rule was introduced because “plantation forests are established for the purpose of harvest and are not designed to be permanent plantings”.
- activities for which the establishment of vegetation is on land that has been subject to clearing of a native forest, or draining of a wetland (that was not an illegal clearing or draining) (S 3.36 (f)), within:

  (i) 7 years of the lodgement of an application for the project to be declared an eligible offsets project; or

  (ii) if there is a change in ownership of the land that constitutes the project area, after the clearing or the draining—5 years of the lodgement of an application for the project to be declared an eligible offsets project;

  The 7-year period is intended to provide a disincentive to clear land for carbon projects, but also to recognise that landholders may clear land for other purposes but then wish to convert back to forested land. The shorter 5-year period is to ensure new land owners who wish to undertake a project on land that was cleared or drained by the previous land owner are not penalised.
- those activities that protect native forest on freehold or leasehold land, for which a clearing consent or harvest approval plan was granted on the basis that the clearing or harvesting of the native forest:

  (i) would lead to an environmental improvement or benefit, or would maintain an environmental outcome; or

  (ii) was for fire management purposes.

Permanence

Carbon stored in vegetation and soils can be released back into the atmosphere by human action or natural events, thereby reversing the environmental benefit of a sequestration project. Sequestration is regarded as permanent if it is maintained on a net basis for 100 years. For this reason, all sequestration projects are subject to permanence obligations. A permanence obligation maintains carbon stores for which Australian carbon credit units (ACCUs) have been issued. The ERF requires sequestration projects to choose a permanence period of either 25 or 100 years.

Methodology

The research approach taken in the project was review-based - exploring and drawing on empirical research, existing methods approved under the ERF and other carbon schemes and information from industry. No primary empirical research was undertaken.

A review framework was developed based on the ERF method prioritisation criteria and the Offsets Integrity Standards described above. Information gaps and the need for further data collection were identified. For each method a proposal was submitted to the DoEE for consideration and was revised based on feedback provided. This iterative consultation process enabled the refinement of some proposals and the elimination of others.

Table 1: Research Framework

Method Prioritisation Criteria	
Broad business support	There is broad business support for the method likely to result in a high level of up-take.
Likely volume of abatement	There is a significant volume of abatement associated with the proposed activities
Ease and certainty with which emissions reductions can be estimated	Emissions reduction activities can be estimated with a high degree of certainty and at an acceptable cost.
The status of necessary technology.	Any technology that the method is dependent on is proven and commercially ready.
Social, environmental or economic impacts	The activity does not have any adverse social, environmental or economic impacts. Positive impacts were also considered.
Alternative activity promotion measures.	The activity could not be promoted more efficiently through other government measures.
Offsets Integrity Standards	
Additionality	Methods should should result in carbon abatement that is unlikely to occur in the ordinary course of events. This considered. The issue of regulatory compliance was also considered.
Measurable and Verifiable	Estimations of removal, reduction or emission are measurable and capable of being verified. Gaps in available information the time and cost to fill these gaps were considered.
Eligible Abatement	Eligible carbon abatement is abatement that is able to be used to meet Australia's climate change targets under the Kyoto protocol or an international agreement that is a successor to the Kyoto protocol.
Evidence	The method is supported by clear and convincing evidence.
Project emissions can be identified and deducted	Material amounts, in carbon dioxide equivalent, of greenhouse gases that are emitted as a direct consequence of carrying out the project are deducted.
Conservative	Estimates, projections or assumptions included in the methodology are conservative.

Results

The following sections summarise the results of the research and analysis undertaken in the development of proposals for method prioritisation. The approach taken to each method varied. Details are provided in appendices.

Plantation Forestry Methods

The project proposed an assessment of the abatement potential of plantations under two scenarios:

- Carbon sequestration in long-rotation plantations.
- Carbon sequestration through retention of plantations established on economically marginal sites (e.g. in ex-MIS plantation sites) which are under threat of conversion into agricultural lands.

In the course of this project these were considered together.

Introduction to abatement opportunity

The contribution of trees and forests to GHG abatement is well established and has been incorporated into international accounting frameworks, emission trading schemes and carbon offsets programs. The opportunity for abatement through vegetation management has already been recognised though the development of several ERF methods providing for direct establishment of environmental plantings and human assisted regeneration[12] of forest. Timber plantations also sequester carbon dioxide through the growing of trees, and additionally carbon is stored in wood products once they are harvested. The opportunity for developing an ERF method based on plantations was recognised early after this project commenced and the DoEE established a TWG to assist in the development of the method. The members of the project team from this FWPA project participated on the TWG.

The TWG considered the GHG abatement potential of plantations under a number of scenarios. Options were prioritised taking into account factors such as costs and risks associated with method development and likelihood of adoption (Table 2).

While the abatement associated with new long-rotation plantations was relatively clear, the opportunity presented by short-rotation plantations was less straight forward. As with long-rotation plantations, short-rotation plantations sequester carbon dioxide and store carbon. However, carbon storage in the products typically made from short-rotation grown wood tend to have shorter in-service lives and, by their very nature the sequestration period (growing time) and carbon stored in tree biomass is shorter. There may also be an increased likelihood that short-rotation plantations are converted to other land uses if economics drives this land use choice - for example converting plantation to agriculture. This risk can be ameliorated if the value of a wood plantation is enhanced through recognition of its carbon abatement contribution, especially where plantations have been grown in economically marginal areas. From a greenhouse gas abatement perspective, retaining these plantations has a net benefit compare to other non-tree land uses.

[12] http://www.environment.gov.au/climate-change/government/emissions-reduction-fund/methods

Table 2: Summary of Assessment by Planted Forest technical Working Group

Category	Activity	Potential Issues	Risks to method development	Risks to adoption	Rank
Reforestation	Developing new plantations on previously cleared land	• Determining baselines given regional differences in 'likelihood' of new plantation development. • Restrictions through the negative list reduce up-take.	Low	High	1a
Forest Management (Existing plantations)	Change from short to long rotation within the current rotation	• Unclear if ex-MIS forests are excluded from forest management activities. • Potential challenges with demonstrating change in management activities.	Medium	Medium	3
	Extend existing rotation lengths without changing product	• Unclear if ex-MIS forests are excluded from forest management activities. • Potential challenges with demonstrating change in management activities. • Potential market risks – processing facilities not equipped to manage larger log sizes.	High	Medium	4
	Change from short to long rotation after the current rotation	• Unclear if ex-MIS forests are excluded from forest management activities. • Can potentially pick up avoided deforestation projects where baselines would be conservative.	Low	Medium -> High	1b
Avoided Deforestation	Maintain plantation area rather than converting it to a non-forest land use.	• Unclear if ex-MIS forests are excluded from avoided deforestation activities. • Potential challenges with demonstrating a change in management activities without project level financial additionality tests. • A fine grade of evidence would be needed to distinguish between marginal and viable plantations.	Medium -> High	Low -> Medium	2

Summary Against Priority Assessment Criteria

A plantation forestry method was prioritised in recognition of *broad business support* which was established through consultation with industry representative bodies. The *likely volume of abatement* and the *ease and certainty with which emissions reductions could be estimated* were established through the proposed use of the national Full Carbon Accounting Model (FullCAM) which also provides for the necessary technology for abatement calculations. The status of existing technology for plantation establishment and management is well established for in the long history of the plantation sector in Australia. No *alternative promotion measures* were identified for the activity and while there were some perceived social, environmental or economic impacts, these were not viewed as insurmountable nor necessarily negative.

Summary Against Offsets integrity Standards

Compliance with the Offsets Integrity Standards was established through consultation with the TWG, commissioned assessments and consultation with relevant government departments.

Additionality was initially assessed through a commissioned report on the likely establishment of new timber plantations in Australia (InduFor 2014). Availability of robust data on plantation establishment within National Plantation Inventory (NPI) regions allowed for the assessment of the likelihood of expansion of the plantation estate in the business as usual scenario in each region, and therefore the likelihood of meeting the additionality criteria. A lack of data on plantation establishment outside NPI regions limited such an assessment for those areas. The assessment found the likelihood for new plantation establishment across Australia in the five to six years subsequent to the assessment to be limited except for Indian Sandalwood in general, and African Mahogany only in the Northern Territory.

As a consequence of this assessment and to ensure additionality, the method is constrained to plantations only within NPI regions and excludes Indian Sandalwood and African Mahogany only in the Northern Territory. It also limits certain activities to specific tree species and new management actions.

The eligibility of abatement was established through the crediting abatement from a new plantation, changed management of an existing plantation, or maintaining a plantation already eligible under another Determination[13] and accounting for carbon pools and emissions sources recognised in Australia's National Greenhouse Accounts through the use of FullCAM.

The required use of FullCAM also ensures that abatement is *measurable* and specific reporting requirements, such as a requirement for plantation management schedules, provide for project activities and abatement to be *verified*. The method sets out requirements for using FullCAM and more detailed requirements and instructions are provided in FullCAM Guidelines.

The use of FullCAM, which is supported by peer reviewed and internationally agreed scientific research, together with consultation with the TWG, ensures the method is *evidence based*.

To ensure the abatement calculations are *conservative* the method provides for activity-specific baseline modelling scenarios over 100 years, and applies a maximum abatement level through calculating the long-term average carbon stock. This avoids fluctuations in crediting due to harvesting and other management activities. Generally, FullCAM is also considered to be

[13] Measurement based methods for new farm forestry plantations method, http://www.cleanenergyregulator.gov.au/ERF/Choosing-a-project-type/Opportunities-for-the-land-sector/Vegetation-methods/Measurement-based-methods-for-new-farm-forestry-plantations

conservative. It uses ABARES average yield tables, which are generic across regions and default values for assigning the percentage of biomass to each wood product type.

A 25 per cent permanence period discount was introduced for short-rotation plantation forestry projects electing a 25-year permanence period to address perceived risks associated with 25-year short-rotation plantation projects not being re-established post-harvest at the completion of their permanence period. Material emissions associated with project activities are also accounted for.

Overview of the method

The Plantation Forestry method provides a mechanism to increase carbon sequestration through the establishment of new plantation forests, and increase sequestration in existing plantation estates through transition from short-rotation plantation forests to long-rotation plantation forests.

Three project activities are eligible:

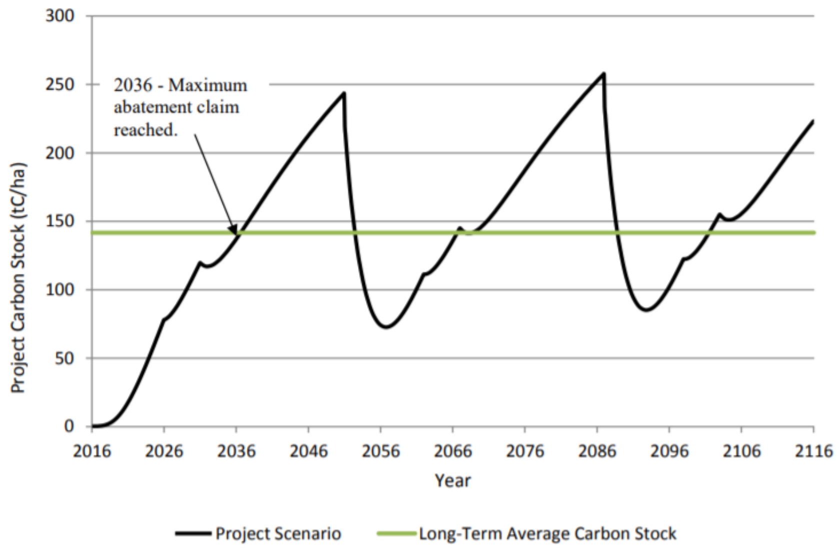
- The establishment of new plantations by planting or seeding on land on which plantations have not been established for the previous 7 years. Plantation rotations must be no more than 60 years long and no more than 2 years apart.
- The conversion of short-rotation to long-rotation plantations.
  - By establishing a new long-rotation on land where no rotation is underway;
  - By completing a current short rotation and then managing a new rotation as a long rotation; or
  - Changing the management of a current short rotation to become a long rotation.
- By transitioning an existing farm forestry[14] projects to the Plantation Forestry Method.

The method requires accounting for carbon stock changes in trees, debris and HWPs using the FullCAM model.

New plantations are credited up to a limit that represents the average carbon stocks of repeated harvest rotations over the long-term (100 years), with a zero baseline (Figure 2, source Draft Carbon Credits (Carbon Farming Initiative—Plantation Forestry) Methodology Determination 2016 Explanatory Statement)).

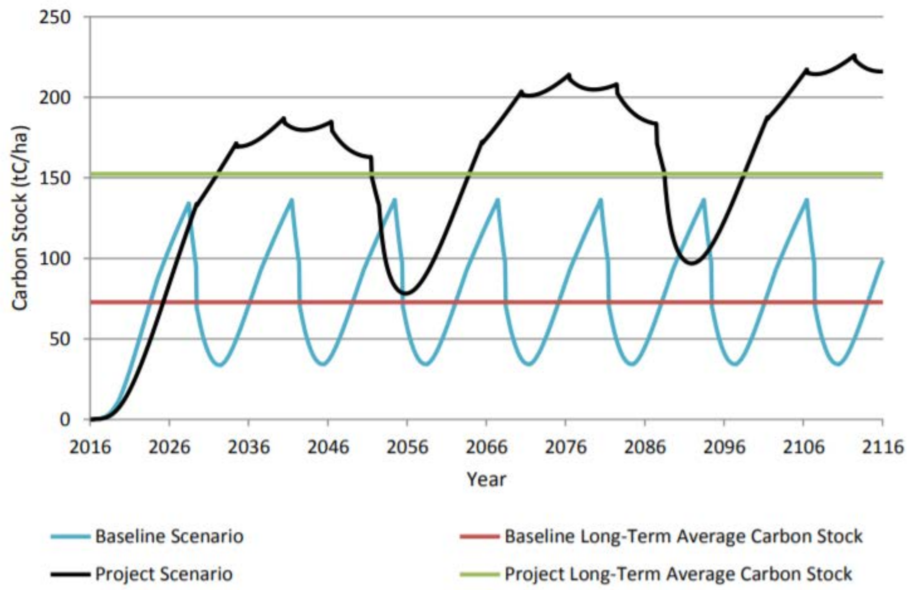
[14] http://www.environment.gov.au/climate-change/government/emissions-reduction-fund/methods/measurement-based-methods-new-farm-forestry-plantations

Figure 2: Example showing calculation of abatement for a plantation established on an area that is eligible for a new plantation. Note that in this example the project has a zero baseline



For projects that convert a short-rotation plantation to a long-rotation plantation, net abatement is calculated by subtracting a baseline representing the average carbon stocks for the short rotations from average project carbon stocks. Net abatement is credited in equal annual instalments over 15 years (Figure 3, source Draft Carbon Credits (Carbon Farming Initiative—Plantation Forestry) Methodology Determination 2016 Explanatory Statement, Note that in this example the conversion involves establishing a new rotation with a different species.).

Figure 3: Example showing calculation of abatement for a project that converts a plantation from short-rotation to long-rotation.



Abatement estimates must account for the effects of disturbances such as fires.

Participants can choose either a 25-year or 100-year permanence period. To ensure the plantation forestry method is consistent with the *Carbon Credits (Carbon Farming Initiative) Act 2011*, a permanence period discount of either 25 per cent (for plantations with rotation <

20 years) or 20% (rotation > 20 years) is applied to a project's net abatement for forestry projects that elect a 25-year permanence period[15].

Eligible plantations are restricted to those that are managed with the intention of harvesting forest products. In addition, eligibility is restricted to plantations established in NPI regions because these regions are considered potentially feasible for plantation forest establishment, based on biophysical and logistical constraints.

Projects must not be an excluded offsets project as defined in sections 3.36 and 3.37 of the *Carbon Credits (Carbon Farming Initiative) Regulations 2011* ("the Regulations"). In particular, if the project in an area that, according to the CFI rainfall map, receives more than 600 mm long-term average annual rainfall, it will have to meet water entitlement requirements set out in the Regulations. This may require accessing a water entitlement or seeking advice from the relevant State or Territory water authority to demonstrate the project will not impact water availability or reliability in or near the project area for the duration of the project. For some projects, the duration of the project will exceed 100 years.

Proponents need to submit a plantation notification to the Minister for Agriculture and Water Resources for an assessment to determine whether it is likely to have any undesirable impact on agricultural production in the region and new plantations must only be established be on land where there has been no forest for the previous seven years.

Limitations of the Method and Recommendations to Address them

There are a number of limitations in the Plantation Forestry method that are intended to ensure it is conservative, but which may inhibit uptake by possible project proponents.

<u>FullCAM</u>

The use of FullCAM makes the method conservative and analysis against site specific data showed marked inconsistency for different plantation species. While it was recognised that growers have developed robust yield tables for their estates and that it is technically possible to use these in FullCAM, several issues with using yield tables were noted:

- The type of volume reported by yield tables can vary between growers (e.g. total volume versus merchantable volume), making development of default conversion values more difficult.
- To use yield tables would likely require consideration of other parameters in FullCAM, in particular those that affect debris pools.
- A yield table method has not been tested for application under natural disturbances.
- Yield tables often implicitly include the effects of management, and these would need to be assessed prior to changing management.
- Guidelines on how to implement calibration with tree yield tables would be needed and these would need to be tested and peer reviewed.

However, hybrid methods utilising FullCAM and project specific data do already exist. Under the *Carbon Credits (Carbon Farming Initiative) (Measurement Based Methods for New Farm*

[15]http://www.cleanenergyregulator.gov.au/ERF/Pages/Choosing%20a%20project%20type/Opportunities%20for%20the%20land%20sector/Vegetation%20and%20sequestration%20methods/Plantation-forestry-method.aspx

Forestry Plantations) Methodology Determination 2014 (Varied 2015) ('New Farm Forestry Method') project proponents undertake field inventories to estimate the amount of carbon sequestered by the plantings. The method sets out requirements for designing a sampling plan, undertaking a forest inventory and determining the relationship between the in-field measurements and the carbon in the forest. Impacts of disturbances such as fires are also accounted for. For projects featuring harvests, FullCAM is also used to work out the long-term average carbon captured in the plantings taking into account harvest cycles. Landholders can earn credits from harvest projects up to the long-term average carbon estimated by FullCAM.

Recommendation: Excessive conservativeness in the method could be addressed if project proponents were able to use reliable (and potentially independently verified) inventory data, collected routinely throughout most commercial forest estates, as one of the inputs to FullCAM. This functionality has been present in previous releases of FullCAM, and so could be relatively easily included in versions to be used for this Methodology Determination . The method uses technical documents (guidance) on the use of FullCAM to ensure accurate application of the method by proponents. The use of such guidance, that sits outside the determination, was promoted by the Department because it allows for more efficient updating of technical requirements and accounting factors; variations to determinations requiring ERAC consideration may not be needed. Instructions on the use of project specific data could be incorporated into the technical guidance.

Baselines

The method applies a non-zero-baseline for projects that replace short-rotations with long rotation plantations or extend the plantation rotation length. In such cases, the proponent must use FullCAM to model a baseline scenario which represents the long-term (100 year) average carbon stocks on the land had the project not been carried out. The average carbon stock is used to account for fluctuations in carbon stocks as the result of the harvest cycles in the baseline. The default use of a non-zero baseline for all projects where a short rotation crop is being converted to a long rotation crop, irrespective of whether there was any realistic chance that the short rotation crop would be replanted without a price on carbon, will result in the bulk of the carbon benefit that this project type provides being excluded from the calculation of abatement that the project can claim. Other offset programs have developed reasonable guidance that can be used as a basis for determining commercial feasibility, thereby providing a consistent and objective assessment of future crop viability.[16]

Recommendation: An exploration of the potential of changing to a zero baseline for short-rotation stands that are not viable to replant, when converting to long-rotation, could use generic productivity estimates and distance to market to generate a ruleset for assessing project viability.

Harvested Wood Products

The quantity of carbon stored in HWPs depends on the lifespan of the products. The method requires proponents to specify the types of forest products harvested and the proportions going to end uses. Carbon stock estimates in FullCAM use parameters for each national plantation inventory region, species, log class and end use.

Under the method, carbon in HWPs is only included while the product is in service, and the service life factors used are conservative. HWPs in the long-term storage pool in landfill is not

[16] New Forests submission http://www.environment.gov.au/submissions/emissions-reduction/methods/plantation-forestry/new-forests-asset-management-pty-limited.pdf

included in the method. This is to avoid potential double counting of abatement under other ERF methods which can generate abatement through the combustion and in some cases capture of methane from landfill sites[17].

The *Carbon Credits (Carbon Farming Initiative) Methodology (Landfill Gas) Determination 2015* (Landfill Gas Method) applies to the abatement of emissions through the installation of new landfill gas collection and combustion. The determination requires the use of one of the approaches in the *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (NGER (Measurement) Determination) to model the landfill gas that is generated in the landfill. The NGER (Measurement) Determination includes calculation of the percent of 'paper and card board' and 'wood and wood waste', based on the tonnage of each waste mix type received at the landfill. Default waste stream percentage for waste mix types (refer Table 3**Error! Reference source not found.**) and the degradable organic carbon values are provided.

Table 3: Default waste stream percentages

Waste mix type	Paper and cardboard	Wood and wood Waste
Municipal solid waste class I (%)	13	1
Municipal solid waste class II (%)	15	1.2
Commercial and industrial waste default (%)	15.5	12.5
Construction and demolition waste default (%)	3	6

The Carbon Credits (Carbon Farming Initiative—Alternative Waste Treatment) Methodology Determination 2015 (Waste Treatment Method) avoids emissions by diverting waste from landfill to alternative waste treatment (AWT) facilities. Under this method eligible waste includes mixed solid waste which is commercial and industrial waste, construction and demolition waste or municipal solid waste but does not include some specific waste types such as recyclable paper and paperboard and green waste or wood waste that is separated at the point of generation. These are excluded because these would generally be disposed of in ways other than landfill. Otherwise the definitions of waste that are applied are those within the NGER (Measurement) Determination. Assumed avoided emissions from the decomposition of HWPs in landfill can be credited under a project that diverts these products from landfill. That is, where HWPs are physically separated from general landfill and converted into, for example compost or fuel. Abatement is calculated by comparing the methane assumed to be produced in the baseline against methane produced after the introduction of the AWT (taking into account emissions associated with the AWT).

The AWT method applies the emissions factors as set out in the NGER (Measurement) Determination. In the calculation of landfill baseline emissions, project proponents are required to use the decay factors listed in the Technical Guidelines for the estimation of greenhouse gas emissions by facilities in Australia (Australian Government 2017). The decay factor for wood and engineered wood products is 23%, and project proponents may also use a default decay value of 50% if they do not have data on the composition of the waste mix. Use of decay values that are too high will lead to perverse environmental outcomes, where carbon credits are awarded based on avoidance of projected emissions that would not have occurred instead of rewarding alternative projects that may be more likely to achieve actual emission reductions. However, some research has conclusively demonstrated that there is minimal decay of wood under anaerobic conditions in landfill[6,7]; and in the National Greenhouse Gas Inventory, default

[17] Carbon Credits (Carbon Farming Initiative) Methodology (Landfill Gas) Determination 2015

decay factors for wood in landfill have been revised down to 10%, as a reflection of the new research. The new value of 10% is also part of the draft text of the Waste Chapter of the IPCC Revised Guidelines (in press). This means that landfills represent long-term store of carbon in HWPs. Thus, for projects that rely on anaerobic decay of organic materials in the production of methane there would be little risk of double-counting. Modelling undertaken by this project, as described in the next section and submitted to DoEE, makes the case for the inclusion of HWPs in landfill.

Recommendation: NGER (Measurement) Determination factors could be altered such that decomposition of HWPs in landfill is effectively zero' carbon in HWPs *in situ* in landfill would be permanently stored. As a result, however, there would be no contribution to the generation of methane or to avoided emissions that can be credited to landfill projects. This would require some revision to existing methods.

<u>Agricultural Land</u>

The Australian Government Minister for Agriculture and Water Resources (the Agriculture Minister) has a role to assess whether proposed projects under the Plantation Forestry Method would lead to an undesirable impact on agricultural production in the region where the project would be located[18]. Proponents who intend to apply for either a new plantation forestry project (including a new project under the measurement-based methods for farm forest plantations) or an expansion of an existing plantation forestry project are required to submit an ERF plantation forestry notification by email to the Department of Agriculture and Water Resources (the Department) so that an assessment of the impact on agricultural production can be made.

ERF projects based on conversion from short- to long-rotation plantations are not required to make such a notification.

With respect to practicalities of implementing the method in relation to the project's potential impact on agricultural production in a region, the guidelines state that 'region' means the area of land, which:

i. Is in the vicinity of the proposed project area; and
ii. may be subject to undesirable impacts on agricultural production as a result of the proposed project going ahead.

In making an assessment, the Agriculture Minister may use Australian Bureau of Statistics (ABS) Statistical Area Level 2 (SA2) and Level 4 (SA4) boundaries, or multiple areas where required. The average "region size" of SA2 boundaries is around 7100 km^2, while the size of SA4 regions is over 131,000km^2. In the case of the latter the information required to satisfy the Minister that there are no undesirable impacts on agricultural production is potentially extensive and costly. A level of materiality needs to be incorporate in any assessments

The regulation is inconsistent in its application across all methods in the scheme; for example, it does not apply to reforestation projects that are permanent environmental plantings or projects that result in the regrowth of forest through changes to agricultural practices.

While in some cases projects may result in the conversion of agricultural land to plantation, over the broader landscape primary production will be maintained and with it the other socio-economic benefits that do not arise from conversion to permanent plantings or native forest that cannot be harvested. It is therefore unreasonable that Plantation Forestry projects should

[18] The Carbon Credits (Carbon Farming Initiative) Rule 2015 provides for such procedures.

be subject to a specific assessment that is not applied to all land sector methods that may impact overall agricultural productivity.

Recommendation: The requirement for Ministerial Assessment of undesirable impacts on agricultural production should be removed or applied consistently across all ERF methods resulting in a change in land use. If this requirement is retained, a single 'regional' boundary measure could be used, and to assist in making applications this information should be uploaded into the CFI mapping tool.

<u>600 mm rainfall limitation</u>

Under the method, projects must not be an excluded offsets project as defined in sections 3.36 and 3.37 of the Regulations, as summarised above. The Department of Agriculture and Water Resources (DAWR) (the Water Department) is responsible for assessing the interception management arrangements in place for regions that receive greater than 600mm average annual rainfall. The assessment will determine if such arrangements are consistent with the NWI, and therefore considered to be adequate for the purpose of managing water interceptions by new commercial forestry plantations.

Based on DAWR assessments and consultation with relevant state/territory government departments to date, DAWR is satisfied the following regions (water catchments) are NWI compliant for the purpose of CFI Regulation 3.37(4): Lower Limestone Coast (South Australia), Mount Lofty Ranges (South Australia)[19].

While it is acknowledged that all forests planted in high rainfall areas can have adverse impacts for other water users and environmental flows due to the amount of water they intercept,[20] the regulation is inconsistent in its application across all methods in the scheme; it does not apply to reforestation projects that are permanent environmental plantings and/or planted forests that address salinity. Such plantings, which must be able to become forest in order to be eligible, are equally as likely to impact water interception and flow as plantation forests. In fact, where the intent of plantations and forests is to mitigate salinity it is counterintuitive that you could have (or would want to have) a salinity project that was not having an impact on water.

Furthermore, the approach taken to assess compliance with the rule by DAWR is to focus on those regions that are either i) subject to a CFI project proposal or ii) have been identified as a region of priority development in commercial forestry. While it is not clear what the exact process is by which areas for priority development are being identified, for proposed ERF projects it seems as if assessments will not take place until the DAWR become aware of projects, which is most likely to be at the time that proponents make a submission to the Minister for assessment. This increases uncertainty for proponents.

In terms of complying with the rule:

- National water plans are not readily accessible on the NWI website.
- Boundaries of water catchments are not readily available on the NWI website. Water catchment boundaries should be included in the CFI mapping tools to assist project proponents in seeking information with respect to meeting this eligibility requirement.

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[19] http://www.agriculture.gov.au/water/policy/carbon-farming-initiative

[20] http://www.environment.gov.au/climate-change/government/emissions-reduction-fund/cfi/negative-list/activities/specified-tree-planting

Recommendation: The 600 mmm rainfall limitation rule should be consistently applied to all tree planting projects or it should be removed.

NPI limitation

Only projects that are located within the NPI regions are eligible to participate. The NPI covers regions where plantations are potentially feasible without carbon revenue based on biophysical and logistical constraints; effectively they are areas were plantations are already present.

The justification for the use of NPI regions is that data collected under the NPI allows the level of business-as-usual plantation establishment activity to be determined, and therefore enables assessment of whether new plantation establishment meets the additionality criteria and offsets integrity standards. There has been little new meaningful plantation development other than for two species - African Mahogany and Indian Sandalwood, that are excluded within specific NPI regions – these plantation types in these regions are considered likely to see expansion of the plantation estate in the business as usual scenario.

Conversely, it is argued that for areas outside NPI regions, the lack of data on plantation establishment means that it is not possible to determine whether potential new plantation establishment would occur in the ordinary course of events.

The report written to inform the making of the method looked at trends and the outlook for plantation establishment in each of the NPI regions but not outside of the regions (Indufor 2014). That report also surmises that "much of the suitable land that was available has been established – and new plantation establishment may need to push further on biophysical site characteristics or land prices".

Queensland has two NPI regions (South East Queensland and North Queensland), and is one of the few states that currently has commercial timber plantations outside of these regions. Australian Plantation Statistics 2016 (ABARES, 2016) indicates that there are significant softwood and hardwood plantations adjacent to the South East Queensland NPI region. These plantations could arguably be included within the South East Queensland NPI region and would have similar characteristics to those within that region.[21]

Recommendation: to assist potential project proponents the NPI boundaries should be included in the CFI mapping tool. Consideration should also be given to reviewing the NPI boundaries to ensure that they capture all suitable plantation areas, with a particular focus on areas with existing plantations.

[2121] QDAF submission on Draft Plantation Method. http://www.environment.gov.au/submissions/emissions-reduction/methods/plantation-forestry/queensland-department-agriculture-fisheries.pdf

Harvested Wood Products Method

Introduction to abatement opportunity

Harvested Wood Products (HWPs) comprise sawnwood, wood-based panels and paper and paperboard produced from the harvest of trees. Carbon is stored in HWPs and is subsequently emitted over time. The rate at which carbon is emitted from HPWs is a function of the rate of retirement of products from end uses and the various processes used to dispose of products.

- Carbon is emitted directly to the atmosphere through the decomposition of wood products;
- Carbon may be emitted to the atmosphere through burning of wood products;
- If wood products are burned for energy production, the carbon is emitted but the energy produced likely displaces fossil fuels that therefore remain in storage, resulting in emission reductions;
- Retired wood products may be recycled, extending the duration of carbon storage in end uses;
- When retired products are landfilled, the rate of decomposition is extremely slow and a high proportion of carbon in the product is considered to be stored indefinitely.

The GHG abatement from HWPs while in use was recognised in the ERF Plantation Forestry method, as described above, for products derived from those sources. A method proposal was developed for HWPs from all sources for products in use and whilst products remain in landfill.

Summary Assessment Against Priority Criteria

The wood products and forest industry indicated a high level of *business support* for the development of a method for the abatement of carbon in HWPs.

The *likely volume of abatement* is material, and would enhance the likelihood of uptake of the Plantation Forestry method by possible proponents, and provide for new opportunities to others in the sector.

Methods for estimating carbon in HWPs are well established and approaches have been incorporated into Australia’s National Greenhouse Gas Inventory through FullCAM. Other approaches are well developed and in use in GHG abatement methods developed under other standards.

The *necessary technology* is well established and in use. HWPs that store carbon are an output of all commercial forestry enterprises in Australia.

There are no identified negative *social, environmental or economic impacts* of incorporating carbon in HWPs into an ERF method.

There may be *other policy measures* that include HWPs but none specifically promote carbon storage in HWPs. HWPs may be diverted from waste for alternative uses that also reduce GHG emissions, such as through the generation of bioenergy, which has fuel substitution benefits. This is permitted under the Renewable Energy Act and promoted under the Renewable Energy Target. Other ERF methods also allow for the diversion of waste from landfill or the capture of methane from landfill, both of which cover HWPs. This risk of double counting associated with these measures can be minimised.

Summary Against Offsets Integrity Standards

The development of a method for GHG abatement through HWPs would result in *additional* abatement. With the exception of the ERF Plantation Forestry method, most vegetation methods under the ERF do not allow the harvesting of wood for commercial use and do not include carbon stored in HWPs. Some other methods allow for the use of biomass from forests and waste from processing for bioenergy[22] and the capture of methane from the decomposition of wood waste and paper and cardboard in landfill[23]. These methods are generally considered to be emissions reduction activities. However, carbon stored in HWPs in landfill represents sequestration rather than an avoided emission opportunity and the risk of double counting can be minimised.

Carbon in HWPs is *eligible* abatement; HWPs are included in Australia's National Greenhouse Gas Inventory. The Australian Government is required to report its greenhouse gas inventory using two different frameworks: the United Nations Framework UNFCCC) reporting framework and the Kyoto Protocol (KP) accounting framework. The key difference between the two approaches is that the UNFCCC approach more closely reflects what the atmosphere actually sees, whereas the Kyoto framework is constrained by political decisions designed to change behaviour (Cowie et al. 2006).

The 1996 IPCC guidelines required Parties to account for HWPs using the "instantaneous oxidation" method, which implies no net change in carbon stocks in HWPs, as the carbon in HWPs entering the pool was assumed to be offset entirely by the loss of carbon through decay of HWPs harvested previously, unless the HWP pool was increasing. In the latter case, parties were able to count carbon in HWP in service and in landfill, using a simple decay function. The 2014 IPCC Good Practice Guidance (IPCC 2014) allows Parties to choose methods for accounting for carbon in HWPs in service.

- The instantaneous oxidation method applies in cases where transparent and verifiable activity data for the default HWP categories of sawnwood, wood-based panels, paper and paperboard are not available; or
- If countries do have the appropriate information, then they can select between a Tier 2 first-order decay method (i.e. the annual loss is a constant proportion of the amount of product in service, using default half-lives provided by the IPCC), or, if they have robust country-specific data, they may elect to use these (Tier 3 Method). In practice, most countries adopt the "Tier 2" option. The default half-lives and associated decay constant provided by the IPCC are included in Table 4.

Table 4: IPCC default half-life and decay constant factors (IPCC 2014)

HWP type	Half-life (years)	Decay rate (k)
Paper and Particleboard	2	0.346
Panel products	25	0.027
Sawnwood	35	0.020

In the first commitment period of the Kyoto Protocol, parties were required to use the instantaneous oxidation approach for HWP – that is, they were unable to include increases in

[22] For example, the "Facilities Method" https://www.environment.gov.au/climate-change/emissions-reduction-fund/methods/facilities

[23] For example, the "Landfill Gas Method" https://www.environment.gov.au/climate-change/emissions-reduction-fund/methods/landfill-gas

the HWP pool in their Kyoto Protocol accounting (carbon entering the HWP pool was assumed to be in balance with carbon leaving the HWP pool). For the second commitment period, parties are able to include HWPs in service, using the 2014 IPCC methods, but there is a clear difference in the estimation of carbon in HWPs in landfill. Under Kyoto Protocol accounting rules, the carbon in HWPs is assumed to be completely oxidised at the time of disposal to landfill. This was a result of a negotiated agreement between signatory countries, with the aim to reduce incentives for HWPs to be deposited in landfill, and does not reflect what the atmosphere sees. There is strong evidence that there are only minimal losses of carbon from HWPs in landfill[3]. Under the UNFCCC, calculation of carbon loss from decomposition of HWPs in landfill under anaerobic conditions requires two key factors: the degradable organic carbon (DOC), that is, the fraction of wood that may be subjected to biochemical decomposition, and the fraction of DOC that is dissimilated (DOCf), that is, the fraction of DOC that is actually decomposed in a landfill. The default DOC and DOCf values recommended by IPCC (2006) for dry wood (and other organic materials) in a landfill are both 0.5. This factor is generic and designed to take into account the fact that some organic materials are quickly digested (e.g. food waste), and others only decay to a minimal extent (e.g. HWPs). This factor is currently been reviewed by the IPCC, with a new factor of 0.1 (10% carbon loss) proposed in the Revised IPCC Guidelines (in press).

Australia has opted to report on the carbon stock changes and associated emissions and removals of carbon dioxide and methane from the HWPs pool including HWPs in service and in landfill (under the UNFCCC framework) and HWPs in service only (under the KP framework). Thus, in Australia's accounting framework, carbon in HWPs in service is accounted for in a slightly more sophisticated way than the IPCC first-order decay approach. The decay rates used assume that losses of material from service will increase with product age (cascading effect). Therefore, the entry and exit of material from production to loss from each product pool is tracked and aged according to three age classes; young, medium and old (DoEE 2011)[24]. The amount lost from each age class for each product pool is capped and different proportions are lost according to age. This feature of the model provides for 'steps' in product loss rather than functioning on either a simple linear or exponential loss applied to a whole product pool, irrespective of the average age of the pool (NIR 2009). Loss of carbon in service and maximum possible loss factors used in the Inventory are listed in Table 7.12 of the National Inventory Report 2009 (DoEE 2011). A national database of domestic wood production, including import and export quantities, has been maintained in Australia since the 1930s. The approach includes emissions from all wood products within Australia, regardless of their country of origin. Exported wood products are excluded and are the responsibility of the importing country.

Until relatively recently Australia's Greenhouse Gas Inventory used default IPCC 2006 factors for decomposition of HWPs in landfills (i.e. 50%). However, in recognition of a growing body of evidence, the then Department of Environment changed the factor to 23% (consistent with the US EPA)[25]. In the 2015 Australian inventory, the factor for wood and wood products was reduced further to 10% (DoEE 2017), based on the mid-point of observations of DOCf values for various wood products examined in Wang et al., (2011), for timber, plywood and MDF used in the United States. Ximenes et al (2015)) recently published which strongly suggest that the factor should be significantly lower than 23%, and in the case of the most common types

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[24]https://www.environment.gov.au/climate-change/greenhouse-gas-measurement/publications/national-inventory-report-2009

[25] This is also reflected in the *National Greenhouse Energy Reporting (Measurement) Determination 2008*

of HWPs used in Australia, the research suggests that no decomposition at all takes place. This research is based on the use of laboratory-scale bioreactors, which are designed to represent idealised decomposition conditions in municipal solid waste landfills. They represent the most extreme conditions for decay to occur, and are therefore conservative. Even under these conditions minimal or no decomposition has been demonstrated in these recent studies. Importantly, the vast majority of HWPs in Australia are deposited in construction and demolition landfills, which are much drier than landfills receiving municipal waste, and which typically generate only minor amounts of methane. Thus, the confidence in applying the very low decomposition factors to HWPs in landfills in Australia is very high.

The calculation of GHG abatement in HWPs is *measurable* and *verifiable*. In addition to the approaches developed for the national inventory, FullCAM is able to calculate carbon stored in HWPs in service, as evidence under the Plantation Forestry Method. Methods for accounting for HWPs have also been developed and applied at the project level under other standards and could be adapted under an ERF method.

Several methods developed under other standards, for example the Verified Carbon Standard (VCS), account for carbon in the HWPs pool and there is a generic VCS module for the estimation of carbon stocks in the long-term HWP pool which allows for *ex ante* estimation of carbon stocks. All methods draw on Winjum *et al.* (1998) and note the need for the updating or refining emissions factors as new information becomes available. One VCS method[26] includes HWPs in landfill – both as a store of carbon and a source of carbon dioxide and methane. The method provides for the use of default values and project specific product mixes and includes factors for HWPs in North America (based on Dymond 2012) or elsewhere (based on Winjum *et al.* 1998) including the fraction of carbon dioxide remaining in-use and in landfill per year, by product category.

Generally, in VCS methods HWPs are divided into the following classes:

- short-lived <3 years – immediate oxidation,
- medium-lived >3<100 years – oxidation over a 20-year period after harvest after which it becomes zero
- long-lived/permanent >100 years - no loss of carbon,

The Climate Action Reserve (CAR) Forest project[27] protocol includes accounting for HWPs in service and in landfill (where it is conservative to do so). The protocol bases the accounting of HWPs on the average amount of carbon sequestered over a 100-year period. The average amount of carbon remaining sequestered over the 100-year period is determined by calculating the amount of carbon delivered to the mills, the portion of the carbon that is converted to HWPs using a coefficient that estimates the mill's efficiency, and determining the HWP classes manufactured by the mill, as different HWPs have different decay rates.

The United States Forest Service (Smith et al. 2006) has developed methods for accounting for the portion of harvested carbon sequestered in HWPs in the United States. The approach includes carbon stored in products in service and carbon in landfill. Carbon emitted to the atmosphere by products in service is classified according to whether or not it occurred by combustion for energy production.

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[26] VM0034 British Columbia Forest Carbon Offset Methodology: http://www.v-c-s.org/methodologies/british-columbia-forest-carbon-offset-methodology-v10

[27] http://www.climateactionreserve.org/how/protocols/forest/#monitoring_calculation_worksheet

The method applies three approaches for calculating carbon in HWPs based on the type of data initially available:

i. the volume of wood in a forest available for harvest and subsequent processing,

ii. industrial roundwood harvest from a forest in the form of saw logs and pulpwood, and

iii. primary HWPs.

The model used to estimate carbon storage over time in HWPs following harvest and emissions to the atmosphere is the same for all three starting points. Fractions of HWP carbon in-use, landfill, and emitted with or without energy production are based on allocation patterns in Row and Phelps (1996).

There is a strong *evidence base* for how HWPs should be accounted for; the approaches for HWPs in service are relatively well documented and FullCAM, which is based on peer-reviewed science, could be used. A review of FullCAM's HWP accounting function revealed that a number of simplifications built into the model and the absence of essential calculation steps could compromise the abatement assigned to an ERF project. In particular, the lack of a log grading function, difficulties in prescribing HWP decay dynamics and in-use storage as well as difficulties with integrating the HWP dynamics with landfill were identified. The work also identified the need to update the accounting of HWPs in landfill taking into account new research and the proposed landfill factors, described above, which are robust, are contained in the peer-reviewed literature, and have been adopted by the National Inventory team and the IPCC in their draft revised Guidelines (IPCC in press).

Overview of the proposed HWP method

This study further explored potential approaches for incorporating abatement from HWPs into an ERF method. The details of the approach are described in Appendix 1 and summarised below. Two approaches were considered:

a) though their contribution to the long-term average carbon stock, or

b) by the calculation of carbon stock change in a period.

The choice of approach is largely dependent on the dynamics of the specific pool.

In the case of HWPs in service the calculation of a long-term average was considered to be appropriate, as there is constant addition of 'new' carbon and also removals as products transition out of use including as transfer the landfill pool. However, the HWPs in landfill pool works more like a 'reservoir' of carbon, as new carbon is added, and little is lost because, as the latest research suggests, little material decomposition takes place.

While carbon in HWPs in service can be incorporated in the long-term average carbon stock in a way that is consistent with the proposed approach for accounting for sequestration in trees, under the the Plantation Forestry Method, there remains a need to consider what the best approach is for calculating and incorporating the contribution of the carbon in HWPs in landfill over a 100 years modelling period. To better understand this, a hypothetical analysis was undertaken to demonstrate the potential for abatement in HWPs in service and in landfill in a new long rotation softwood plantation.

Carbon in HWPs in service was modelled to estimate the potential contribution to the overall carbon balance of softwood plantations after three clearfall harvest events. Generally, after each harvest event carbon enters the HWP in service pool and then moves out of this pool over time.

Two approaches to HWPs in service were assessed:

- One approach calculated the sum of carbon in HWPs that is actually still in service at the end of the project period (100 years) after the three harvest events. The calculations took into account inputs from each harvest event and decay over time.
- The second approach considered carbon in HWPs in service, as the sum of the average carbon in HWPs in service from each harvest event, where each harvest event was averaged over the 100 years project period.

In both cases carbon in HWPs in landfill was modelled by assuming that 80% of the carbon that leaves the in-service pool each year is deposited in landfill (based on current and historical disposal rates). Once in landfill, a decay rate of zero was assumed (i.e. carbon in HWPs once in landfill is considered to be permanent and cumulative as discussed earlier). This approach essentially ignores any benefit from the component of in service HWPs that does not end up in landfill, and treats the component of in service HWPs that does end up in landfill as being permanently stored from the time it enters the in-service pool.

Further modelling could be undertaken to consider scenarios where different percentages of the HWPs in service that end up in landfill are reduced over time, for example, by 80% at Harvest 1, 50% at Harvest 2 and 25% at Harvest 3. However, taking such an approach would need to be justified through appropriate evidence. As the volume of carbon in HWPs in service reduces over time, so will the annual volume that moves to landfill, but overall the volume of the carbon in HWPs in the landfill pool will increase.

While calculating a long-term average that includes carbon in HWPs in service is relatively straightforward, the method for including HWPs in landfill is less simple due to a number of factors:

- carbon in HWPs in landfill is cumulative, and
- the period over which this pool will reach its maximum volume based on the HWPs produced within the 100-year project modelling period is significantly longer than 100 years, because of the lag in time between when long-lived products are manufactured and eventually discarded.

The challenge, therefore lies with combining average values from trees and HWPs in service with a cumulative value for HPWs in landfill. There are two possible accounting options for dealing with this dilemma (hypothetical results presented in Table 5).

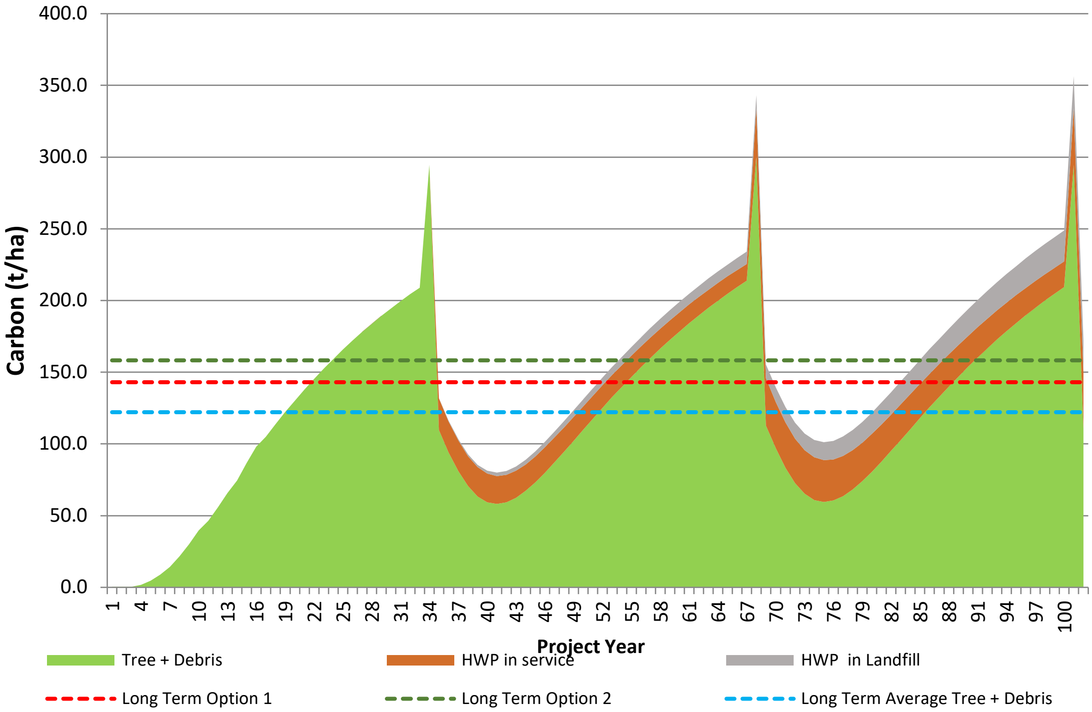
- The first option involves combining the averages for each of the carbon pools over the 100-year modelling period: C in trees and debris, C in HWPs in service and C in HPWs in landfill. Producing a combined long-term contribution.
- The second option recognises the permanent nature of the carbon in HWPs in landfill combining its value at year 100 with the average carbon stocks for trees and debris and HWPs in service.

Figure 4 highlights the difference between the two options (red and brown dashed lines) and the accounting approach which does not credit any of the carbon in HWPs (dashed blue line). Under Option 1 the long-term average is reached in project year 22, while under Option 2 the long-term average is reached in year 24, which may be significant for a project with a crediting period of 25 years.

Table 5: Impact of options for accounting for HWPs in landfill

	100-year permanence		
	Component	**Method**	**Value**
OPTION 1	Forest	ave 3 rotations	122.1
	In service	ave 3 rotations	13.8
	Landfill	ave 3 rotations	7.1
	Total		**143.0**
OPTION 2	Forest	ave 3 rotations	122.1
	In service	ave 3 rotations	13.8
	Landfill	total 3 rotations	22.9
	Total		**158.9**

Figure 4: Carbon in all pools, with combined long-term averages.



The risk of double counting HWPs in landfill

As described above under the Plantation Forestry Method there is a perceived risk of double counting of carbon in HWPs in landfill arising from projects based on ERF methods that capture emissions from, or divert and treat waste from landfill. Adopting this approach would require changes to other the relevant methods.

Outcome

Carbon in HWPs in service has been incorporated within the Plantation Forestry Method. Carbon in HWPs in land fill was not included, due to the perceived risk of double counting and challenges with revising the default waste stream percentages within the NGERS (Measurement) Determination. It was not considered appropriate to develop a stand-alone method for HWPs from non-plantation forests.

Analyses found that including HWPs in methods for carbon abatement in production forests would make a material difference to the abatement that could be generated and as such would be likely to significantly impact the uptake of such methods. Recent developments that were not apparent at the time of method development (adoption of low decay factors for HWPs in the National GHG Inventory and also as recommended by the IPCC) have added weight to the proposed inclusion of HWPs in landfills in the plantation method accounting framework.

Recommendations

It is recommended that this source of abatement be officially recognised and that the following accounting treatments be applied.

1. carbon in HWPs in-service be included in methods on the basis of the sum of the average carbon from each harvest event over the 100-year project period. This approach best reflects what the atmosphere sees and can be readily applied to the long-term average carbon stocks over 100 years.
2. carbon in HWPs in landfill – be recognised as permanent abatement and as such be credited with the full amount that accumulates over the 100-year modelling period.

To facilitate this, it should be requested of the ERAC and DoEE, that, when undertaking future period reviews of the group of ERF landfill methods, consideration be given to the treatment of HWPs and the application of appropriate decay factors.

Residues method

The project proposal originally included a method to account for abatement through the use of biomass from forest harvest operations and wood processing facilities to generate bioenergy. However, as the project progressed opportunities for the utilisation of residues and waste for long-lived wood products was also identified and considered.

The premise of the approach was that as residues are created when forests are harvested for wood products or thinned as part of the silvicultural regime adopted for the forest; only a proportion of the tree biomass is removed from the forest for processing and the residue remains in the forest and is burnt or decays over time. This impacts the carbon stocks in forests and produces potentially significant volumes of greenhouse gas emissions. The residual biomass could be extracted and used for bioenergy production.

Similarly, wood waste is created through the sawmilling and production processes. While some may be used for on-site heat and energy, in other cases this waste is utilised for very short-lived products which produce greenhouse gas emissions through decay, or the waste is not used at all.

In both cases, if a proportion of this biomass can be used for bioenergy or for products with longer lives, such as in the manufacture of engineered wood products the greenhouse outcome would be more favourable (Ximenes et al. 2008; Ximenes et al. 2015)[28.]

Summary Assessment Against Priority Criteria

The proposed method has attracted *broad business support*; it would directly benefit two industry sectors being the forest owner/management sector and the wood processing sector. Both are supportive of measures to increase productivity and reduce wastage at harvesting and during processing. For forest managers the method is attractive because the costs associated with the management of residual fuel loads through planned burning and for site preparation can be significant. Providing an avenue to a viable market for off-site use of biomass would generate income through the sale of previously non-commercial biomass and reduce both costs and the risks associated with burning. For the processing sector, the method provides for new opportunities through emerging technologies, such as for novel engineered wood products or for bioenergy.

The method has the potential to generate a *high volume of abatement*. An estimate of the annual volume of harvesting residues was determined by considering the area of harvestable forest, the area actually harvested, and the volume removed.

The proposed method can be applied to all forests that are legally harvested for wood products - native forests and plantation, both public and privately owned. There are 5.5 M ha of public native forest that is legally available for harvesting each year, of which approximately 100,000 ha is actually harvested in any one year. Additionally, harvesting occurs on private and leasehold native forest. There are 2.0M ha of plantations – 963,000 ha of hardwood plantation and 1,023,000 ha of softwood plantation (ABARES 2016) (Table 6). Between 2012/13 and 2014/15, on average 3.85M m^3 per year of logs were harvested from native forest, 6.9M m3 from hardwood plantations (mostly pulp logs) and a further 14.3M m^3 from softwood plantations (ABARES 2016).

[28] see http://wastetowisdom.com/ as an example of how this approach is being developed in the USA.

Table 6: Area of Plantation by State

State	Hardwood Plantation (ha)	Softwood Plantation (ha)
New South Wales	90.6	296.7
Victoria	206.0	226.0
Queensland	41.6	189.4
South Australia	59.7	128.5
Western Australia	287.3	98.5
Tasmania	235.6	75.1
Northern Territory	42.3	2.4
Aust. Capital Territory	0.0	7.7
Australia	963.2	1,024.2

For the total hardwood volume (native and plantation), taking a broad but conservative estimate, this would result in around 3.2 Mt of harvesting residues per year (refer Table 7), of which 2.1 Mt could be extracted for further use under the method, allowing for retention of a proportion for environmental and site productivity purposes. There are a further 1.7 Mt of low-grade materials that are harvested in native forests each year, the use of which is based on prevailing market conditions. Where a market exists for pulp logs these may be extracted from the forest, otherwise they remain on site as residue From native forests and hardwood plantations the extractable residues are estimated to contain in the order of 1.1MtC (the equivalent of 3.8Mt $C0_2$-e) of which a significant proportion is emitted through burning and decay over time. For softwood plantations, an estimated 2.1 Mt of residues per year may remain on site following harvesting[29]. Of this, waste logs and branches (> 80 mm diameter) together are estimated to account for 35% of the total; or around 750,000 Mt.

Table 7: Annual volume of residues from native forests and hardwood plantations

State	Extractable residues (‘000 t green tonnes)	Non-extractable residues (‘000 t green tonnes)*	Pulp logs from Native forest only (‘000 t green tonnes)
NSW	623	415	290
VIC	558	239	788
TAS	392	168	640
QLD	316	79	0
WA	229	153	126
Total	2,118	1,054	1,843
* This includes bark / stump/ smaller parts of crown material in the forest retained			
Sources: ABARES 2015; pers. comm. by Fabiano Ximenes			

For waste from sawmills, estimates can be based on recovery rates as derived from previous studies and also on usage patterns of residues (Ximenes *et al.* (2015); Ximenes *et al.* (2004) Jaakko Pöyry Consulting (1999)). Table 8 shows estimates of the volume of waste from the processing of sawlogs harvested from native forests and hardwood plantations (based on average volumes from 2012/13-2014/15, sourced from ABARES 2015).

[29] Conservatively based on 15% of harvested volume (Ximenes *et al.* 2012)

Table 8: Estimate of available waste ('000 t/year) from processing sawlogs from native forests and hardwood plantations

State	Green waste ('000 green tonnes)	Dry waste (12% moisture, '000 tonnes)
NSW	354	38
VIC	200	61
TAS	141	35
QLD	99	25
WA	95	24
Total	**889**	**183**
Assumes approximately 25% of waste generated is already committed to stable, higher-value markets		

This wood waste can be further processed for a variety of uses, the abatement from which would be determined by current use (e.g. whether it is already used for a product such as landscaping chip or simply wasted), the new end-product, how it is produced and what is replaces.

The accounting approaches for the *estimating of emissions reductions* from residues are relatively straightforward. Tools such as FullCAM and ForestsHWP (a new model designed by CSIRO - Ximenes et al 2016) could be utilised to calculate emissions abatement associated with wood products. A measured approach based on actual volumes harvested or diverted from mill waste stream could be applied.

The technology associated with extracting residues from the forest is available and in limited use in Australia. The technology associated with segregating and collecting waste during processing is available and in wide use. The availability and readiness of the technology associated with converting the residues and waste to other products is variable. Several studies have been undertaken to assess the state of readiness, such as by URS 2015 and Greaves and May 2012 as summarised in Table 9.

Table 9: Readiness of technology

Possible End-Product	Currently used in Australia	Feedstock used in Australia	Comment
Bioenergy	Yes	Residue and waste from trees and other biomass sources	Currently in use in wood processing facilities.
Engineered wood products	Yes	Softwood	The use of hardwood, particularly plantation grown Eucalypt for LVL more common overseas. Further research is needed for plywood and glulam
Composite wood products	Yes	Softwood	The use of hardwood, particularly plantation grown Eucalypt is more common overseas.
Wood-plastic composites	Limited	All	Technology is well developed overseas.
Biochar	Limited	Tree and non-tree feedstock	Production technology exists

There are no known direct adverse economic impacts from the activity or extracting harvesting residues or using wood waste. Economic benefits will arise through increased employment and economic diversification, particularly in rural and regional Australia.

Adverse environmental impacts may arise through excessive removal of biomass from forests, with consequential impacts on soil quality, hydrology and water quality, site productivity, or forest biodiversity and nutrient cycling within the forest, although this is highly dependent on a range of factors particularly site fertility (discussed further below, see Mendham *et al*. 2014; Guo *et al.* 2006). These impacts, and others, may be mitigated through limits placed on the volume of residues that can be removed, particularly those with higher nutrient value (e.g. leaves, bark), and particularly from native forests.

There may be some opposition[30] to the project activity associated with negative perceptions in projects where native forest biomass is used for bioenergy, particularly a perceived risk that harvesting could occur for the sole purpose of generating biomass. The method would need to be constrained to legal harvesting events that are undertaken for the purpose of wood production.

There are social benefits associated with the development of alternative pathways to the use of residues, particularly at the urban rural interface, including reductions in fuel loads and therefore bushfire threat and reductions in smoke, resulting in positive health and aesthetic outcomes[31].

There are no *other existing policy measures* that promote the use of residues and waste for use in longer-lived wood products. The use of residues for energy is not included in the method.

Summary Against Offsets Integrity Standards

The project activity is considered *additional* because emissions from the decay or burning of residues on site or the use of processing waste in short-lived wood products would be reduced. Project proponents would need to demonstrate that harvesting residues are not already being removed from the forest, or where they are being removed, that volume is either subtracted from the baseline or is diverted to a new product that has a higher abatement potential. For sawmill waste, the proponent would need to demonstrate that the waste wood is being processed into a product with a longer life than under the business as usual scenario.

In processing facilities, abatement through the diversion of wood waste to a new product results in the storage of carbon where this would otherwise have been instantaneously oxidised. Emissions arising from the manufacture of the new product would need to be accounted for Emissions abatement through product substitution (e.g. wood for concrete or steel) could also be included.

The proposed method does not prescribe the end use of the residues. However, proponents would need to demonstrate that the products are new and would need to justify the accounting approach taken for claims of emissions abatement. The inclusion of default factors for some end uses could be incorporated in the method, and expanded upon over time. However, the method could specify end-products that are ineligible.

The proposed method would result in *eligible abatement* that can be used to meet Australia's targets. The method can be applied to all forests that can legally be harvested. A 'no harvest' project activity would not be eligible

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[30] For example: https://www.wilderness.org.au/articles/burning-native-forests-power-lifeline-woodchippers

[31] For example: http://ausfpa.com.au/publications/policies/can-we-better-fire-proof-our-country-towns/

The 2014 IPCC Guidelines provides guidance on accounting for forest that is remaining forestland, but which is harvested. Methods to account for gains and losses from carbon pools vary depending on the level of information available at the country level including, for example, species specific wood density, species specific forest inventory and allometrics. While forest inventories and operational records may document growing stock, annual increment or wood removals of merchantable volume, non-merchantable above-ground components such as tree tops, branches, twigs, foliage, sometimes stumps, and below-ground components (roots) can be calculated on the basis of biomass expansion and conversion factors, which may be country specific.

The inventory requires data on wood removals, including fuelwood removals and biomass losses due to disturbances, in order to calculate biomass stock changes and carbon pool transfers. In addition to wood removals for industrial purposes, there may also be wood removals for small scale processing or direct sales to consumers from land owners. Wood from branches and tops of felled trees must be subtracted from transfers to the dead wood pool.

In Australia's National Greenhouse Gas Inventory, the annual change in living biomass in native forests that are subject to harvesting is the net result of uptake due to forest growth (above and belowground as determined from growth models) and losses due to forest harvesting. The fraction of biomass allocated to tree components varies according to forest type and for each tree component the carbon fraction of biomass is also provided.

The forest type and harvest type influence the proportions of biomass transferred to the HWP pool or residue material (including belowground biomass) moved to dead organic matter (DOM). The annual change in DOM in harvested native forests is the net result of additions from turnover and movement of living biomass to and from DOM. This is due to harvesting and the losses caused by decomposition and burning of residues as part of some silvicultural systems. Losses from the DOM pool are accounted for as emissions in the year in which they occur.

In plantations, the ratio of stem (merchantable) quantities to non-merchantable components is particularly important for the calculation of the amounts of forest slash generated by thinning and harvesting activity. The potential accumulation of slash can make a considerable contribution to increased carbon stocks, particularly on former pasture sites. The amount of carbon moved from living biomass to the DOM pool due to forest harvesting is determined in the model (FullCAM) by the age, type of harvest and species characteristics. The turnover rate of leaves and fine roots affects both the amount of fine litter on the forest floor, and subsequently, most of the contribution to soil carbon.

Abatement could be *measured* through the use of FullCAM and project scenarios *verified* through the keeping of records associated with harvested volumes or wood processing input-output statistics, plus new-product manufacture. However, the current version of FullCAM cannot adequately deal with the dynamics of carbon in the end products potentially covered by this method. There is at least one other existing model that, with some minor modifications, would be able to carry out the product level accounting – ForestHWP, which has been produced by CSIRO (Ximenes et al 2016). A potential option would be a combined approach using FullCAM for the forest level accounting and ForestHWP for the product level accounting.

The use of FullCAM would also provide an *evidence base* for the abatement calculations. There are also several methods developed under the VCS that account for carbon stored in deadwood and emissions from harvesting residues where this is burnt. Approaches include, for example, estimating methane emissions based on the biomass of harvest residues burnt, multiplied by factors that adjust for the mass of methane versus carbon released, and for its global warming potential.

There are no known methods that specifically account for the emissions avoided from the use of harvesting residues for other purposes, other than where this is diverted to facilities for use as bioenergy. In these cases, it is the avoided emissions through the displacement of fossil fuel that are accounted for rather than those associated with the fate of the biomass in the forest.

In order to be *conservative* methods must account for emissions from fossil fuel use where these are material. Sources of fossil fuel emission are:

- Harvesting – it is unlikely that a residues project would increase these emissions as the same harvesting occurs under the baseline and project scenario.
- Treatment of residues *in situ* – there may be some increase in the use of fossil fuel for the treatment of residues on site (e.g. trimming, loading)
- Transport of residues – there will be an increase in the use of fossil fuel in the transport of residues from the project area to the point of processing or end use.
- Processing of residues into the end product - there may be an increase in fossil fuel use in the processing of residues to end products, however this will be product dependent.

Different approaches to accounting for fuel use have been applied under ERF methods, such as

- Direct measurement - proponents are required to record actual fuel use and associated emissions associated with the project activity and apply NGER factors to calculate emissions.
- Estimation – fuel use may be estimated based on bulk fuel purchases, by applying appropriate assumptions, for example on the basis of the age and type of vehicle fuel type distance and distance travelled.
- Predicted fuel emissions – based on the use of emissions factors relative to another parameter, for example the draft Plantation Forestry Determination allows the prediction of fuel emissions by applying an emissions factor of 0.035 (i.e. 3.5%) relative to the mass of wood products harvested.

A similar approach could be applied to this method on the basis of the volume of residues removed.

Consultation with the Department of Environment and Energy

A draft of this proposed method was provided to DoEE in September 2016 for comment and a meeting to discuss the proposed method was held in October 2016. Further comments were subsequently received from the Department. These are summarised in Appendix 2. Key concerns raised were with respect to eligibility of emissions avoidance through the use of residues for bioenergy, double counting for non-renewable energy displacement between potential harvest residues projects and the Renewable Energy Target or other ERF methods, and the verifiability of abatement wherein producers of new products are required to provide an auditable chain of evidence, additionality due to market changes and the increased production of engineered wood products.

Outcome

Taking into account the feedback from the DoEE, a proposal was made that a method for the use of residual biomass from legal forest harvesting and waste from wood processing should be placed on the priority list for method development and a Technical Working Group should be established to further progress method development.

The proposal was not adopted, and method was not prioritised for development.

Recommendation

There remains a strong potential opportunity for revising existing methods to encourage greater use of residues for energy and biofuel that could enhance both uptake of the existing methods and additional abatement.

To facilitate this, it should be requested of the ERAC and DoEE, that, when undertaking future period reviews of the group of ERF industrial energy efficiency and facilities methods, consideration be given to opportunities to encourage greater use of residues for energy and biofuel that could enhance both uptake of the existing methods and increase abatement.

There is also substantial abatement potential associated with the use of biomass for bioenergy that remains unrealised through all of the current policy approaches. Research has shown that there are significant volumes of forestry biomass that have significant potential for a range of uses. At present these represent a net loss to the industry and a lost abatement opportunity.

Industry is promoting the potential of use of sustainably sourced woody biomass for renewable energy (including renewable heat and biofuels) displacing fossil fuels and the development of new generation value-added products such as biomaterials, biochemicals and bioenergy from Australian renewable wood fibre[32]. AFPA has proposed a number of measures including the development of a National Biofutures Roadmap; the establishment of a National Biofutures Industry Development Fund; a ‘Bioproducts Innovation Hub’ connected to the existing Industry Growth Centres initiative to focus on research and development, technology transfer and bridging the investment and industry deployment gap for bioproducts in Australia and recognition, and incentivisation of bioenergy and renewable heat in the design of the National Energy Guarantee (NEG) or any such energy policy mechanism.

Further research into opportunities for strategically aligning the plantation sector, including ERF plantation projects, and options for Bioproducts hubs would assist in realising the potential, aligning it with regional needs and setting some priorities for pilot projects.

[32] http://ausfpa.com.au/wp-content/uploads/2018/01/Towards-a-National-Forest-Industries-Plan-Key-Industry-Asks.pdf

Enhanced Management of Native Forests Method

The propose method for native forests assessed whether there is abatement opportunity through increasing carbon stocks in native forests due to increased productivity arising from specific forest management interventions such as native forest silvicultural practices (e.g. ecological thinning; extended rotation length) and actions to improve forest health (e.g. more effective lantana control and regenerating forests impacted by Bell miner associated dieback).

Introduction to abatement opportunity

Native forests and woodlands sequester carbon dioxide and store significant volumes of carbon. However, large areas are degraded or are in decline as a result of a wide variety of factors that either inhibit their ability to fully regenerate or that accelerate degradation. Low carbon stocks in native forests may be indicated by a number of, typically, structural characteristics. These may be specific to a forest ecosystem type, or more generic. For example:

- Cypress pine forests may stagnate (become 'locked up') as a result of altered fire, grazing or silvicultural management practices. This results in highly-stocked dense stands of small trees, which are atypical of these forest types under a 'normal' disturbance regime.
- River red gum regrowth forests may stagnate and decline in health as a result of human induced reductions in water availability caused by the regulation of river flow levels and exacerbated by drought events.
- Forests that have been harvested in the past may have failed to successfully regenerate due to invasive weeds and or inappropriate silvicultural treatment or inappropriate fire management.
- Intensive grazing, for example in rangeland areas, or cropping may be preventing successional regeneration of woodlands.
- Invasive native scrub may dominate ecosystems in which fire or grazing management has ceased, preventing regeneration of native woodland trees and grass species.
- Forest may dieback at the canopy or go into decline through a range of causes which may be species specific and localised, or widespread.

An opportunity was identified to account for carbon abatement generated through activities that alter the management of native forests to increase the amount of carbon stored, for example:

- ecological thinning in appropriate forest types (e.g. cypress pine and river red gum regrowth forests);
- thinning of invasive native scrub;
- extending the rotation length;
- enrichment planting;
- human induced natural regeneration such as through the exclusion of degrading agents such as grazing
- halting the spread of agents of decline and dieback in susceptible forest types and thereby prevent the degradation of the carbon potential of native forests by reducing tree mortality.

Under the project research it was not possible to explore and develop specific methods for all of the possible activities that could result in emissions abatement in native forests. To explore the possible the research focussed on dieback. However, it was envisages that ultimately a single broad method which could be applied to multiple business-as-usual scenarios with a number of possible project activities could be developed, as has occurred with other methods, such as the Human-Induced regeneration of a permanent even-aged native forest V1.1 method.

Of relevance to this method was the prioritisation of a method for restoring degraded woodlands, through for example, changing management of grazing, fire or weeds to increase carbon stocks in existing woodlands (native forest with 20 to 50 per cent crown cover). That proposal is conceptually similar to the method discussed here.

Summary Assessment Against Priority Criteria

The propose method was a tenure neutral method applicable to forests on private land and the public estate which are managed for conservation, timber production or other uses. As a result, it drew *broad industry support* from the public sector agencies responsible for managing large tracts of native forest: Forestry Corporation of NSW, Forest Products Commission of WA, Vic Forests, Crown Lands NSW. Associations that represent the timber industry were also supportive.

Given the breadth of the possible factors that could degrade or impede forest carbon stocks, *estimating volume of abatement* from the method was difficult however it was possible to determine the spatial applicability of the method. It was estimated that degradation is likely to be prevalent in 59 M ha of Australian woodlands (forests with canopy cover 20-50%) that lie outside of conservation or other protected tenures (Paul et al. 2016). Specific causes of degradation in forests were researched but there is no nation-wide review similar to that undertaken for woodlands. Bell Miner Associate Dieback (BMAD) has been recorded in NSW, Victoria and QLD, and estimates of the extent and potential for spread vary depending on the proposed cause and characteristics of susceptible forest types (Silver and Carnegie 2017). Between 2015 and 2017 around 1.25M ha of native forest was surveyed for BMAD in NSW by helicopter, and approximately 44,000 ha was identified as BMAD affected (*pers. comm.* A Carnegie). Wardell-Johnson et al. 2006 estimated that 2.5 Mha could be considered to be at risk of BMAD across eastern NSW while other sources estimate around 781,000 ha of east coast forests as being predisposed to decline (Vic Jurskis unpub. data 2008 in Meek 2008).

While the applicability of a method may be potentially extensive in geographic scope, the volume of abatement will vary on the basis of the vegetation type affected and the project activity undertaken. Paul et al. (2016) calculated that the national potential abatement for woodlands (assuming restoration across the 59 M ha) was 4 – 10 Mt C yr^{-1} (or 15 – 37 Mt CO_2-e yr^{-1}) when averaged over the first 25 years following restoration. This mitigation potential is of a similar order to that estimated for savanna burning (estimates of 5 – 13 Mt CO_2-e yr^{-1}), or reduced livestock enteric emissions (16 – 26 Mt CO_2 yr^{-1}), but much less than the potential for mitigation from establishing farm forestry or environmental plantings (143 – 750 Mt CO_2-e yr^{-1}).

Several approaches were assessed for estimating carbon abatement: (i) project-based direct measurement, (ii) modelling using FullCAM and; (iii) application of regional-based model-informed defaults. While direct measurement is technically feasible, it was found unlikely to be viable at the project level due to excessive costs of implementation. The use of remote assessment technology (principally high-density LiDAR) has the potential to dramatically reduce the cost. FullCAM could be used to estimate the long-term average carbon stocks in the forest. However, FullCAM currently simulates only even-aged forests, which would not reflect the diversity/multi-aged structure of degraded forest. Furthermore, FullCAM cannot account for the planting of trees into landscape that are already forested.

The *status of the technology* necessary to undertake the projects activities varied depending on the specific activity and a review of literature undertaken by this project (see Appendix 3 and c.f. Silver and Carnegie 2017 with respect to BMAD) found that there is inconsistent opinion on the types of interventions that should be applied to different causes of degradation (. Forest can be managed using a range of activities to address decline or degradation.

There are few likely *adverse economic, social or environmental impacts* arising from the project activity. The method would address a serious environmental problem that has significant economic and some social consequences. Depending on the factors impeding forest growth or causing degradation there may be some localised consequences. There are challenges in finding affordable and practicable methods for restoring carbon stocks in some affected areas. While fire is a preferred low-cost management tool it may need to be supported with chemical and mechanical treatments.

There are *other measures* through which forest degradation and decline could be addresses, but to date these have been largely ineffective on a broad scale. Addressing some causes of forest growth impediment or degradation could be addressed through increased public funding, for example.

Summary Against Offsets Integrity Standards

The demonstration of whether the project method would result in *additional abatement* was challenging due to the intent to apply the method across all land tenures, thus the underlying land management activities could vary significantly. While in some cases this could be addresses relatively easily, for example timber harvesting in the baseline and project scenario, other activities were more challenging. Regulatory additionality was found to be a particular problem. Activity that is already required under the regulations of a State or Commonwealth may not be eligible and this varied on a State-by-state basis. For example, lantana which is thought by some to contribute to BMAD is a weed of National Significance, and is regulated differently by each State and Territory. For example

- In NSW lantana is listed in the 2014 Noxious Weed Control order of the *Noxious Weed Control Act 1993*. This order specifies the weed control class and therefore the management activities that must be undertaken. For the majority of NSW lantana is a Class 4 noxious weed, this requires that "The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control …'. The Minister (for public land) or a Local Control Authority (for other land) may issue a weed control notice to a land owner for the control of a weed. Each LCA develops and implements its own management plan.
- In Queensland lantana is a Class 3 declared pest plant under Queensland legislation. The intent of Class 3 is to prevent sale, therefore preventing the spread of these pests into new areas. Landholders are not required to control Class 3 plants unless their land is adjacent to an environmentally significant area and they are issued with a pest control notice. It is a serious offence to supply a Class 3 pest without a permit issued by Biosecurity Queensland.

Specific processes that threaten ecological communities or species may also be proscribed under State regulation. In NSW, for example forest eucalypt dieback associated with over-abundant psyllids and Bell Miners has been listed as a key threatening process under the *Threatened Species Conservation Act* 1995. A Threat abatement Plan, which is a statutory document, may be made for a process. However, such a plan has not been written for BMAD.

Additionally, management practices intended to be introduced under project activities may be limited by regulation. In NSW again, high frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition has been determined to be a key threatening process. High frequency fire and inappropriate fire regimes (which largely equates to too high a fire frequency) have been identified as threats to a number of species and communities listed on Schedule 1 or 2 of the Threatened Species Conservation Act, including. Specific ecological communities and species are listed including some that are known to be susceptible to BMAD such as Sydney Blue Gum High Forest.

The management of fire is regulated in every state and territory, and where fire management is a project activity it must comply with these regulations both in terms of seeking required approvals (Fire Permits) and meeting other requirements specified in the regulations. In NSW for example, fire management is regulated under the *Rural Fires Act 1997*. In accordance with this Act each local Bush Fire Management Committee develops a Bush Fire Risk Management Plan which sets out the types of work scheduled to deal with the risk of bush fires in an area. Bushfire management plans include an assessment of vegetation types and apply a fire interval threshold considered appropriate. However, specified fire intervals may not be compatible with the project activity; changing the frequency or intensity of fire is considered necessary to reduce the risk of BMAD outbreak.

Government funding may also impact additionality. Projects that cover activities that also funded under existing Commonwealth, state or territory government programmes may be excluded from participating in the ERF. This is intended to ensure that emissions reductions are not paid for twice – once under the ERF and again under another government programme.

The proposed method would result in *eligible* abatement that can be used to meet Australia's targets. Reference levels are used to track changes in carbon stocks in forests. For forest management countries set a "forest management reference level" (FMRL) against which performance is measured. Australia has defined Forest Management lands as those forests (on all tenures) that are managed under a system of practices that include forest harvesting; silvicultural practices; and the protection of natural resources within the areas of land available for harvest. Forests included under this definition are Multiple Use Forests and pre-1990 Plantations.

Limitations were found in the ability to measure and verify abatement. A review of available literature demonstrated that there is currently insufficient evidence to conclude the magnitude or direction of changes in biomass as a result of any one activity associated with inhibiting agents of degradation in isolation from other causes of change. Various causes of decline or degradation and management interventions were explored and a detailed case study was undertaken for BMAD (presented in Appendix 3).

Outcome

The outcome of this assessment was that a method was not prioritised for development. Reasoning included, uncertain baselines, difficulties in estimating the cause and magnitude of abatement and likely low level of abatement.

Recommendation

There are opportunities to generate greenhouse gas abatement through enhanced management of native forest that remain as yet unrealised. While evidence indicates that actions to address forest degradation could result in significant abatement and have important co-benefits, there are currently some technical and information barriers to translating these into an ERF method or methods. However, in progressing a landscape approach to native forest and native vegetation management consideration should be given to the ways in which the incentives provided by a scheme such as the ERF can incentivise better forest management. This could be through a comprehensive review of the application of existing forest and vegetation methods – such as for avoided deforestation, avoided forest clearing and restoration of native forests from regeneration and regrowth and their application in different types of productive landscapes.

As the Government considers the future priorities for ERF method development and for the operation of the Fund, it is recommended that a specific technical working group be convened to explore opportunities to expand the scope of methods for abatement from native forests and native vegetation, taking into account policies for economic development, social expectations and environmental drivers as well as future markets for products from these landscapes.

Conclusions

From the perspective of actual method development, the outcomes of the project can be summarised as follows:

- An ERF method for Plantation Forestry[33] was made into a legislative instrument (*The Carbon Credits (Carbon Farming Initiative—Plantation Forestry) Methodology Determination 2017*) which has enabled participation by plantation companies in the ERF.
- The Plantation Forestry Method provides for projects that sequester carbon dioxide in new long rotation plantations.
- Opportunities for some short-rotation plantations were also incorporated in the Plantation Forestry Method - both for new short-rotation plantations and for extending the rotation age of existing short-rotation plantations.
- Carbon in HWPs in service was included in the Plantation Forestry Method, while carbon in HWPs in landfill were not included, due to perceived potential conflicts with other existing methods related to emissions avoidance from landfill.
- A proposal for a method for carbon in HWPs from other forests, such as native forests and short-rotation plantations ineligible under the Plantation Forestry Method was developed and presented to DoEE but was not taken up.
- Options for GHG emissions abatement through enhanced native forest management were developed in consultation with industry partners and DoEE. The method was not prioritised for development due to methodological challenges with establishing baselines and detecting change in carbon that could be attributed to project activities. Challenges associated with regulatory additionality were also identified.
- Opportunities associated with the use of forest residues and processing waste were considered. However following consultation with industry partners and processors (softwood and hardwood processors, and engineered wood products) they were not pursued. Nevertheless, research revealed potential opportunities for the wood processing sector in existing methods that could be enhanced through a review of those methods and associated regulations.
- Following early discussion DoEE a method for emissions avoidance through the prevention of wildfire was not pursued.

Based on the process utilised and research undertaken the following observations can be made.

With respect to the process:

- The institutional environment for method development is challenging but it provides a clear structure around which cases for method development can be made.
- A collaborative approach, involving the DoEE, research organisations and industry stakeholders can both streamline the process and enable the identification of realistic and 'best-bet' opportunities and quickly eliminate unrealistic or unviable options for methods.

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[33] http://www.environment.gov.au/climate-change/government/emissions-reduction-fund/methods/plantation-forestry

- The participation of research organisations and industry in the development of technical and procedural elements of methods is essential if they are to be practical and reliably implemented.
- There are good mechanisms in place for reviewing and improving methods and the direct interaction between the DoEE, other ERF institutions (such as as the ERAC), project proponents and the broader forest and wood industry in essential to identify and address weaknesses and complexities and improve abatement calculations.
- The time take from the identification of abatement opportunities, through prioritisation and ultimately method development is long.

With respect to opportunities for GHG abatement from production forests and wood industries:

- Other than with respect to the core functions of production forestry (growth and wood production), there is inadequate supporting research that specifically informs the question of abatement opportunities - for example in the management of native forests for forest health or the management of fire, generally. Given the current policy and institutional settings, and level of funding for method development and research, this creates a Catch 22 situation in which in absence of a method forest managers are unlikely to invest in specific research to answer these questions but a method will not be developed unless the information exists.
- Where methods have been created, as in the case of the Plantation Forestry Method there are opportunities to improve these through inputs from industry and direct engagement in review processes.
- Cross-sectoral opportunities exist within methods - for example in the use of plantation residues for biofuel which are eligible project activities in the transport methods, or in the use of residues for bioenergy production. These should be identified and assessed during method review processes including broader that sector-specific technical consultation.
- While the production and use of engineered wood products is growing opportunities remain to create a more favourable environment for this through recognising the abatement potential of the use of residues and wood waste in production and arising from the substitution of other more GHG emissions intensive products. Further research should be undertaken to explore these.
- An integrated approach for combining abatement opportunities from various methods into one hub or area, along the lines a landscape approaches for vegetation methods, should be explored. For example, by combining opportunities for plantations, residues for energy and wood in the built environment a greater abatement opportunity may arise that for one approach on it its own.

Recommendations

There are several as-yet unrealised opportunities for method development for the forest and wood products sector, both through improvement to existing ERF methods and the development of new methods.

With respect to the Plantation Forestry Method there are opportunities to improve the method during a formal review exercise.

There is scope for modelled abatement estimates to become more closely aligned with actual abatement by expediting updates to FullCAM that allow project proponents to use reliable (and potentially independently verified) inventory data, collected routinely throughout most commercial forest estates, as one of the inputs to FullCAM. This functionality has been present in previous releases of FullCAM, and so presumably could be relatively easily included in versions to be used for this Methodology Determination

In addition, consideration should be given to the following elements:

f) **Baseline –** Exploring the potential of a zero baseline for short-rotation stands that are not viable to replant; when converting to long-rotation could use generic productivity estimates and distance to market to generate as a ruleset for assessing project viability.

g) **HWPS in landfill –** reviewing new research and reconsidering the inclusion of HWPs in landfill in the scope of the method.

h) **Ministerial Assessment of impacts on Agricultural land** - reconsider the need for this assessment. It is not equally applied to all land sector methods that could impact agricultural lands. If retained. Apply it to all land sector methods and provide improved online information to assist proponents in decision making.

i) **600mm rainfall limitation** - The rule should be consistently applied to all tree planting projects or removed. If retained DWAR should expedite Commonwealth-State discussion across all NPI regions to provide advice to proponents and improve on line information to assist with decision making.

j) **NPI regions** - Review the NPI boundaries to ensure that they capture all suitable plantation areas, with a particular focus on areas with existing plantations. Include NPI regions boundaries in the CFI mapping tool.

With respect to expanding opportunities within other methods, consideration should be given to:

f) **Greenfield activities –** allowing greenfield activities (such as replacing a coal powered station with a biomass powers station) where these are within one entity's operations, so as to avoid leakage.

g) **Limits on energy generation -** revising the limits on energy generation in the IEFE method, to allow for activities that generate electricity greater than the current restriction of 30 megawatts to increase demand for biomass feed stock from plantation forests, including project registered under the ERF Plantation Forest Method; a double win for abatement.

h) **Residues from harvesting –** reviewing the scope of the Renewable Energy Act rules with respect to energy crops, and how this could be revised to bring it in line with the CFI Regulation. This could enable broader participation in renewable energy activities, both under the RET and ERF industrial methods.

i) Opportunities to generate abatement through **enhanced management of native forests,** taking a landscape approach.

Future Opportunities

There is currently substantial abatement potential associated with the use of biomass for bioenergy that remains unrealised through all of the current policy approaches.

Research from the current project, and others (e.g Australian Biomass for Bioenergy Assessment - ABBA) has shown that there are significant volumes of forestry biomass that have significant potential for a range of uses. At present these represent a net loss to the industry and a lost abatement opportunity.

Industry is promoting the potential of use of sustainably sourced woody biomass for renewable energy (including renewable heat and biofuels) displacing fossil fuels and the development of new generation value-added products such as biomaterials, biochemicals and bioenergy from Australian renewable wood fibre[34]. AFPA has proposed a number of measures including the development of a National Biofutures Roadmap; the establishment of a National Biofutures Industry Development Fund; a 'Bioproducts Innovation Hub' connected to the existing Industry Growth Centres initiative to focus on research and development, technology transfer and bridging the investment and industry deployment gap for bioproducts in Australia and recognition, and incentivisation of bioenergy and renewable heat in the design of the National Energy Guarantee (NEG) or any such energy policy mechanism.

Further research into opportunities for strategically aligning the plantation sector, including ERF plantation projects, and options for Bioproducts hubs would assist in realising the potential, aligning it with regional needs and setting some priorities for pilot projects.

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[34] http://ausfpa.com.au/wp-content/uploads/2018/01/Towards-a-National-Forest-Industries-Plan-Key-Industry-Asks.pdf

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Appendices

Appendix 1: Harvested Wood Products

Background

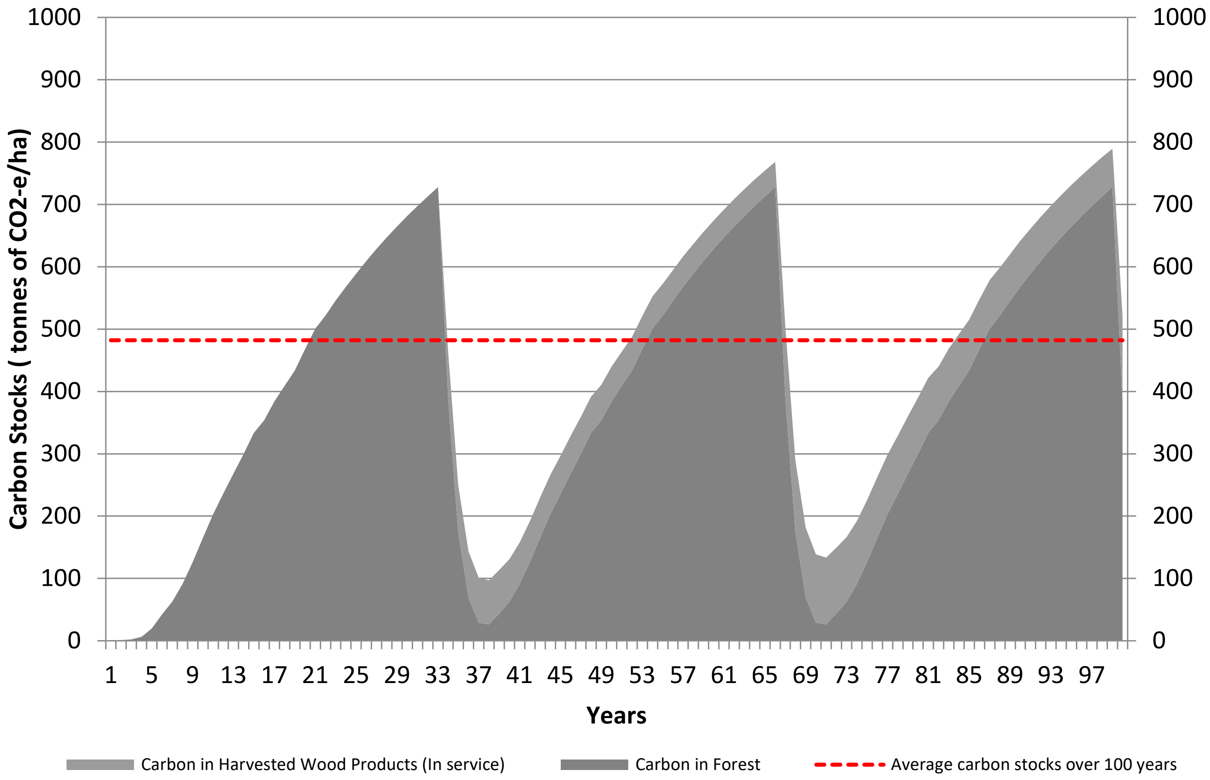
A simple analysis was presented to illustrate the potential contribution of HWPs carbon pools to emissions reduction in forestry projects; and to demonstrate options for inclusion of these pools in forestry carbon accounting methods, such as the ERF Plantation Forestry Method.

Potential for Abatement from HWPs

HWPs can be included in accounting approaches through their contribution to the long-term average carbon stock, or by the calculation of carbon stock change in a period. The choice of approach is largely dependent on the dynamics of the specific pool.

In the case of "forest carbon" and "HWPs in service", the calculation of a long-term average is appropriate, as there is constant addition of "new" carbon and also removals via harvest events, natural decay and fire (Figure 5).

Figure 5: 100-year plantation carbon stock profile showing carbon stored in the forest and in HPWs in service over three consecutive rotations



However, the HWPs in the landfill pool works more like a "reservoir" of carbon, as new carbon is added and little is lost, and in the case of the most common types of HWPs used in Australia, the latest research suggests that no material decomposition takes place. While HWPs in service can be incorporated in the long-term average stock in a way that is consistent with the approach for accounting for sequestration in trees, there remains a need to consider what the best method is for calculating and incorporating the contribution of the carbon in HWPs in landfill over the 100-year modelling period.

To better understand this, a hypothetical analysis was undertaken to demonstrate the potential for abatement in HWPs in service and in landfill in a new long rotation softwood plantation. The analysis applies a number of assumptions as summarised in Table 10.

Table 10: Assumption applied in analysis

Parameter	Factor	Source/Reference/Justification
Forest type	Plantation softwood (*Pinus radiata*)	Consistent with proposed ERF method
Project length (years)	100	consistent with ERF options for project modelling period and permanence
Planting events (number)[35]	3	allowing for three 33 year rotations
Thinning events (number)	0	No thinning events were included to simplify the modelling
Area Planted (ha)	33	estimate @ 300 m^3/ha sawlog only
Volume Sawlog Harvested (m^3 per event)	10000	Hypothetical, does not include thinnings
Basic density of wood (BD, kg/m^3)	0.46	Consistent with Australia's National Accounts for softwood
Carbon fraction of wood (CF)	0.5	Consistent with Australia's National Accounts
Sawlog (tC) (S)	2300	Volume Harvested x BD x CF
Wood product in service (tC)	736	S x GMR x KD x DMR
Green mill recovery (GMR)	0.5	typical industry data
Proportion of green rough-sawn boards that are kiln-dried (KD)	0.8	typical industry data
Dry mill recovery (truss and frames) (DMR)	0.8	Conservative as only considers kiln-dried boards, not storage in green products or in engineered wood products manufactured from residues
Proportion of sawnwood product disposed of in landfill at end of service life	0.8	Ximenes 2008
Proportion of carbon in HWP in landfill that is lost to decay	0	From Wang et al 2011; Ximenes et at 2013 and Ximenes et al 2015
Half-life (years)	35	latest IPCC factors for HWP in service
Fraction of products in service lost each year (k) (constant)	0.019804	IPCC
FullCAM scenario		FullCAM version 4.00.3 P. radiata, Macquarie Region NSW Harvesting years: 33, 71, 99.

HWPs in Service

Carbon in HWPs in service was modelled to estimate the potential contribution to the overall carbon balance of softwood plantations after three clearfall harvest events. Generally, after each harvest event carbon enters the HWP in service pool and then moves out of this pool over time.

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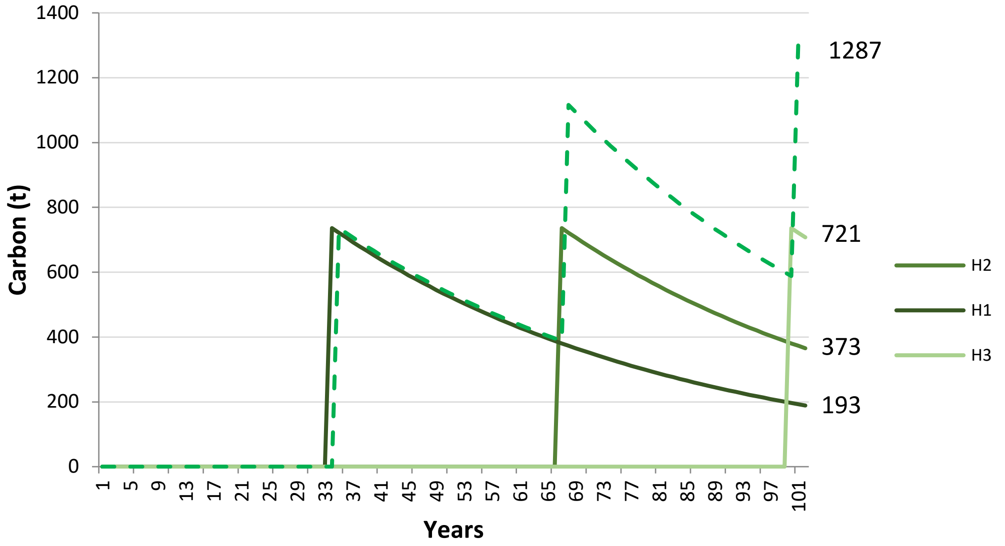
[35] Actual plantation regimes would also include thinning events

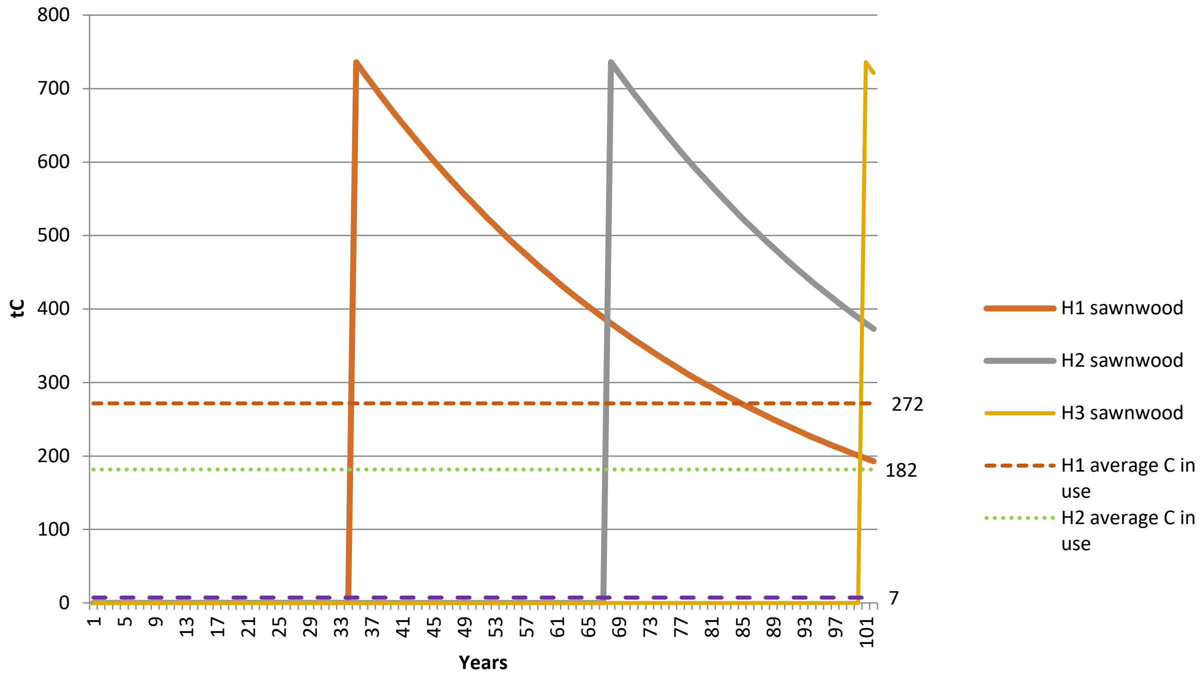
One approach calculats the sum of carbon in HWPs that is actually still in service at the end of the project period (100 years) after the three harvest events. The calculations take into account inputs from each harvest event and decay over time (Figure 6). In this scenario this results in 1287 tC at the 101st project year.

Figure 6: Additions and losses of carbon in the HWP in service pool arising from three harvest events over 100 years.



Another approach is to consider carbon in HWPs in service as the sum of the average carbon in HWPs in service from each harvest event, where each harvest event is averaged over the 100-year project period. This results in 461 tC in the 101st year (Figure 7).

Figure 7: Carbon in HWP in service and average over 100 years for three harvest events

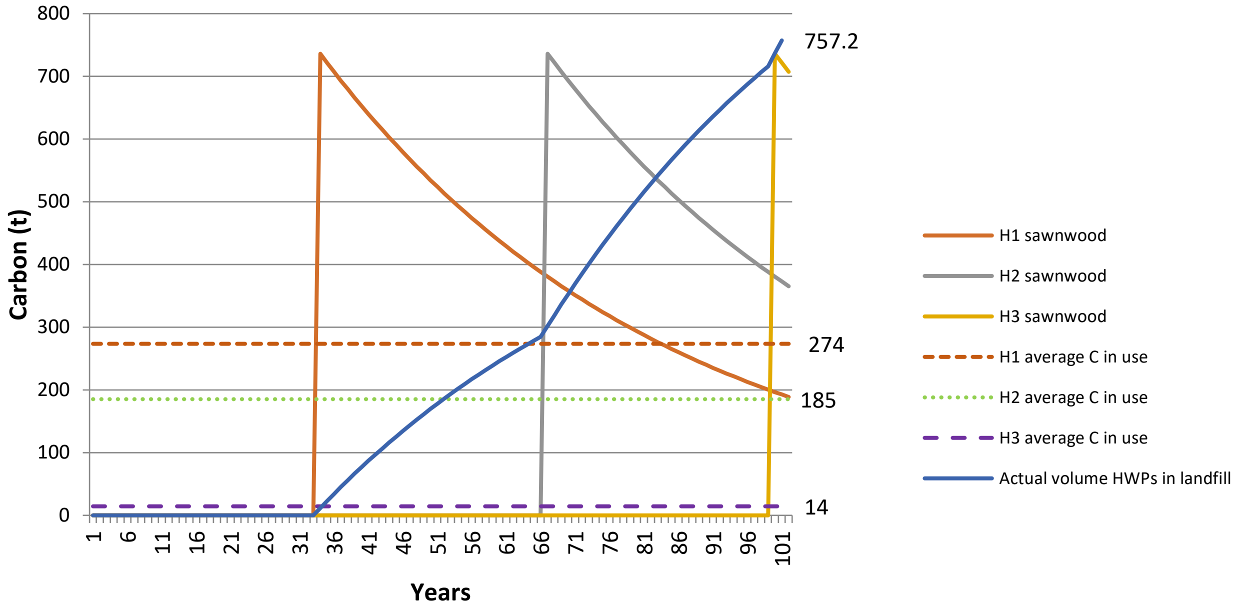


HWPs in Landfill

Carbon in HWPs in landfill can be modelled by assuming that 80% of the carbon that leaves the in-service pool each year is deposited in landfill. Once in landfill a decay rate of zero is assumed (i.e. carbon in HWPs once in landfill is considered to be permanent and cumulative as discussed earlier).

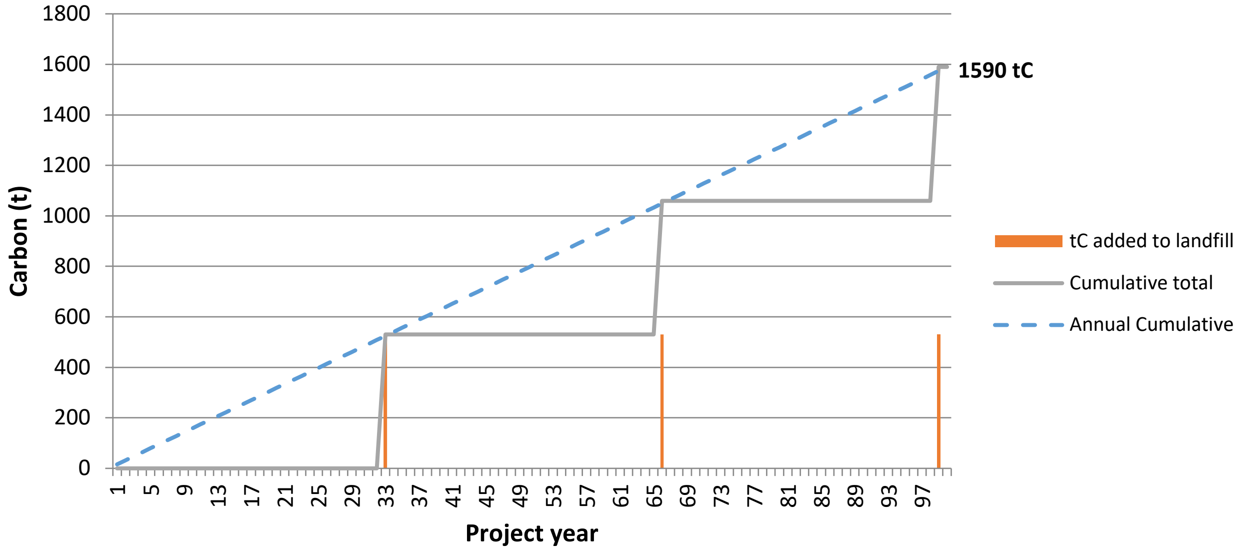
As the volume of carbon in HWPs in service reduces over time, so will the annual volume that moves to landfill, but overall the volume of the carbon in HWPs in landfill pool will increase. Based on this approach 757 tC will have accumulated to landfill by project year 101 (438 tC from Harvest 1, 296 tC from Harvest 2 and 23 tC from Harvest 3). Figure 8 shows the combined contribution of C of HWPs in service to HWPs in landfill.

Figure 8: Carbon in HWPs in service and in landfill



Alternatively, a simplified method that combines the in service and landfill pools for HWPs could be used, based on the fact that the majority (80%) of the total volume of sawnwood ultimately ends up in landfill and is therefore permanently sequestered. This method would essentially ignore any benefit from the component of in service HWPs that does not end up in landfill, and treat the component of in service HWPs that does end up in landfill as being permanently stored from the time it enters the in-service pool. Based on the example data above, this would amount to 530 tC from each harvest event being permanently sequestered, and the total C permanently stored in HWPs would eventually reach 1590 tC by project year 101 (Figure 9).

Figure 9: Carbon permanently stored in HWP under a simplified method

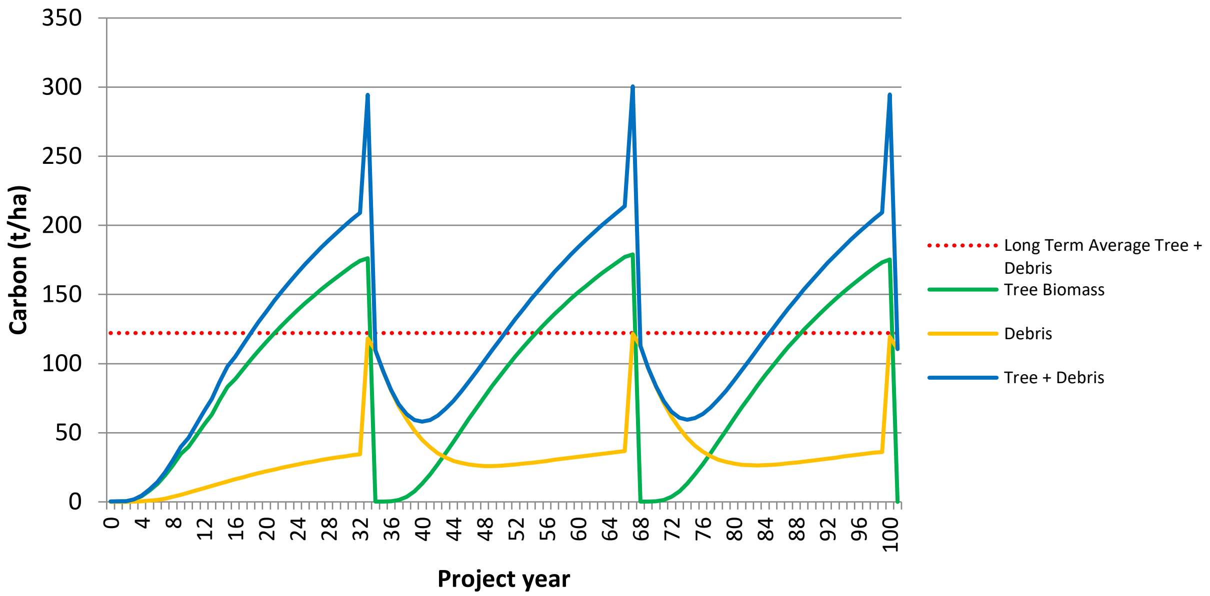


Calculating Long-Term Averages

The ERF Plantation Forestry Method utilises a long-term average to set the upper limit to crediting abatement. The long-term average is based on the combination of carbon in trees and debris and carbon in HWPs To understand the interaction between these pools and in determining the contribution over the long term, a FullCAM model was run to generate forest carbon values on a hectare basis, using a similar set of parameters as described in Table 10.

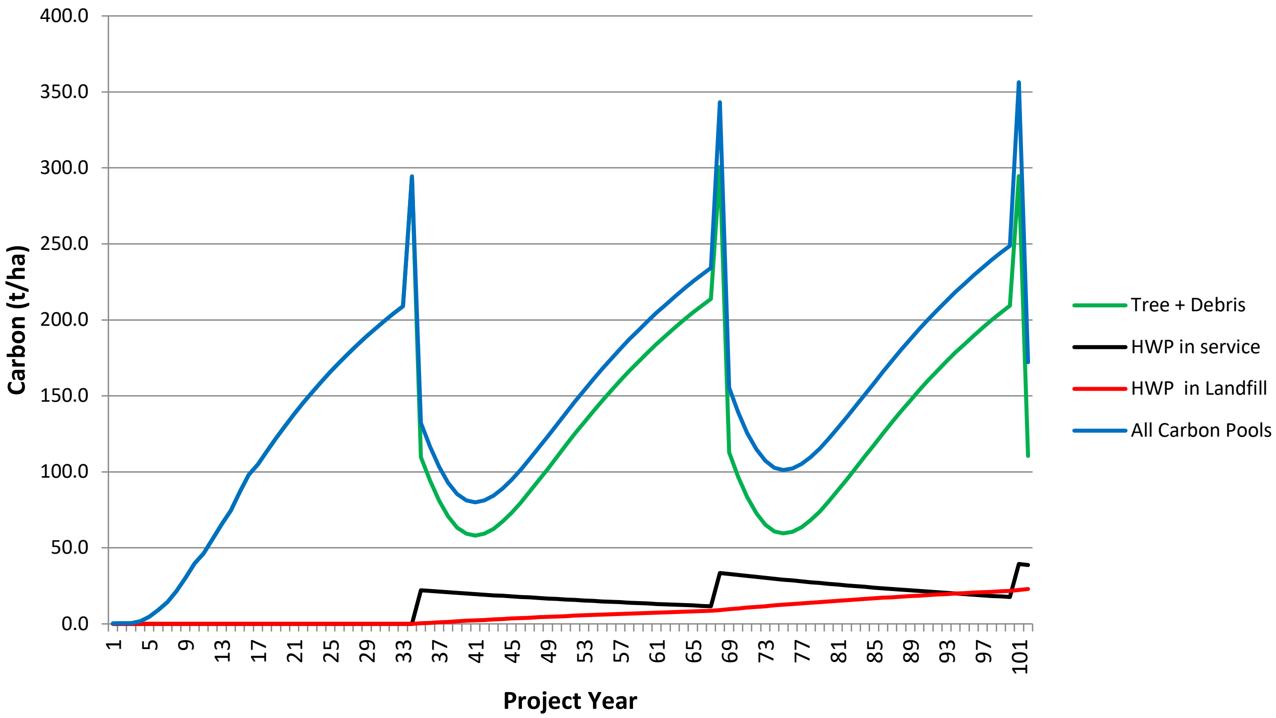
Figure 10 shows the carbon in "Tree biomass", "debris" and these two pools combined, with the long-term average calculated over the 100-year period.

Figure 10: Carbon in Forest based on FullCAM modelling.



These forest carbon values from FullCAM were then combined with the data for HWPs (using the approach described above) to show the relationship between C in the plantation (tree and debris biomass) and carbon in HWPs in service and in landfill (Figure 11). This shows the cumulative nature of HWPs in landfill.

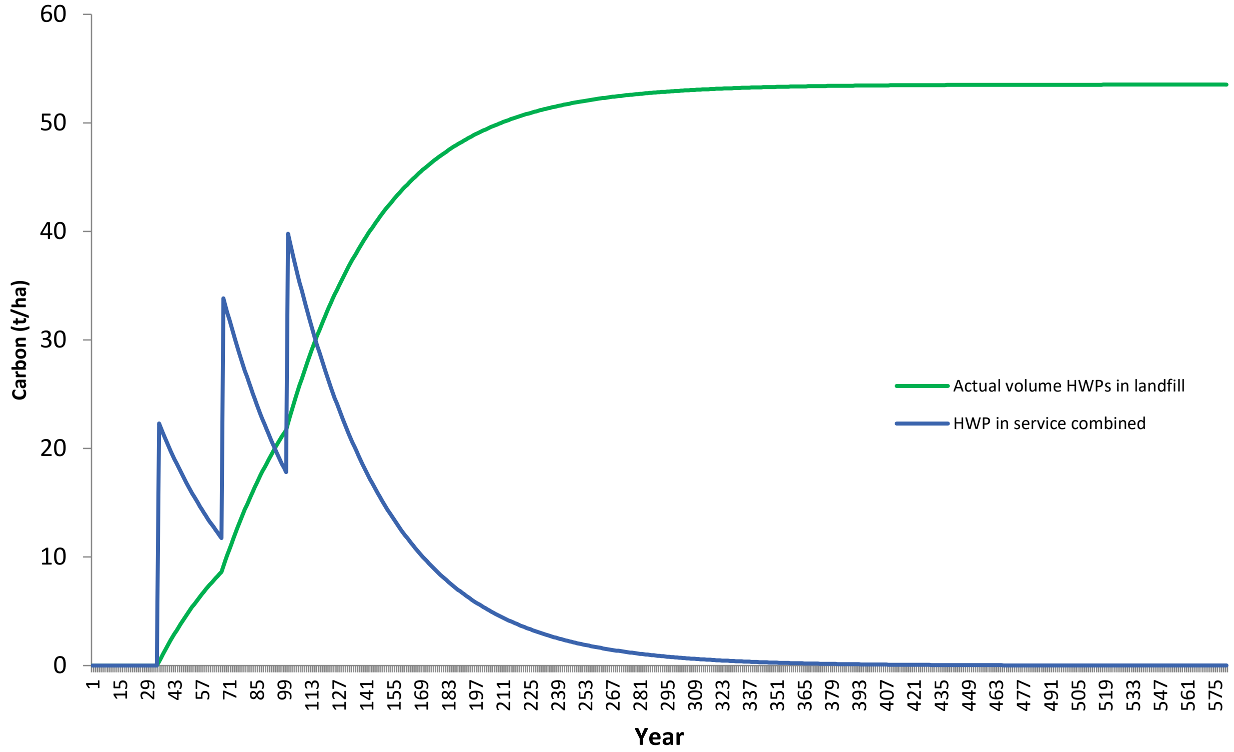
Figure 11: Carbon in all pools



While calculating a long-term average that includes C in HPWs in service is relatively straightforward, the method for including HWPs in landfill is less simple due to a number of factors:

- carbon in HWPs in landfill is cumulative, and
- the period over which this pool will reach its maximum volume based on the HPWs produced within the 100-year project modelling period is significantly longer than 100 years, as shown in Figure 12 This projects forward the two HWP pools over 500 years, until all carbon has moved from "in service" to "landfill", and then until HWPs in landfill has attained its maximum volume. The total volume of carbon that will be stored in landfill will be 53.5t per hectare, reached in year 453, whereas at the end of the project modelling period at year 100 only 23 t/ha will have reached landfill.

Figure 12: Long-term profile of Carbon in HPWs in service and in landfill



The challenge lies with combining average values from trees and HWPs in service with a cumulative value for HPWs in landfill.

There are two possible accounting options for dealing with this dilemma. The first option is the most straightforward, it involves combining the averages for each of the C pools over the 100-year modelling period, which are as follows:

- C in trees and debris 122 tC/ha
- C in HWPs in service 13.8tC/ha
- C in HPWs in landfill 7.1 t/ha

Producing a combined long-term contribution of 143 tC/ha (Option 1 in **Error! Reference source not found.**).

it may be argued that option 1 underrepresents the actual contribution of the HWPs in the landfill pool from products originating with the project activity as at year 100 the accumulated carbon in HPWs in landfill is 22.9 tC/ha and is increasing.

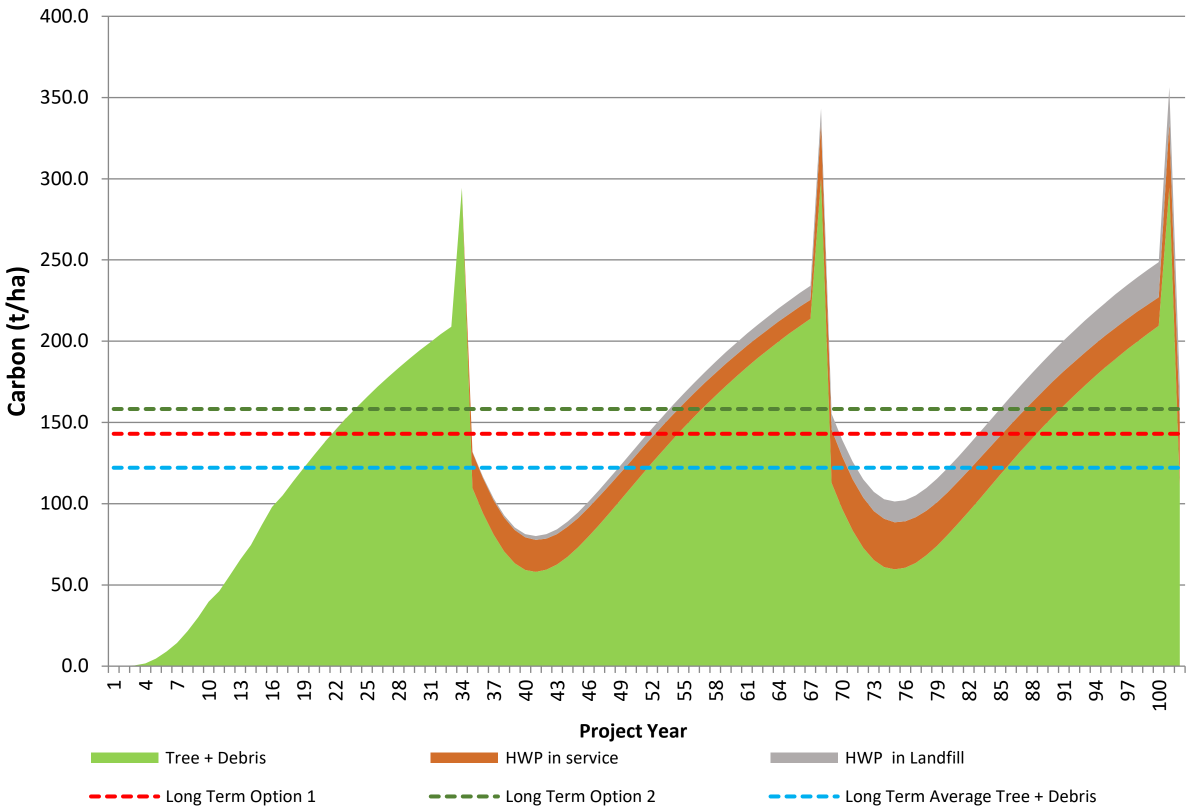
The second option recognises the permanent nature of the carbon in HPWs in landfill combining its value at year 100 (22.9 tC/ha) with the average carbon stocks for trees and debris and HWPs in service. This option generates a long-term contribution of 158 tC/ha (Table 11).

Figure 13 highlights the difference between the two accounting options (red and brown dashed lines) and the accounting approach which does not credit any of the carbon in HWP (dashed blue line). Under Option 1 the long-term average is reached in project year 22, while under Option 2 the long-term average is reached in year 24, which may be significant for a project with a crediting period of 25 years.

Table 11: Impact of options for accounting for HWPs in landfill

	100-year permanence		
	Component	**Method**	**Value**
OPTION 1	Forest	ave 3 rotations	122.1
	In service	ave 3 rotations	13.8
	Landfill	ave 3 rotations	7.1
	Total		**143.0**
OPTION 2	Forest	ave 3 rotations	122.1
	In service	ave 3 rotations	13.8
	Landfill	total 3 rotations	22.9
	Total		**158.9**

Figure 13: Carbon in all pools, with combined long-term averages.



Permanence and modelling periods

One hundred years has been identified as the *modelling period* for determining the long-term carbon stocks for plantation forestry projects, as this would normally ensure there are multiple rotations reflected in the simulation, and will adequately account for harvest events. Under the draft Plantation Forestry Determination modelling should be based on a plantation management plan for the project which sets out the events that will occur – such as thinning and harvesting.

The ERF requires that sequestration projects are subject to a *permanence period* which is either 100 years, or 25 years with a 20% abatement discount.

The permanence period begins at the date of project declaration[36]. The ERF draft Plantation Forestry Determination requires that once established, the proponent is obligated to maintain the land as a plantation for the duration of the project's permanence period. That is, "where the plantation is harvested through clearfelling, the plantation must be re-established", and regardless of whether project permanence is for 25 years or 100 year the modelling must take place over 100 years.

The 20% abatement discount applied to a 25-year project permanence period was a policy decision that was introduced to encourage participation in the scheme, while at the same time account for the likelihood that not all projects that opt for a 25-year permanence period will retain forest cover for the full 100 years of the modelling period. Whether this approach is appropriate in relation to crediting the C in HWPs, and whether there are alternative approaches that may be more appropriate when considering HWPs and a 25-year permanence obligation period should be considered.

The most logical approach would be to only credit the C in HWPs arising from rotations that are planted during the 25-year permanence obligation period, and to credit this fully rather than applying a 20% discount. However, this would require that a different level of discount be applied to the components of carbon storage in trees and debris (20% discount) versus HWPs (0% discount). This would introduce additional complexity, and would require changes to relevant legislation. **Error! Reference source not found.** provides a comparison of crediting of carbon in HWPs under three scenarios: 100-year permanence; 25-year permanence with 20% discount; and, 25-year permanence with 0% discount but only considering HWP from the first rotation. The data suggest that applying a 20% discount to the estimate of carbon in HWPs over the entire modelling period gives a result that is midway between the value for 100-year permanence obligation and if we only consider HWPs from the first rotation. The simple approach of applying the 20% discount on HWPs seems to be a reasonable compromise outcome, given that a percentage of projects with a 25-year permanence obligation period will replant after harvest and maintain forest cover well beyond the obligation period.

Table 12: Application of 20% discount to crediting of carbon in HWPs. Option 1 and Option 2 refer to the consideration of average or total carbon in landfill, as presented in Table 11.

	100-year permanence			**25-year permanence with 20% crediting discount**			**25-year permanence with HWPs only from first rotation**		
	Pool	**Method**	**Value**	**Pool**	**Method**	**Value**	**Pool**	**Method**	**Value**
OPTION 1	In service	ave 3 rotations	13.8	In service	ave 3 rotations	11.0	In service	ave 1 rotation	8.2
	Landfill	ave 3 rotations	7.1	Landfill	ave 3 rotations	5.7	Landfill	ave 1 rotation	5.4
	Total		**20.9**	**Total**		**16.7**	**Total**		**13.6**
OPTION 2	In service	ave 3 rotations	13.8	In service	ave 3 rotations	11.0	In service	ave 1 rotation	8.2
	Landfill	total 3 rotations	22.9	Landfill	total 3 rotations	18.3	Landfill	total 1 rotation	13.2
	Total		**36.7**	**Total**		**29.3**	**Total**		**21.4**

36 Refer Section 87 of the CFI Act.

Other Method Issues

Crediting

While sequestration projects have a crediting period of 25 years, emissions reduction projects only have a crediting period of seven years. Landfill project methods are generally considered to be emissions reduction activities. However, it can be argued, if a decomposition rate of zero applies, that carbon in HWPs in landfill represents sequestration rather than an avoided emission.

Careful consideration of an appropriate crediting period for HWPs in landfill is required.

Certainty over the destination of HWPs in service

The analysis undertaken above makes an assumption about the destination of wood after its service life; 80% is assumed to end up in landfill (based on current and historical disposal rates). However, there are a number of alternative destinations for this wood.

For example, wood or paper may be recycled, in which case it remains in service, or diverted from landfill for treatment into an alternative end use (an ERF method for alternative waste treatment is discussed below). Wood may be burnt for energy (potentially displacing fossil fuels/electricity) or converted to biochar. Each of these has GHG abatement implications, relative to the abatement benefits of long-term storage in landfill.

Although wood disposal levels in landfill sites has remained stable, it is reasonable to expect that volumes of HWPs entering landfill will gradually decrease over time, as alternative markets for the wood waste are developed. However, there are physical limitations associated with the use of certain types of HWP which can make up a significant proportion of the wood waste stream. For example, preservative-treated wood is typically disposed of in special contained areas in landfills and cannot be recycled or burnt. Thus, it is reasonable to assume that there will be a need for disposal of at least a fraction of HWPs in landfills well into the future.

Further modelling could be undertaken to consider a progressive reduction in the percentages of HWPs in service that ends up in landfill, for example, by 80% at Harvest 1, 50% at Harvest 2 and 25% at Harvest 3. However, taking such an approach would need to be justified through appropriate evidence.

Double counting HWP in landfill

There may be some perception that there is a risk of double counting of C in landfill arising from projects based on ERF methods that capture emissions from, or divert and treat waste from landfill.

The *Carbon Credits (Carbon Farming Initiative) Methodology (Landfill Gas) Determination 2015* (Landfill Gas Method) applies to the abatement of emissions through the installation of new landfill gas collection. The determination requires the use of one of the approaches in the *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (NGER (Measurement) Determination) to model the landfill gas that is generated in the landfill. The NGER (Measurement) Determination includes calculation of the percent of 'paper and card board' and 'wood and wood waste', based on the tonnage of each waste mix type received at the landfill. Default waste stream percentage for waste mix types (refer Table 13) and the degradable organic carbon values are provided.

The Carbon Credits (Carbon Farming Initiative—Alternative Waste Treatment) Methodology Determination 2015 (Waste Treatment Method) avoids emissions by diverting waste from landfill to alternative waste treatment (AWT) facilities. AWT describes a range of activities that process mixed solid waste that would have gone to landfill, into products (such as compost, fuel or biogas) and increase recovery of resources including plastics, glass and metals. AWT projects avoid the emissions that would have occurred if the waste had been sent to landfill.

Table 13: default waste stream percentages

Waste mix type	**Paper and cardboard**	**Wood and wood Waste**
Municipal solid waste class I (%)	13	1
Municipal solid waste class II (%)	15	1.2
Commercial and industrial waste default (%)	15.5	12.5
Construction and demolition waste default (%)	3	6

Under this method eligible waste includes mixed solid waste which is commercial and industrial waste, construction and demolition waste or municipal solid waste but does not include some specific waste types such as recyclable paper and paperboard and green waste or wood waste that is separated at the point of generation. These are excluded because these would generally be disposed of in ways other than landfill. Otherwise the definitions of waste that are applied are those within the NGER (Measurement) Determination. Assumed avoided emissions from the decomposition of HWPs in landfill can be credited under a project that diverts these products from landfill. That is, where HWPs are physically separated from general landfill and converted into, for example compost or fuel. Abatement is calculated by comparing the methane assumed to be produced in the baseline against methane produced after the introduction of the AWT (taking into account emissions associated with the AWT). The method applies the emissions factors as set out in the NGER (Measurement) Determination.

If NGER (Measurement) Determination factors are altered such that decomposition of HWPs in landfill is effectively zero, C in HWPs *in situ* in landfill will be permanently stored and there would be no contribution to the generation of methane or to avoided emissions that can be credited to landfill projects. This may require some revision to existing methods. However as the plantation methodology will not generate significant C in HWPs in landfill for another few decades there is plenty of time to address this.

<u>Who is the project proponent?</u>

With respect to crediting it is not readily apparent to whom credits should be allocated.

One option is to credit the location at which the C abatement is produced:

- The grower could be credited for the sequestration in the tree crop
- The processors could be credited for the C that enter the HWP pools
- The landfill operator could be credited for the long-term storage in landfill.

However, this would require three separate methods and exposes grey areas – such as where to account for emission in harvesting (grower or processors), emissions during transport (grower, processor or manufacturer), and the differing timing of the benefit associated with each of the stages.

If the landfill owner owns the credits this would present challenges with respect to tracking the origin of the credits to an ERF eligible forest. It might also provide perverse incentives with respect to landfilling.

Other approaches could see projects with multiple proponents (grower + sawmiller) or a single proponent, such as the grower, with the market dictating how the extra revenue is then shared downstream. However, it seems unlikely that industry will negotiate its royalty/payment system on the basis of ERF plantations that will not yield their timber for another 33 years.

Appendix 2: Residues Method

Key Issues in Method Development

<u>Determining the volume of residues</u>

An ERF method for biomass from harvesting residues would require that a clear definition of residues is provided. At the basic level *harvesting residue* is the proportion of the harvested tree that remains in the forest after harvesting is completed and products have been removed. However, the biomass that is considered to be residual will vary depending on the forest type, market of the day and the region of application.

For example

- Ximenes *et al.* (2015) include the 'crown', 'bark', 'stump' and 'other' components in their study on carbon stocks and flows in native forests and harvested wood products in South-east Australia, where the 'other' category includes non- commercial species, dead and small trees as well as parts of the stem that had no commercial value due to damage during felling, decay or a reflection of the current market for that region.
- In their analysis of residues for Tasmanian forests URS (2015) refer to residues as the material generated through the harvesting and processing of forests. This includes harvested wood not taken for sawlog, veneer or peeler billets, including pulp logs, crown, roots and offcuts from harvested logs and thinnings.

Differing perceptions may affect what constitutes residual biomass. In native forests, for example pulpwood has historically been regarded as a residual by-product from the harvesting of sawlogs. If a market exists for pulplogs they will be extracted from the forest, if not they will remain on site. In short rotation hardwood plantations, the harvesting of trees for pulp production may be the primary management intent, and in the case of long-rotation hardwood plantations, they are an essential intermediate economic product produced through thinning. Some products, such as firewood which are a residue of timber harvesting, may be collected for domestic and commercial use; forests are generally not harvested specifically for firewood.

Furthermore, a proportion of the biomass from harvested trees may be retained for silvicultural, ecological or nutritional purposes, as determined by best practice (e.g. to facilitate stand regeneration or for site nutrition) or prescribed in regulations. While non-commercial, the value of the residues is in the contribution to site productivity or environmental factors.

The definition of harvest residues for the purpose of an ERF method therefore needs to be broad enough to allow for project specific definitions based on the business-as-usual scenario (the baseline). Similarly, where there is a regulatory requirement or management prescription that requires the retention of biomass for ecological or silvicultural purposes this should be taken into account.

A definition of 'harvesting residues' was proposed as 'that proportion of the tree biomass that, under the baseline scenario, does not constitute a merchantable product or which are not required to be retained on site for ecological or silvicultural purposes as set out in regulations or industry specific codes of practice or according to forest management plans for the project area'.

The production of residues

The production of residues during harvesting will vary on the basis of a number of factors including the type and condition of the forest, the species being harvested, harvesting practices, products and markets.

For native forests, the amount of above ground biomass (AGB) that is typically harvested for processing into wood products varies between 45% and 80% (Ximenes *et al.* 2015); this means that between 20% and 55% remains on site as residues. Trees are typically debarked in the forest and bark may constitute a significant proportion of residual biomass (Ximenes *et al.* 2015). Preliminary results of recent studies on the North coast of NSW have found that the amount of potentially extractable residues currently left on site range from approximately 60-140 tonnes of biomass per hectare.

For softwood (*Pinus radiata*) plantations trees may be cut-to- length (CTL) or removed to the roadside as whole trees (WT). The practice employed can significantly affect the volume of residues that remain on site. In the Tumut region of NSW Ximenes *et al.* (2008) estimated that 65% of AGB was recovered as commercial logs, resulting in residues of 35%. However, subsequent research (Ximenes *et al.* 2012a) for plantation radiata pine in the Bathurst/Oberon regions of NSW indicated that residual biomass may account for only between 13 – 25%. Trials have shown that the final harvest of pine plantations, done by harvester and forwarder CTL harvesting systems, have a significant level of postharvest residues with estimates of 9% (Turner 2011) and 20% (Ximenes and Gardner 2006) of the total AGB (in Ghaffariyan et al. 2015). The number of thinning treatments applied in a rotation also significantly affect the volume of residual biomass at clearfall (Ximenes *et al.* 2012a), but these events also produce residues that may be utilised for new products.

For hardwood plantations, there is limited information available on residues, because the majority of the plantations are short rotation for pulp wood, and few long rotation plantations have been researched at harvesting. Studies include those by Mathers et al. (2003- E. *globulus* Western Australia), O'Connell at al. (2004 - E. *globulus*, Western Australia), Ghaffariyan et al. (2013 E. *globulus*, Western Australia) and Mendham et al. (2014 - E. *globulus*, Western Australia) and the results vary by site.

Some regional estimates of biomass volumes have been made for Victoria (URS 2010, Regional Development Victoria 2012) and Tasmania (URS 2015, Rothe 2013).[37]

It was therefore recommended that requirements for a forest management plan for the BAU and the project scenarios be included. The plan should describe the forest type, harvesting regime, silvicultural treatments, predicted products and volumes including domestic fire wood, post-harvest treatment of residues and planned post-harvest burning. Under the baseline scenario thresholds for residue volumes could be established on the basis of default factors determined by a defined set of characteristics: forests type, species silviculture and products with the baseline reference period. Under the project scenario the volume of residues removed could be measured based on actual volumes extracted and sold or estimated using biomass conversion and expansion factors based on merchantable volumes sold.

<u>Estimating emissions from the in-situ treatment of residues</u>

This method could include the avoidance of greenhouse gas emissions from the *in-situ* treatment of residues because, under the project scenario, those residues are removed from site and used for a new product.

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[37] http://biomassproducer.com.au/markets/biomass-availability/#.V8kL-zVgiT8

Ximenes *et al.* (2012a) examined the Greenhouse gas (GHG) emissions generated by managing residues from the harvest of *Pinus radiata* plantations in NSW. Greenhouse gas emissions (tonnes/ha) for residue management were compared under three different scenarios:

1. Retaining all residues on site, no burning;
2. Large size residues in windrow, which consisted of retaining small branches less than 80 mm in diameter on site and placing log waste and branches larger than 80 mm in diameter into windrows for burning on site;
3. Large size residues extracted, which consisted of retaining small branches less than 80 mm in diameter on site and removing log waste and branches greater than 80 mm off site.

Scenario 1 (residues retained on site) lead to the highest greenhouse emissions, as residues were all assumed to decay over a relatively short period of time, and all the carbon was assumed to be emitted back into the atmosphere.

Under Scenario 2 the burning of residues lead to lower GHG emissions than leaving residues to decay on site (Scenario. 1), because only a proportion of the biomass was assumed to combust and emit carbon as a result of the controlled conditions of the burn.

In Scenario 3 in addition to GHG emissions due to decay of the proportion of the biomass left on site, GHG emissions due to transport of the biomass to road side and chipping were included in the estimates.

The extraction of a proportion of the biomass for bioenergy generation resulted in GHG emission reductions ranging from 11% to 19% compared to Scenario 2 and 31% to 53% compared to Scenario 1.

A number of other studies have attempted to estimate the greenhouse gas impacts associated with timber harvesting in native forests (e.g. Ximenes et al. 2015 in NSW and Victoria), Moroni and Lewis 2015 in Tasmania, Keith et al. 2014 in Victoria, Ximenes et al. 2012b in NSW, Norris et al. 2010 in Victoria); each applies assumptions to explore scenarios that alter the production and destination of biomass from forests. These studies are mainly focussed on carbon stocks in above ground biomass and the consequences of changes in the end use of biomass harvested with an emphasis on ‘harvesting’ versus conservation options for future management.

Notwithstanding the broader policy debates that these studies seek to inform and the useful contextual information they provide, few focus on the *in situ* emissions from the treatment or removal of harvesting residues.

Ximenes *et al* 2012b note that “the rate and extent of decay of the harvest slash will vary according to the type of residue, species, climate, soil conditions and fungal or termite activity”. They assume the forest harvest residues (above-ground and roots) will decay uniformly over a period of 20 years regardless of harvest slash type, in accordance with the IPCC’s default decomposition factor[38]. With respect to fire they acknowledge that “there is limited information available to allow accurate estimates of the effect of wildfires and prescribed burning on biomass loss and GHG emissions for Australian native hardwood forests and as a consequence they use the fuel load, burning efficiency and emission factors recommended in

[38] Intergovernmental Panel on Climate Change (IPCC). Chapter 3, Section3.2 Forest Land. In Good Practice Guidance for LULUCF; Nabuurs, G., Ravindranath, N.H., Paustian, K., Freibauer, A., Hohenstein, W., Makundi, W., Eds.; IPCC National Greenhouse Gas Inventories Programme: Hayama, Japan, 2003. Available online: http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/ gpglulucf_files/Chp3/Chp3_2_Forest_Land.pdf (accessed on 23 March 2012).

the National Inventory Report to determine the GHG emissions from the options they analyse, but do not include GHG emissions due to wildfire and prescribed burning (non-CO_2) in the calculations of GHG balance presented in their paper.

May et al (2012b), in their study on forest carbon in Tasmania, found that a large proportion of emissions were associated with non-greenhouse gas emission from burning of harvest slash – around 50 kg/m^3 for native hardwood.

Norris et al. (2010), noted that, for forests in Victoria, wildfire results in significant reductions in carbon stocks but that decomposition contributed to emissions to a greater extent than wildfire over the period that they modelled using FullCAM.[39] They also found that emissions associated with harvesting were greater than those associated with wildfire, due largely to emissions from harvesting and prescribed burns, the emissions from the latter estimated at 18t C/ha.

In order to ensure conservativeness within the proposed method emissions avoided from fire as a result of a decrease in situ biomass after the removal of harvesting residues were excluded.

Removal and retention of residues for ecological and silvicultural purposes

The retention of some residues from forest harvesting is viewed as necessary for environmental and site productivity purposes including for wildlife habitat, nutrient cycling, soil structure, water quality, carbon storage, as an important structural component of many forest ecosystems and ecosystem functioning, fire management and regeneration (See Riffell et al. 2011; Jones et al. 2011; Ranatunga *et al*. 2008). In native forests, the role of harvesting debris in environmental factors is of particular concern to some (Grove and Meggs 2003; Woldendorp et al. 2002). At a landscape level, however, the very small area of forest that is harvested annually, coupled with the environmental protection measures that are applied in association with harvesting practices that result in the retention of biomass components with high nutrient content (such as bark and leaves) and biodiversity value (hollow development potential) means that these concerns are largely unfounded. For plantations, the impacts of residues and their removal on future plantation productivity has been a key research focus (Battaglia et al. 2015; Mendham et al., 2014; Jones et al. 2011; Guo et al. 2006 and others) and plantation managers already employ practices intended to maintain site productivity and reduce dependencies on costly additives such as fertilizer (O'Hara *pers. comm*).

High volumes of harvesting residues may have perceived negative impacts including fire risk and increased costs associated with site preparation and increased inputs such as fertilizer may be required, particularly for plantations. However, residues may also be used as an operational tool in the amelioration of site impacts such as reducing soil erosion from constructed tracks (DPI 2005).

Globally there has been some research into the impacts of residue removal on future site productivity, growth and yield in plantations; however, this has been geographically dispersed and applied to a wide range of forest types, species and harvesting regimes, limiting the opportunity for the development of specific recommendations. Findings suggest that while residue removal may impact future site productivity, this is likely to be more significant at sites of inherently lower quality (Mendham et al. 2014), Ghaffariyan and Apolit (2015), drawing on the research of others, summarise general recommendations for radiata pine plantations including retention of residues on sites of low quality. Residues from softwood plantations (and maybe across the board) would typically not include fine woody debris and needles/leaves,

[39] Assumed to be 100 years

which would be retained for nutrient management purposes (O’Hara *pers. comm.*, Sessions, 2012 in Ghaffariyan and Apolit (2015).

Only general recommendations have also been made for residue retention in native forests, such as retention of CWD at ‘natural’ or pre-harvest levels (Riffell et al. 2011).

A comprehensive review of relevant research findings is required to determine acceptable minimum retained-residue levels for the range of site conditions experienced across Australia’s diverse plantation and forest estates. Research conducted in NSW addressed this issue for a range of forest types in the North Coast (Ximenes et al 2016).

The retention or removal of residues is most appropriately determined on the basis of the type of forest and the specific site conditions. Project proponents should specify and apply relevant best practice residue retention and management strategies in a forest/plantation management plan. Where fertilizers are used to offsets nutrient loss associated with residue removal, associated emissions should be accounted for in net abatement calculations.

<u>Product substitution emissions and benefits</u>

Wood products manufactured from harvesting residues may be used as substitutes for other materials. For example, substituting engineered wood for cast-in-place reinforced concrete; For engineered wood products replacing cement results in on average a GHG reduction of 2.1 tonnes of C.

Accounting for substitution effects of products will require that project proponents know the use for the residues and can account for the emissions along the production chain. The abatement gained through substitution must be net of any emissions associated with production. There are numerous potential end uses and the displacement factors associated with the use of biomass will vary. For some end uses, default values required to calculate the relevant substitution impact may be drawn from those applied in Australia’s National Accounts. For others, more detail accounting will be necessary and default values developed.

Risk of double counting

Renewable Energy Target

ERF methods must address the risk of the double counting of abatement. For the proposed harvesting residues method, the risk of double counting is considered low; the exclusion of the use of residues for bioenergy? would prevent double counting with the RET and other ERF methods.

Industrial Methods

The ERF industrial methods can be applied to reduce emissions associated with energy and fuel use in industrial activities. This could include the forest products industry both directly in processing (as a proponent to the methods) or as a supplier of forest biomass residues and wood production waste as feedstock in renewable energy generation or fuel production. Forest owners/managers could indirectly benefit from markets for their residues. There are five relevant methods:

- *The Carbon Credits (Carbon Farming Initiative) Methodology (Facilities) Determination 2015 (“Facilities Method”)*
- *Carbon Credits (Carbon Farming Initiative – Industrial Electricity and Fuel Efficiency) Methodology Determination 2015 (“IEFE Method”)*

- *Carbon Credits (Carbon Farming Initiative – Commercial Buildings) Methodology Determination 2015 ("Commercial Buildings Method")*
- *The Carbon Credits (Carbon Farming Initiative - Aviation) Methodology Determination 2015 ("Aviation Method")*
- *The Carbon Credits (Carbon Farming* Initiative – Land and Sea Transport) Methodology Determination 2015 ("Transport Method")

ERF methods seek to create abatement that aligns with national inventory reporting and the respective international reporting rules[40]. Currently, carbon dioxide emissions from any wood harvested for energy purposes is treated as being immediately emitted into the atmosphere. As the burning of wood residues emits the carbon, or 'instantaneously oxidises' it, this is not treated as creating an additional emission reduction when compared to leaving it on site to decay/burn. Only the displacement of non-renewable energy from biomass/biofuel energy production may be treated as carbon positive – and this concept is already embedded in some of the existing methods.

Facilities Method

The Facilities[41] method aims to encourage emissions reductions through a range of measures and is not prescriptive about what these are or how they are undertaken. It applies to existing facilities that report under the National Greenhouse and Energy Reporting (NGER) Scheme. It excludes aggregated facilities and does not apply to new (greenfield) facilities.

The method enables participants to undertake a broad range of activities to reduce the emissions intensity of the facility. This provides flexibility for participants to determine the activities that are most appropriate for their facility. For example, activities could include replacing or modifying boilers, improving control systems and processes, upgrading turbines, reducing industrial process emissions, or installing low emissions-intensity electricity generation equipment. It does not apply to transport.

All greenhouse gases included in NGER data are covered by the method.

It allows for the use of renewable energy sources, defined under the *Renewable Energy (Electricity) Act 2000* as wood waste from sawmills and harvesting residue (plantations and high-value native forest).

Biomass used to produce energy at a facility to which a Facilities project relates, or biomass used to generate off-grid electricity, or heating or cooling imported by a facility to which a facilities project relates, must be an eligible renewable energy source. An offsets report must include a declaration that the biomass used during the reporting period is an eligible renewable energy source.

There is currently[42] one project registered under the Facilities method, registered by Carter Holt Harvey Pinepanels Pty Limited. This project reduces emissions by changing the energy

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[40] From the annex to decision 2/CMP.7: "Land use, land-use change and forestry", which provides rules for accounting of LULUCF activities under the Kyoto Protocol in the second commitment period: *32. Where carbon dioxide emissions from harvested wood products in solid waste disposal sites are separately accounted for, this shall be on the basis of instantaneous oxidation. Carbon dioxide emissions from wood harvested for energy purposes shall be accounted for on the basis of instantaneous oxidation.*

[41] *The Carbon Credits (Carbon Farming Initiative) Methodology (Facilities) Determination 2015*

[42] Based on the CER register of offsets projects downloaded on 11/01/2017

sources or mix of energy sources used by existing energy consuming equipment. The project was registered in November 2016 and has not yet generated any ACCUs.

Industrial Electricity and Fuel Efficiency (IEFE) Method

The IEFE method[43] is applicable to all sites with existing (usually large-scale) energy intensive equipment.

Projects may involve a broad range of activities that reduce direct fuel combustion emissions and emissions from electricity use. These may include replacement or modification of boilers or heating, ventilation and air-conditioning systems, improving control systems and processes, waste heat capture and re-use, improving the efficiency of crushing or grinding equipment on mining sites, replacing low efficiency motors, fans and pumps with high efficiency versions, installing variable speed drives, improving compressed air processes, and fuel switching. It does not apply to transport.

The method excludes activities relating to equipment that generates electricity at a location if, at the time an application is made for project declaration (S 22 of the Act):

i. in total all the generating equipment at the location has a stated capacity of 30 megawatts[44] or more according to the manufacturers' nameplates;

Green-fields projects that install new energy-consuming equipment 'from scratch' are ineligible, unless they are replacing existing equipment or offsetting grid-supplied electricity use by existing equipment. This is because existing equipment is needed to calculate a baseline emissions model.

Emissions from electricity and fuel combustion are covered under the method.

The method allows for renewable energy sources as defined under the *Renewable Energy (Electricity) Act 2000* and a declaration that the biomass will comply with the definition of eligible renewable energy source is required.

Under the method eligible renewable electricity means renewable electricity generated from equipment installed as part of the project; but does not include renewable energy generated by equipment that under the legislative rules (if any) made for subparagraph 27(4A)(c)(ii) of the Act, must not be included in an eligible offsets project (i.e. excluded due to the government program requirement).

There are currently 34 projects registered under the IEFE method. Several involve switching fuel sources or introducing new, more energy efficient technology, although it is not possible to identify specific cases in which forest-based biomass is used. While 7 IEFE projects have ERF contracts none of the 34 registered projects have generated any ACCUs.

Commercial Buildings Method

The Commercial buildings method[45] covers projects that improve the energy efficiency of existing commercial buildings, which would reduce emissions associated with fuel combustion and electricity consumption at buildings. Activities could include modifying, removing or replacing energy-consuming equipment in the building, changing energy use within the

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[43] *Carbon Credits (Carbon Farming Initiative – Industrial Electricity and Fuel Efficiency) Methodology Determination 2015 ("IEFE Method")*

[44] As an example, the AGL Loy Yang comprises a 2,210 megawatt Loy Yang A power station.

[45] *Carbon Credits (Carbon Farming Initiative – Commercial Buildings) Methodology Determination 2015 ("Commercial Buildings Method")*

building or changing the components or shell of the building to influence energy consumption. It does not apply to new buildings.

Emissions from electricity and fuel combustion are covered under the method.

The method makes use of the National Australian Built Environment Rating System (NABERS) energy ratings and tools for commercial buildings to quantify emissions reductions and energy savings from energy efficiency activities undertaken as part of an ERF commercial buildings project. NABERS rates the energy performance of four types of commercial buildings – office buildings, shopping centres, data centres and business hotels. The Determination calculates emissions reductions associated with upgrades to office buildings, shopping centres and business hotels, but not data centres.

The method applies only to existing commercial buildings that have, or are eligible to have, NABERS energy ratings. It does not specify the particular activities that must be undertaken, but requires that the activities fall under the following broad categories:

- modifying, installing, removing or replacing:
  - energy-consuming equipment;
  - equipment that generates electricity for consumption at the building;
  - a building component or other equipment;
- changing how energy-consuming equipment is controlled or operated;
- changing the energy sources used by energy-consuming equipment; and
- promoting behaviours by occupants of the building that reduce energy consumption by energy-consuming equipment at the building.

Renewable electricity generated and consumed onsite refers to electricity that is:

- generated from renewable sources at the building in the measurement period;
- consumed by energy-consuming equipment at the building;
- generated by equipment that was installed at the building after the beginning of the NABERS rating period for the previous NABERS energy rating;
- generated by equipment that could not be included in an eligible offsets project under the legislative rules (if any) relating to the government programme requirement in section 27(4A)(c)(ii) of the Act; and
- not taken into account in the total amount of electricity consumption recorded in the NABERS energy rating report.

There are currently 4 projects registered in the commercial buildings method. All four are undertaking activities the replace or upgrade energy consuming equipment. None have generated ACCUs or entered into ERF contracts.

Aviation Method

The Aviation method[46] provides for crediting emissions reductions achieved through a reduction in the emissions intensity of air transport (i.e. emissions per unit of transportation service). The method supports a broad range of activities to reduce emissions intensity within the aviation sector, including modifying existing planes, changing energy sources or the mix of energy sources, and changing operational practices.

The method covers emissions from electricity and fuel combustion.

For the purpose of the method, eligible renewable electricity means renewable electricity generated from equipment installed as part of the project; but does not include renewable energy generated by equipment that under the legislative rules (if any) made for subparagraph 27(4A)(c)(ii) of the Act, must not be included in an eligible offsets project (i.e. the government program requirement).

The method makes no reference to renewable energy sources as defined under the *Renewable Energy (Electricity) Act 2000.*

There is one registered project under the aviation method which involves changing energy sources for aircraft. It has not generated any ACCUs and does not have an ERF contract.

Land and Sea Transport Method

The Transport[47] method provides for crediting emissions reductions achieved through a reduction in the emissions intensity of transportation (i.e. emissions per unit of transportation service). It supports a broad range of activities to reduce emissions intensity within the land and sea transport sectors, including replacing existing vehicles, modifying existing vehicles, changing energy sources (fuels and electricity)) or mix of energy sources, and changing operational practices.

The method applies to domestic activities only, that is, does not include activities undertaken outside Australia, or from transport activities that use fuel that is not taxable fuel. Taxable fuel excludes fuel used for international voyages as emissions from this fuel are not captured in Australia's National Greenhouse Gas Inventory.

The method covers emissions from electricity and fuel combustion.

For the purpose of the method eligible renewable electricity means renewable electricity generated from equipment installed as part of the project; but does not include renewable energy generated by equipment that under the legislative rules (if any) made for subparagraph 27(4A)(c)(ii) of the Act, must not be included in an eligible offsets project (i.e., the government program requirement).

The method makes no reference to renewable energy sources as defined under the *Renewable Energy (Electricity) Act 2000.*

There are 7 projects registered under the transport method; several involved changing energy sources. Three projects have contracts under the ERF, but none have generated credits.

<u>Opportunities under Industrial methods</u>

All of the industrial methods mentioned allow for the use of renewable energy.

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[46] *The Carbon Credits (Carbon Farming Initiative - Aviation) Methodology Determination 2015 ("Aviation Method")*

[47] *The Carbon Credits (Carbon Farming Initiative – Land and Sea Transport) Methodology Determination 2015 ("Transport Method")*

For the forest industry (processing, facilities and transport) there is an opportunity to participate by registering a project under the ERF industrial methods and reduce emissions from energy use in processing activities through the use of waste of biomass. For some sawmills there is an opportunity in reducing processing waste - either directly in their own facility or indirectly through sale as feedstock to others. For forest managers the opportunity is in creating a market for their residues.

At present the industrial methods are applicable only to existing facilities or services in which equipment of fuel is replaced or upgraded. They do not apply to new greenfield facilities. As a result, activities with the greatest potential to generate large-scale abatement such as through the installation of electricity-generating biomass power stations to replace coal are excluded. New bioenergy facilities offer the potential for considerable emissions abatement and other economic benefits, including increasing Australia's energy security and reducing greenhouse gas emissions. Bioenergy currently accounts for nearly 1% of Australia's electricity production, and 7% of renewable electricity production. Biofuels account for approximately 1-3% of Australia's fuel consumption.[48]

While there are several policy mechanisms that allow the use of plantation residues for the generation of renewable energy, at present these are unlikely to result in significant uptake. Under the ERF there are opportunities to broaden the scope of activities in a way that would both provide a use for plantation residues, thus enhancing take-up of the ERF Plantation Forestry Method and increase through abatement through emissions avoidance in industrial activities.

Currently greenfield activities are excluded on the basis that project emissions must be compared to a baseline in order to calculate abatement; completely new projects do not directly provide for this opportunity. However, the abatement from projects that replace entire facilities – for example biomass replacing coal for energy production, could be calculated if these are undertaken by an existing power producing entity or if it can be demonstrated that they would be displacing the use of fossil fuels.

Some (larger scale) activities relating to equipment that generates electricity are also excluded.

Revisions of these exclusions to allow for activities that generate electricity greater than the current restriction of 30 megawatts could increase demand for biomass feed stock from plantation forests, including project registered under the ERF Plantation Forest Method; a double win for abatement.

Residues from harvesting

In the Plantation Forestry method, the debris pool is included in the greenhouse gas abatement boundary and must be accounted for. It is determined through the process of allocating the types of forest products and the proportions going to end uses. Harvesting residues from some ERF plantations can be used as feedstock for the generation of renewable energy under the Renewable Energy Act or by industrial projects applying one of five ERF methods (as described further in Section **Error! Reference source not found.**).

The plantation method also includes abatement through carbon stored in HWPs in service. The proposed harvesting residues method may interact with the Plantation Forestry method through the use of biomass from thinnings and through the processing of harvesting residues into HWPs. However, there is little risk of double counting between the Plantation Forestry method and the proposed residues method because the removal of biomass under the proposed residues

[48] https://arena.gov.au/about/what-is-renewable-energy/bioenergy/

method would have to demonstrated additionality against a baseline scenario. If the use of residues is already included within a Plantation Forestry project, then it would not be eligible under the proposed residues method. If an ERF Plantation Forestry project does not include residues, then the proposed residues method will be additional.

ERF methods are designed to create abatement that aligns with national inventory reporting and the respective international reporting rules[49]. Carbon dioxide emissions from any wood harvested for energy purposes is treated as being immediately emitted into the atmosphere. Only the displacement of non-renewable energy from biomass/biofuel energy production may be treated as carbon positive, and this displacement is credible – credited? with RECs under the RET or under other existing ERF methods.

The *Renewable Energy Act* (2000) and Regulations (2001) specify which energy sources are eligible renewable sources (as set out in Division 2.2).

Energy crops including biomass from a plantation where all of the following apply:

- it must be a product of a harvesting operation (including thinnings and coppicing) approved under relevant Commonwealth, State or Territory planning and approval processes;
- it must be biomass from a plantation that is managed in accordance with:
  - a code of practice approved for a State under regulation 4B of the Export Control (Unprocessed Wood) Regulations; or
  - if a code of practice has not been approved for a State as required under subparagraph (i), Australian Standard AS 4708—2007—The Australian Forestry Standard;
- it must be taken from land that was not cleared of native vegetation after 31 December 1989 to establish the plantation.

This pre-1990 threshold was applied for consistency with Australia's international obligations under the Kyoto Protocol for reforestation and afforestation which limited the establishment of new forests by direct human action on land not forested as at 1 January 1990.

These requirements mean that not all plantation projects eligible under the ERF could supply residues for bioenergy generation. Only plantations established on land that was cleared prior to December 1989 are eligible to provide residues to these industrial projects.

Since Australia opted to account for forest management under the second commitment period to the Kyoto Protocol, ERF methods have instead applied a year-based threshold and the CFI regulations which stipulate that the establishment of vegetation, including plantations, on land that has been subject to clearing of a native forest within 7 years of the lodgement of an application for the project to be declared an eligible offsets project is ineligible.

Revising the REA rules to bring it in line with the CFI regulation would enable broader participation in renewable energy activities, both under the RET and ERF industrial methods.

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[49] From the annex to decision 2/CMP.7: "Land use, land-use change and forestry", which provides rules for accounting of LULUCF activities under the Kyoto Protocol in the second commitment period: *32. Where carbon dioxide emissions from harvested wood products in solid waste disposal sites are separately accounted for, this shall be on the basis of instantaneous oxidation. Carbon dioxide emissions from wood harvested for energy purposes shall be accounted for on the basis of instantaneous oxidation.*

Consultation with the Department of Environment and Energy

A draft of this proposed method was provided to the DoEE in September 2016 for comment and a meeting to discuss the proposed method was held in October 2016. Further comments were subsequently received from the Department. Key concerns raised were:

1. An ERF method seeks to create abatement that aligns with national inventory reporting and the respective international reporting rules[50]. Carbon dioxide emissions from any wood harvested for energy purposes is treated as being immediately emitted into the atmosphere. As the burning of wood residues emits the carbon, or 'instantaneously oxidises' it, this is not treated as creating an additional emission reduction when compared to leaving it on site to decay/burn. Only the displacement of non-renewable energy from biomass/biofuel energy production may be treated as carbon positive, and this displacement is credible with RECs under the RET or under other existing ERF methods.
2. Preventing double counting that may arise for non-renewable energy displacement between potential harvest residues projects and the RET or other ERF method could be challenging for auditors/regulators and administratively arduous for proponents.
3. The use of harvest residues for a non-energy purpose where the life would be greater than if left on site may create carbon abatement that could contribute to Australia's targets. However, as uses for harvest residues may change with the new opportunities, mapping/standardising product types and lives could be challenging, as would creating the baselines. Given the wide range of estimates of debris produced per cubic metre of sawlog harvested, standardising the volumes of residues harvested could also be difficult. Alternatively, placing an onus on proponents to themselves provide an auditable chain of evidence of where each product goes would be challenging, and for the Clean Energy Regulator and auditors to administer, and would create some issues with how records are reconciled with modelling.
4. Given that only a limited number of product end uses may create new abatement opportunities, one key question is whether abatement levels may be limited. While the proposal provides substantial information on the availability of harvest residues, a closer examination of the abatement potential of opportunities additional to those already possible under other methods or the RET would help give a better indication of overall abatement potential. The DoEE suggested that it might be worthwhile narrowing the proposal down to options that would create new abatement opportunities credible under international reporting, and examining the abatement potential for these in the first instance.

Response to comments

There was clear concern from the Department about the inclusion of the use of harvesting residues for bioenergy in the proposed method. They cite both the National and international accounting rules and the existence of the RET and other ERF methods as reasons not to include this in the method. The cited UNFCCC decision 2/CMP.7, 32 refers to carbon dioxide

[50] From the annex to decision 2/CMP.7: "Land use, land-use change and forestry", which provides rules for accounting of LULUCF activities under the Kyoto Protocol in the second commitment period: *32. Where carbon dioxide emissions from harvested wood products in solid waste disposal sites are separately accounted for, this shall be on the basis of instantaneous oxidation.* *Carbon dioxide emissions from wood harvested for energy purposes shall be accounted for on the basis of instantaneous oxidation.*

emissions from wood harvested for *energy* purposes, suggesting there would be no in forest abatement from the removal of harvesting restudies for use as energy.

- While the NGGI accounting approach can be changed, this is unlikely to occur where it is significantly inconsistent with international practice. The process of changing the accounting approach requires a 2-stage 'internal' review process (i.e within DoEE) and then submission to the UNFCCC for expert review.
- The other existing measures include emissions avoidance through substitution -the RET focusses on electricity and allows for the use of residues from sustainably managed forests; some ERF methods include electricity and fuel use focussing on reducing emissions through various means that substitute renewable energy or fuel from sources that are also consistent with the RET.
- The concern about double counting indicates that DoEE believes that non-renewable energy displacement through the use of wood biomass may be more appropriately included through the RET.

Response –reference to energy and bioenergy was removed from the proposed method.

The potential volume of residues from harvesting was acknowledged by the Department but there were concerns about the magnitude of the opportunity for abatement from the use of these for other (non-energy) products. The Department proposes that identifying a subset of products and demonstrating the abatement potential of should occur.

Response –In the analysis undertaken for the method the 'non-energy' products identified as having high abatement potential were engineered wood products, composite wood products and biochar.

In reducing the potential scope of the method there was some risk that the volume of abatement would not meet the Government's threshold of "high volume" abatement, in which case it would be unlikely to be prioritised for method development. Furthermore, there are already (growing) markets for engineered wood products and composite wood products, including in medium-rise buildings which may impact considerations of whether such activities would result in additional abatement. The Department will look to the performance of markets that could consume residues to determine whether these may be utilised under business-as-usual. For example, ABARES data for 2015-2016 shows that domestic production of wood -based panels (plywood, particleboard and medium density fibreboard) increased by 7.2 percent to 1.7 million cubic metres. Growth was recorded for all reported panel products in 2015–16, with production of medium density fibreboard up by 9.6 percent, plywood up 7.7 percent and particleboard up 5.8 percent over the year[51]. While this growth is likely to be variable from year to year, the influence of markets on the application/take up of the method will be taken into account.

There was some concern over who the proponent for a project would be and how they could demonstrate the end use in a way that meets the requirements of a method and for auditing purposes. The challenge arises in part because there are two potential sources of abatement and two potential proponents: a) emission avoidance in the forest logically attributed to the forest owner and b) storage in wood products logically attributed to the processor.

[51] ABARES (2017) Australian forest and wood products statistics, September and December quarters 2016, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra, May 2017

- Where the emissions abatement occurs in the forest the logical proponent is the forest owner. The challenge arises when the ownership of the residues transfers to a processor. To claim in-forest abatement the forest owner requires evidence for demonstrating the removal (via sales) of harvesting residues from the forest and processing to a subsequent longer-lived use. While demonstrating sales may be relatively straightforward this also requires the forest owner to track the use of the residues once they have left the forest and into all end products to account for and reduce uncertainty about any abatement reversals (e.g. should the residues be subsequently used for mulch) as well as emissions associated with processing This would be arduous to audit, and this step is therefore likely to be costly to the proponent.
- Where the C in the residues or waste is processed and stored in a longer-lived wood product the processor is the logical proponent. The proponent claims net abatement associated with C storage in the new product. The proponent would need to be able to demonstrate the source of the residues as being additional. An approach similar to that developed for the use of wood waste under the RET could be used[52] to demonstrate the eligibility of residues to assist with record keeping and auditing. Accounting for the in-forest abatement would be possible, given the national inventory accounts for emissions from harvesting slash in native forests and plantations; a similar set of default value could be applied to the volume of biomass removed from site.

Response – The proponent is the wood processor. The wood processor gets the credit for both emissions avoidance and C storage in longer-lived products. The forest owner benefits through the creation of a market for otherwise unsaleable residues and, in some instances, reduce post-harvest operational costs.

Taking into account these comments, a revised proposal has been drafted and is proved below. On the basis of the high-level assessment presented below it is proposed that a Method for the use of residual biomass from legal forest harvesting and waste from wood processing should be placed on the Priority list for method development and a Technical Working Group should be established to further progress method development.

[52] The Clean Energy Regulator has developed a series of assessment sheets to assist electricity generators interpret the wood waste provisions in the Renewable Energy (Electricity) Regulations 2001. These assessment sheets can be used by generators to build and keep appropriate record sets to demonstrate the eligibility of wood waste to the Clean Energy Regulator during the accreditation process and the validation of large-scale generation certificates. http://www.cleanenergyregulator.gov.au/RET/Scheme-participants-and-industry/Power-stations/Large-scale-generation-certificates/Large-scale-generation-certificate-eligibility-formula/Wood-waste-guide-and-assessment-sheets

Appendix 3: Enhanced Native Forest Management Method

Research Activity

A method for preventing a reduction in the carbon carrying capacity of forests due to dieback is based on the premise that dieback affects tree growth, potentially resulting in tree mortality. Declining tree growth reduces the capacity of trees to sequester and store carbon. By preventing dieback, the carbon carrying capacity of forests is not compromised. Where forests are already affected by die back, regeneration may be encouraged through enrichment planting using non-susceptible species or human induced natural regrowth that includes active management of understory competition. These activities increase tree growth and the sequestration and storage of carbon in biomass. A number of causes and effects of dieback were reviewed including:

Table 14: Examples of Decline and degradation

Dieback Type	Agent	Prevention	Treatment	Forest Types	Domain	References
Bell Miner Associated Dieback	Psyllid + Bell Miner	Forest structure management	Forest structure management; Insecticide	Wet/Dry Sclerophyll	East-coast Australia	Wardell-Johnson et al 2006; Stone et al 2008
Pytophthera Dieback	P. cinammomi	Prevention of soil/spore transport	Nil	All Eucalypts	>400mm average annual rainfall	WWF 2004; Davison 2014
Insect dieback (e.g Monaro Dieback)	Gonipterus sp	unknown	Insecticide	E. viminalis	Monaro Plains	Ross and Brack 2015
Prolonged drought/ ground water decline	Extended lack of water	Nil	Application of water	Stringybarks; River Red Gum	Various	Kath et al 2014; Evans, Stone and Barber 2013; Fensham and Fairfax 2007; Rice et. al 2004
Cyclone	Wind	Nil	Nil - salvage logging to promote regen	All	Northern Australia	Metcalfe et al 2008; Murphy et al 2014
Fire Management	Frequency or intensity	Altered fire management	Altered fire management	? All	All	Jones and Davidson 2014; Close et al. 2009; Jurskis 2005a
Mammal induced dieback	Crown destruction by mammals (e.g. Koala, Flying Fox)		relocation of mammal agent	Various	Various	SEQ Catchments 2012; Martin 1985 in Jurskis 2005b

Dieback Type	Agent	Prevention	Treatment	Forest Types	Domain	References
Mangrove Dieback	Insects, disease, Agricultural chemicals; siltation; climate change	Run-off management	Replanting	Mangroves - Avicennia spp	All coastal/estuary	Duke 2003

The case of Bell Miner Associated Dieback

Psyllid-associated crown damage can occur extensively on many eucalypt species. In NSW dieback associated with psyllids and Bell miners (*Manorina melanophrys)* known as Bell miner Associated Dieback or BMAD is now of such concern that is has been listed as a Key Threatening Process and the volume of research into the relationships between the various agents has been significant. While there is an observed coincidence of psyllid-associated crown damage and colonisation of forests by Bell miners not all areas with psyllid-associated crown damage are colonised by Bell miners (Wardell-Johnson et al. 2006) and there are various theories about the interrelationships. Theories suggest:

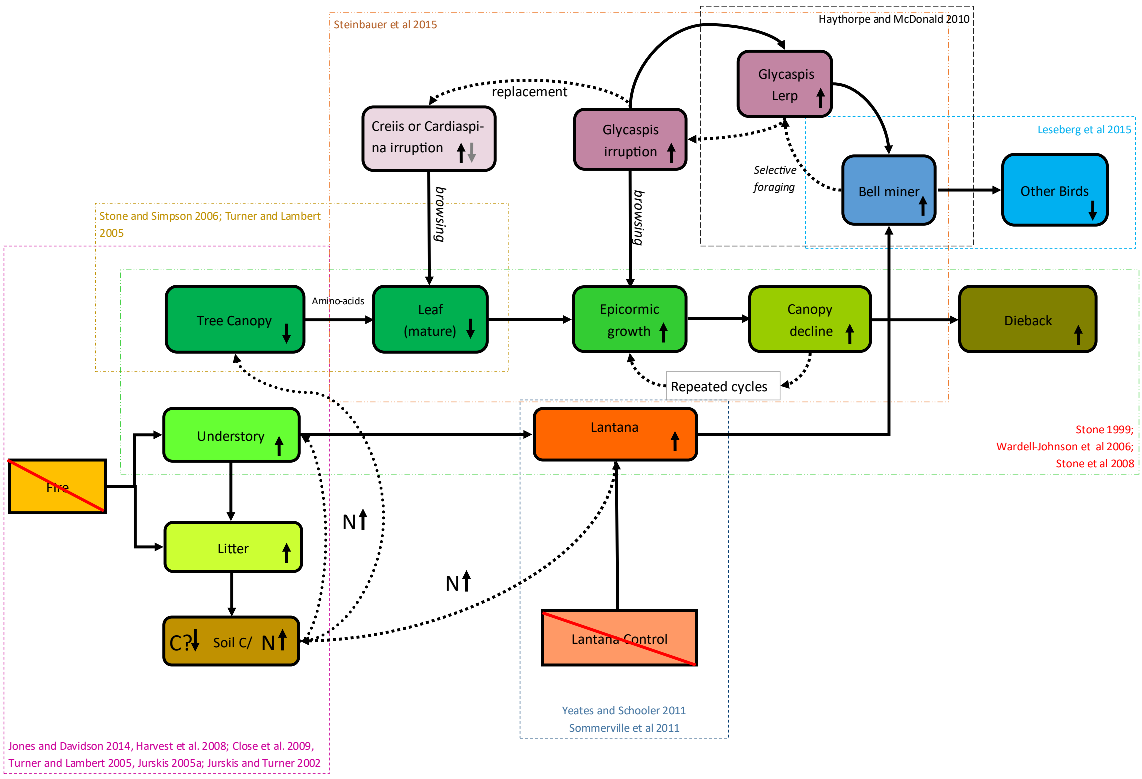
- Changed management practices alter forest structure, floristics and the flow of nutrients. For example, reduced fire frequency increases shrubs; a dense shrubby understorey reduces C/N ratio and nitrification; more free amino acids result from nitrification; and nitrification increase foliage desirability to psyllids (Wardell-Johnson 2005, Jones and Davidson 2014, Close et al. 2009, Turner and Lambert 2005, Jurskis 2005a; Jurskis and Turner 2002);
- Trophic cascades associated with leaf age and nitrogen content, increasing and changing psyllid populations, increases in psyllid parasitoids and culminating in, rather than being initiated by, increased Bell miner populations (Steinbauer et al. 2015).
- Structural or floristic changes due to management activities, such as logging or fire, or environmental stresses may exacerbate natural psyllid populations which result in an increase in Bell miners (Jurskis 2005b); but with lack of field-based or experimental research to resolve links between disturbance, management and Bell miners (Carnegie 2015 unpublished).
- Management practices which create habitats with a structure and floristic composition favouring the establishment of Bell miner colonies are more likely to favour the establishment of psyllid outbreaks (and vice versa). Over-abundant psyllid populations and Bell Miner colonies tend to be initiated in sites with high soil moisture and suitable tree species where tree canopy cover has been reduced by 35 – 65 % and which contain a dense understorey, often, but not always, of *Lantana camara*. Such conditions arise as a consequence of landscape-level disturbance of forest ecosystems (Stone 2005).
- The presence of lantana contributes to the persistence of dieback but may not be a primary causal factor initiating dieback (Stone, in Wardell-Johnson et al 2006).

Control of lantana may contribute to a BMAD solution (Yeates and Schooler 2011, Sommerville, Sommerville and Coyle 2011) but this is not conclusively proven.

- BMAD also occurs in areas devoid of lantana (Stone 2005) and may be associated with proximity to a rainforest gully (Hastings 2012) or mid-storey with preferred nesting conditions for Bell miners. Fire may eliminate the rainforest understorey.
- Bell miners are capable of establishing a small colony before psyllid numbers reach high damaging levels, and after bell miners gain control of the site psyllid numbers rise substantially (Clarke and Schedvin 1999 in Stone 2005).
- Bell miners selectively feed on lerp casings, ‘farming’ psyllid populations. Feedback loops result in increases in psyllid populations resulting in canopy decline (Haythorpe and McDonald 2010).

Figure 14 depicts the processes of BMAD based on the various theories and research.

Figure 14 BMAD process and relationships.



While it is now generally accepted that dense shrubby understorey over a sparse eucalypt canopy is common to forest stands colonised by bell miners (Haywood and Stone 2011) no single cause explains this form of dieback and it appears that BMAD cannot be arrested by controlling a single factor. The links between disturbance, fragmentation, outbreak initiation and maintenance have not yet been definitively described and the time taken from initiation until there is evidence of decline is not well documented. Jurskis (2005b) suggests that tree crowns develop epicormic shoots before there are any obvious outbreaks of pests, and before bellbirds move in, indicating a response to changing soil conditions arising due to other causes.

He proposes that the birds are a tertiary factor, responding to increased food provided by outbreaks of pysllids feeding on flushes of young epicormic leaves. Several other studies have demonstrated that bell miner behaviour results in elevated psyllid populations and that sustained feeding damage from these sap-sucking insects results in premature leaf death and defoliation (Stone 1996 in Stone et al. 2008). Continued initiation and growth of replacement foliage depletes the tree's carbohydrate reserves resulting in branch death and crown contraction. Affected trees become weakened and more susceptible to other stressful agents such as wood borers and fungal pathogens, but if the bell miners vacate the affected stand, psyllid numbers significantly decrease (Clarke and Schedvin 1999) and, if the trees have not become too debilitated, crown recovery can occur (Loyn et al. 1983; Stone 1996 in Stone et al. 2008).

There are, therefore, several phases that forests at risk of BMAD may pass through, and potentially a lengthy period of time before changes in tree health, such as epicormic growth, defoliation or crown contraction, may be detected. This may also apply to detecting changes in psyllid numbers (Dare et al., 2007; Hastings 2012) and elevated insect populations which can be maintained for several seasons before crown contraction becomes evident and the tree succumbs to secondary stressors (Stone 2005).

BMAD has been recorded in NSW, Victoria and QLD. Estimates of the extent and potential for spread vary depending on the author’s opinion on the cause and characteristics of susceptible forest types. Wardell-Johnson et al 2006 estimated that 2.5 million hectares could be considered to be at risk across eastern NSW while other sources estimate are around 781,000 hectares of east coast forests as predisposed to decline (Vic Jurskis unpub. data 2008 in Meek 2008). In 2004 surveys of over 300,000 ha of native forest in north-eastern New South Wales visually mapped 20,000 ha of BMAD affected forest. Of the affected area, approximately one third was been assessed as ‘severe’, with ‘many dead trees, severe thinning of crowns, low stocking rate of susceptible species and greatly increased mesophyllic ground story vegetation including weeds such as lantana.

Dieback becomes evident when stands are at least decades old. Turner and Lambert (2005) hypothesise that at the time that dieback symptoms are apparent on trees the ‘negative’ processes in the soil being a determinant for dieback may have been occurring for at least ten years.

Mapping of BMAD, once it is evident in the canopy, is possible: trees and outer branches are dead or dying with epicormic leaf production and discoloured leaves. Predicting those areas of forest that are susceptible to BMAD requires modelling and analysis to firstly identify the relationships between stand factors associated with the presence of the damaging agent or process and metrics derived from remotely sensed and ancillary geographical information system (GIS) data (Coops et al., 2006 in Haywood and Stone 2011). The second step is to develop a predictive model that most accurately maps the actual as well as the predicted distribution of the damaging agent and hence the areas of affected forest or susceptible to damage (Haywood and Stone 2011).

The production of predictive maps covering large areas at high spatial resolution and derived from multiple sources of data is being developed by DPI NSW as part of a project that aims to:

- Map current extent and severity of BMAD in coastal native forests (aerial surveys) across all tenures
- Compare to previous mapping undertaken in 2004 (State Forests of NSW) and 2013 (OEH)

- Produce BMAD risk maps based on predictive spatial models using remotely sensed data (SPOT, LiDAR) and ancillary topographic data etc.
- Develop an "identifier" for bell miner calls (remotely record bell miners)

Producing BMAD risk maps could be used as the basis of delineating eligible project areas based on the level of severity or risk.

Comparisons of existing extent with past mapping may indicate the nature and rate of spread.

The impacts of dieback on forest productivity can be severe. Dieback defoliates the crown, ultimately leading to protracted growth and ultimately the death of standing trees. Not only do the standing trees die, but the lack of foliage and flowering and subsequent fruiting, reduce and eventually eliminate the seed production necessary for forest regeneration (http://www.bmad.com.au/about.html). Thus, dieback not only causes a decline in the carbon carrying capacity of the affected forests as the health of trees reduces and their ability to sequester carbon dioxide is diminished, but it may also affect future abatement in successional forests.

In multiple-use forests the impact on the value of trees to store carbon in timber is also lost. Studies have shown that the potential for carbon abatement in such forests is greater than in conservation areas because of the contribution of the timber to a HWP pool and the ability of harvested forest to regenerate and thereby continue to sequester CO_2 (Ximenes at al 2012a; Ximenes at al 2012b) although this is contested (Keith et. al 2014).

Regardless of the general management intent, in all forests affected by dieback which are unable to recover, CO_2 sequestration in above ground live tree biomass will cease when trees die, and the stored carbon is transferred to the debris pool. Increase in carbon the debris pool will either decay overtime or be emitted as a result of fire.

Given the diversity of agents and processes that could be at play in BMAD there is likely to be no single or simple management solution to address it and thus many project activities may be possible. In managing forests, it is also necessary to recognise that there is a complexity of connections and interactions, many of which have yet to be deciphered (Wardell-Johnson et al 2006). Any management practice that reduces bell miner density will in turn reduce the density of insect herbivores and hence foliar damage in the eucalypt tree crowns. Then, if the trees have not become too debilitated, crown recovery is likely to occur (Stone 2005). \

The main management methods being trialled is bell miner habitat modification by weed control or fire, along with limited psyllid control through tree injection with insecticide. Bell miner removal has been trialled largely for the purposes of experimentation, but is not a common management intervention.

- **Lantana**: Where lantana occurs, weed control removes the dense midstorey and allows a more open forest structure to establish and native composition to be restored (Yeates and Schooler 2011, Somerville, Sommerville and Coyle. 2011). By removing Bell Miner habitat numbers of Bell miners are reduced as the colony reclocates, thereby breaking the feedback cycle with Glycaspis psyllids. Other bird numbers increase which resume foraging on all insects in the forests: Figure 15.

- **Insecticide**: The use of insecticides to control psyllids can be undertaken via spraying on trees less than 4 m) or via stem injection in larger trees. Insecticides are not specific and other insects are killed after application. By the time effects of insect damage are evident it may be too late for the use of insecticides. Reduced numbers of psyllids affect the feeding of Bell Miners, which relocate, and other bird species repopulate the forest. - Figure 16.

- **Removal of Bell miners:** Removal of bell miners can result in an immediate influx of other bird species, and a reduction in the psyllid population (Clarke and Schedvin 1999 in Stone 2005; Hastings 2012) - Figure 17.
- **Ecological Burning**: The introduction of fire - termed 'ecological burning', at higher intervals to alter forest structure, with an intention to alter understorey characteristics, and potentially also controls lantana where it occurs, may inhibit the development of conditions favourable to BMAD. Fire also alters ecosystem process such as nutrient cycling, as well as creating a large disturbance event from which succession in many different parts of the ecosystem can occur. Changes in nutrients improve the resilience of forests to attack from increased number of all inspects, therefore breaking the tropic processes hypothesised- Figure 18.

Figure 15: Lantana Control - Mechanical or Chemical removal

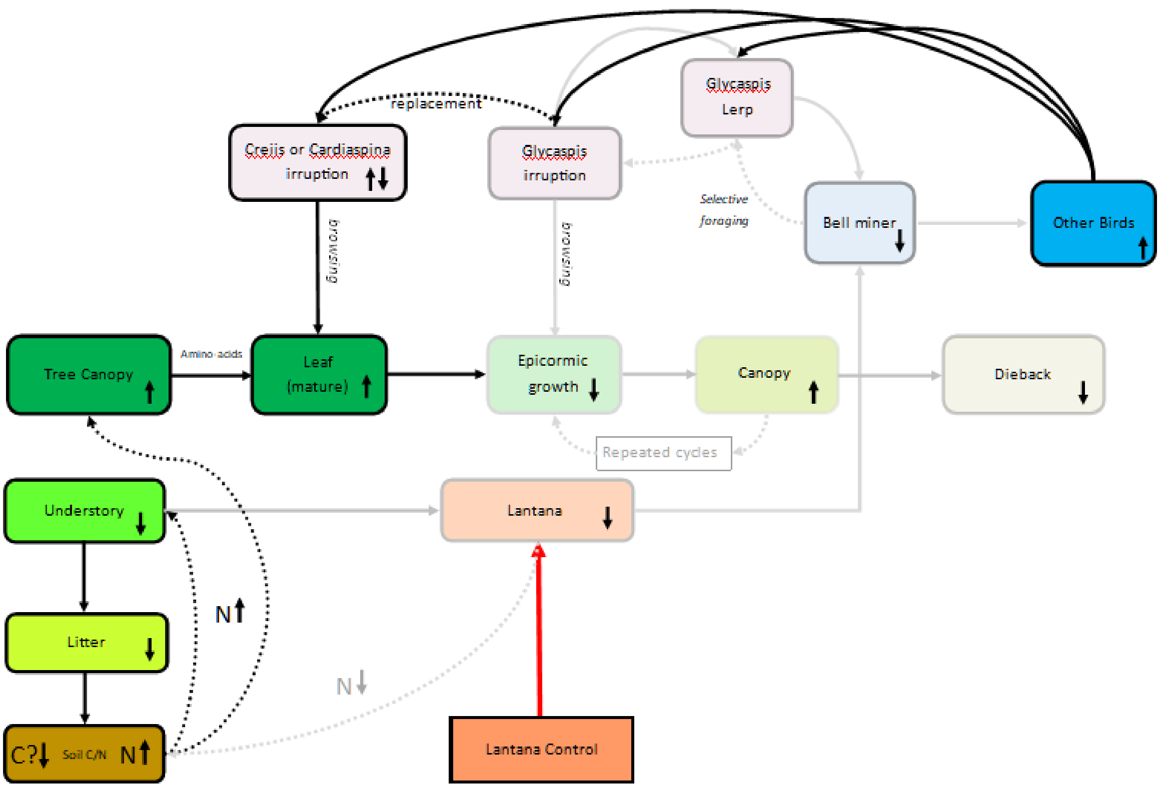


Figure 16: Insecticide

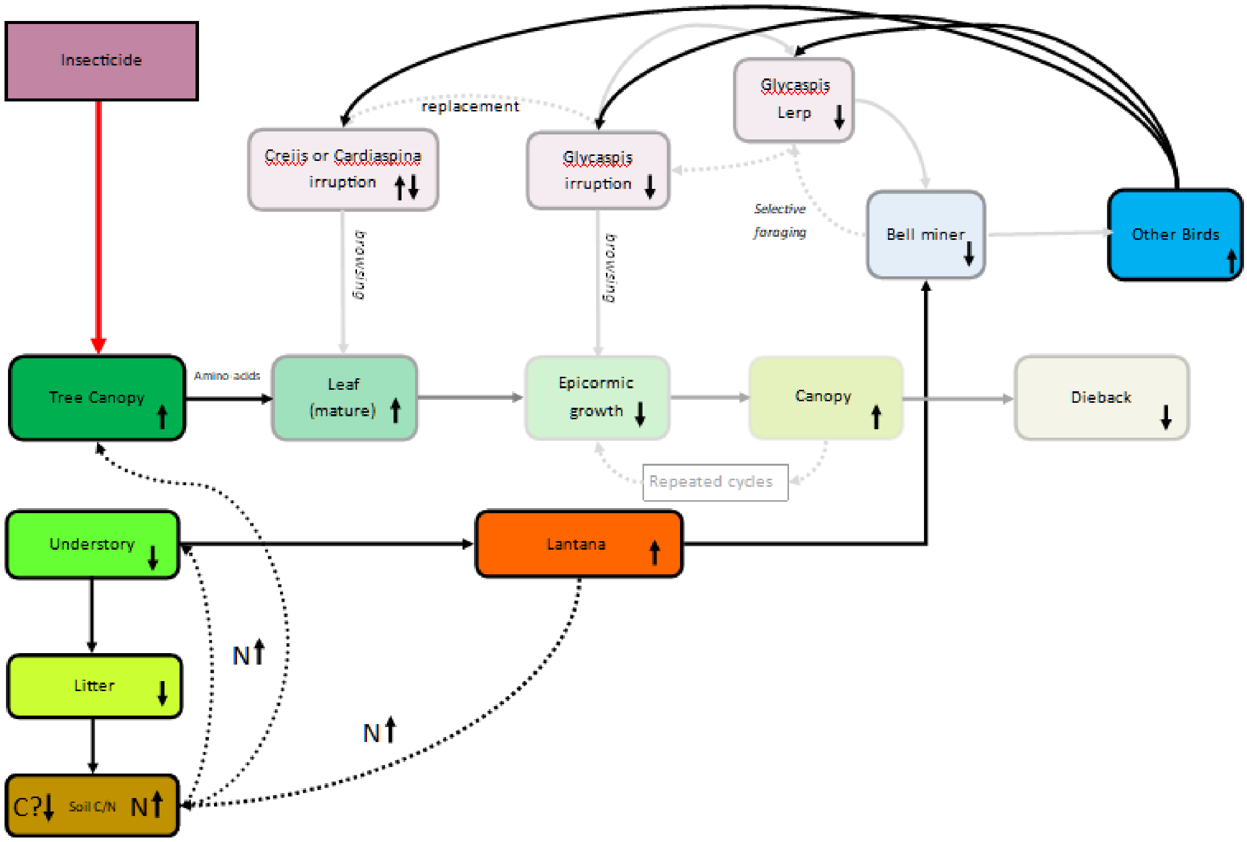


Figure 17: Bell Miner Control

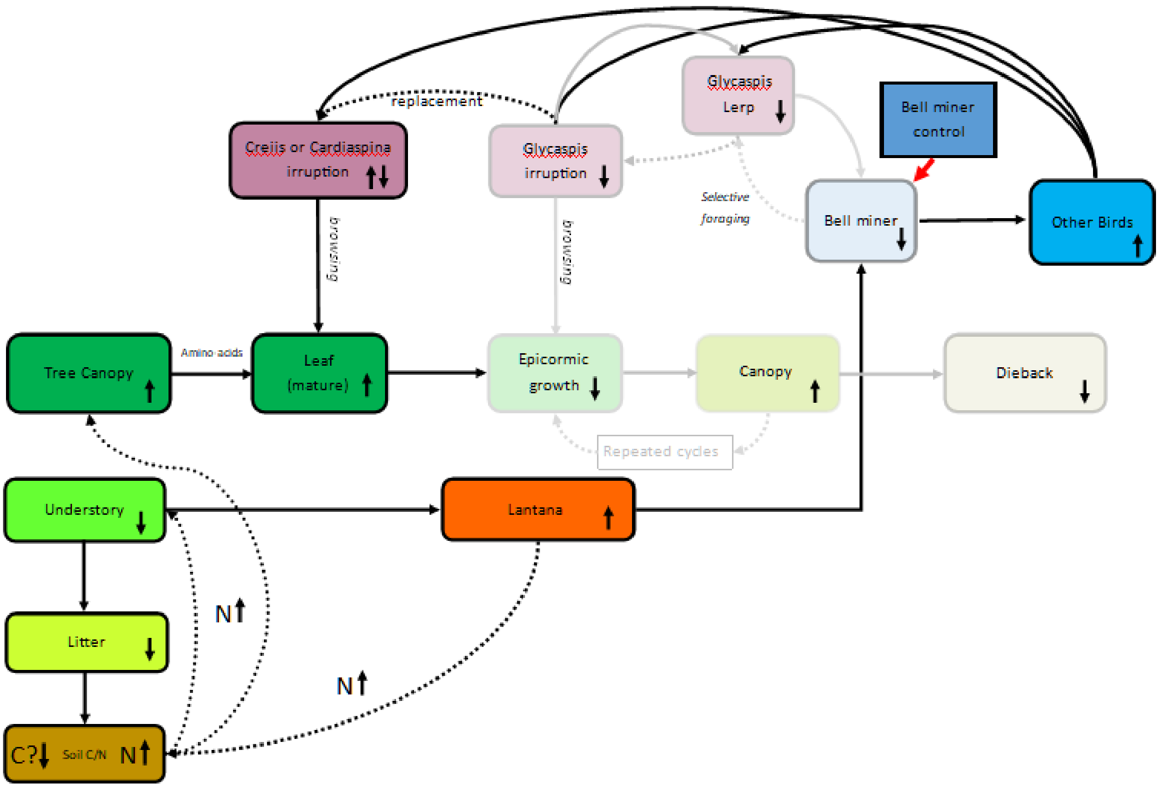
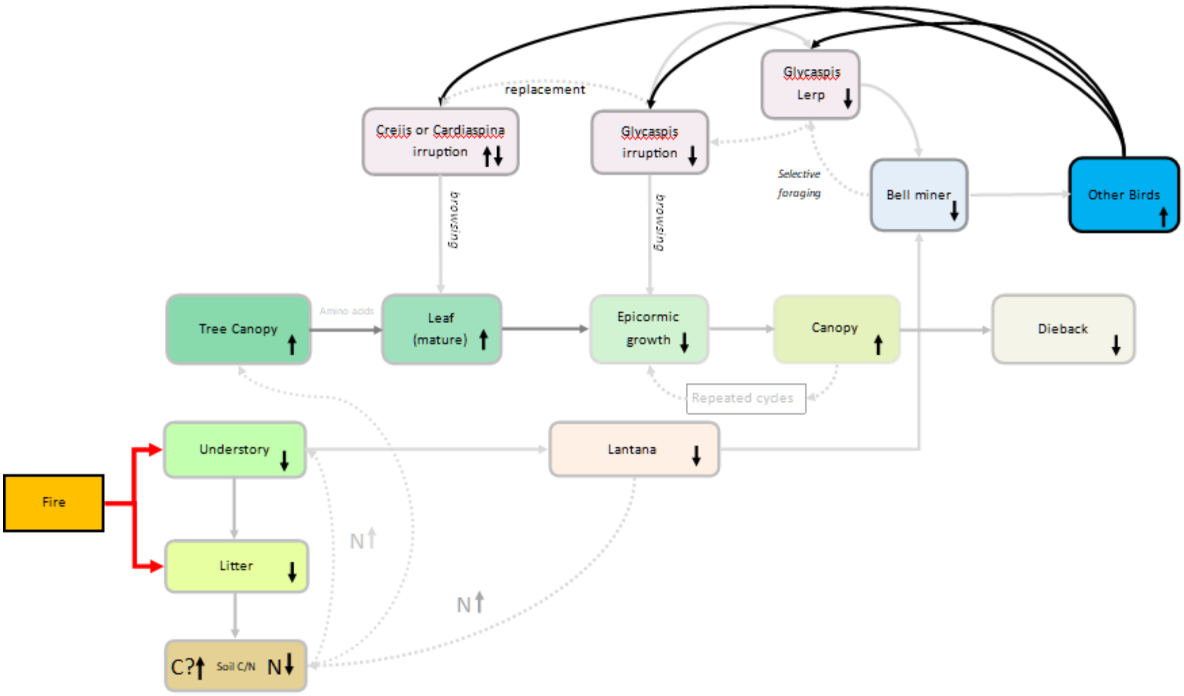


Figure 18: Ecological Burning



The proposed approach to dieback

Baseline

The baseline scenario is the carbon stock in forests that will prevail in the absence of intervention, based on a reference scenario.

The baseline could be a static baseline approach either:

a) based on a long-term average, because decline is not instantaneous – its impact on carbon stock is realised over a long period of time, potentially in several phases, or
b) for forests that are already degraded, based on an estimate of carbon stocks in the initial project start year assuming this remains constant over the project period.

In the project scenario, for forests already affected by dieback, if the project activity is not implemented, carbon stocks will remain static or will decline further as carbon in the standing deadwood pool falls and is burnt or decays. Management activities are implemented leading to an increase the carbon stocks and preventing further decline of carbon stocks.

The difference between the carbon stocks remaining in the project scenario compared to what is estimated under baseline scenario, would be the net GHG abatement over the lifetime of the project.

For projects in which the forest is susceptible to dieback and which are likely to become degraded if management activities are not implemented, modelling could utilise reference scenarios from analogous forests without dieback to establish what is likely to occur in the absence of the project activity.

Modelling of the baseline could be undertaken, taking into account the onset of dieback at relevant/likely growth stages and incorporate other standard management events such as silviculture, timber harvesting and wildfire. The baseline could be modelled over 100 years.

Project Activity

The possible project activities are:

a) the introduction of management interventions that prevent the spread or outbreak of bell miner associated dieback (BMAD) thereby protecting the carbon carrying capacity of that forest. In this case the project scenario is the carbon stock in the forest without dieback, taking into account emissions associated with undertaking the project activity and other relevant carbon flows and emissions.
b) enrichment planting or activities that induce and manage regeneration in forests that are already degraded. In this case the project scenario is the increase in the carbon stock in the forest, taking into account emissions associated with undertaking the project activity and other relevant carbon flows and changes to carbon pools

Some management interventions may increase emissions in a project area for example introducing more frequent fires or reducing understorey complexity by removing biomass through mechanical means. Active management that significantly alters above ground non-woody biomass of natural species may need to be included within the carbon boundary.

The management interventions may vary between project areas:

- Lantana control - various approaches consistent with Lantana Best Practice management control procedures (http://www.weeds.org.au/WoNS/lantana/)
- Changes in fire management
- Injection with insecticide (Note – Insecticides can be used to control psyllids, although by the time damage is noticed it is usually too late to take effective action – SFNSW 995)
- Removal of Bell miners.
- Enrichment planting
- Ecological thinning
- Understorey management

The abatement could be modelled using FullCAM taking into account other events such as ecological burning, silviculture, timber harvesting prescribed burning and wildfire.

Abatement could also be measured on the basis of allometric equations and biomass surveys, projected over 100 years taking into account the project activity and other management practices. Repeated inventory using Permanent Growth Plots may be required in the method as part of the monitoring protocol.

The project proponent would need to demonstrate that the project area is eligible on the basis of the presence of or susceptibility to the risk of dieback, within bounds of certainty. Eligible forest types may be forest with early signs of being affected by dieback or developing the characteristics of being susceptible to dieback - such as lantana infestation and others.

Eligibility to participate under a method to prevent a decline in forest carbon carrying capacity due to dieback will be dependent on factors that indicate forests are affected by or are at a high risk of being affected by dieback such as:

- Forest: as defined in the CFI Regulations 2011 has a minimum canopy cover of 20% over 0.2 ha of land with minimum tree height of 2 m.
- Forest types: specific forest types may be more likely to be affected by dieback. Forests that are unlikely to be affected will be ineligible. Both native forest and planted forests are eligible.
- Forest structure or likelihood of developing a particular forest structure: research indicates that dieback occurs in forests with open canopy and dense mid-understorey.
- Geographical locations
- Affected by die back, at risk of being affected by dieback or proximity to dieback affected forest on the basis of dieback mapping.

Dieback affected forest zone: Forest already showing signs of being in decline due to dieback agents. This area will be treated by project management actions that halt dieback (if in early stages) or restore dieback affected forests. Crediting occurs in this area following the commencement of management actions.

Buffer/monitoring zone: Forest that is at risk of becoming affected by dieback but is not yet showing signs of dieback. This area is the buffer zone in which monitoring should occur. The width of the buffer zone is determined on the basis of the severity of decline in the die back affected forest zone and the rate of spread. Monitoring must take place in the buffer zone for a period of time during which signs of dieback could reasonably be expected to appear following spread from dieback affected areas. Project management actions intended to prevent the spread of dieback should take place in this area. Crediting does not occur until after the initial monitoring period has passed.

At risk forest zone: Forest that is at risk of becoming affected by dieback but which is not yet showing signs of dieback. Project management actions intended to prevent the spread of dieback should take place in this area. Crediting occurs in this area following the commencement of management actions.

Non-Project Areas Forest: Forest that is contiguous with the project area but which is not at risk from dieback or in which the management interventions required are not appropriate for ecological (e.g. sensitivity to fire), social/cultural (proximity to residential areas) to economic reasons (e.g. proximity to water sources). While management actions may occur in these areas, no crediting occurs.

Figure 19: Dieback forest zoning.