

Forests, Wood and Australia's Carbon Balance



Australian Government
Forest and Wood Products
Research and Development Corporation



Cooperative Research Centre for
Greenhouse Accounting

Foreword

The sustainable forest products industry in Australia can help reduce society's energy use and greenhouse gas emissions.

This brochure has been developed to indicate the extent to which plantations and other commercial forests, as well as the wood products produced from those forests, contribute to Australia's carbon balance. It also identifies opportunities to improve that contribution further.

While the storage of carbon in forests is well understood, the important contribution that wood (both in service and after disposal) makes to carbon storage is less well-recognised.

We hope this publication extends your knowledge of the positive role of forest and wood products in the carbon economy.

Dr Michael Robinson

Chief Executive Officer
Cooperative Research Centre for
Greenhouse Accounting

Dr Glen Kile

Executive Director
Forest and Wood Products Research and
Development Corporation

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Forests, Wood and Australia's Carbon Balance

Forests in Australia store an estimated 10.5 billion tonnes of carbon (excluding soil carbon). The carbon store has been built through the forest plants having removed almost 38.5 billion tonnes of carbon dioxide from the atmosphere, about 70 times Australia's annual net greenhouse gas emissions.



Australian plantations and commercial forests removed a net 43.7 million tonnes of carbon dioxide from the atmosphere in 2004.



The accumulated storage in Australia's forest plantations and wood products is about 323 million tonnes of carbon, of which the wood products store more than 230 million tonnes of carbon.



Wood products typically require less energy to make than alternative materials. Because energy rating schemes and environmental assessments are typically not based on full-life-cycle assessments, the comparative environmental advantages of sustainably harvested wood are not fully recognised.



The use of sustainably harvested forest biomass to generate renewable energy permanently eliminates atmospheric emissions that would otherwise have resulted from the use of fossil fuels.



There are ways to recognise better the greenhouse credentials of forests and wood products. These include burning more sustainably harvested wood and waste for energy, extending emissions trading schemes to recognise carbon stored in wood, and making full-life-cycle assessments of building materials.



By removing carbon dioxide from the atmosphere, forests, forestry, and the use of wood products are helping mitigate climate change. They can help much more.

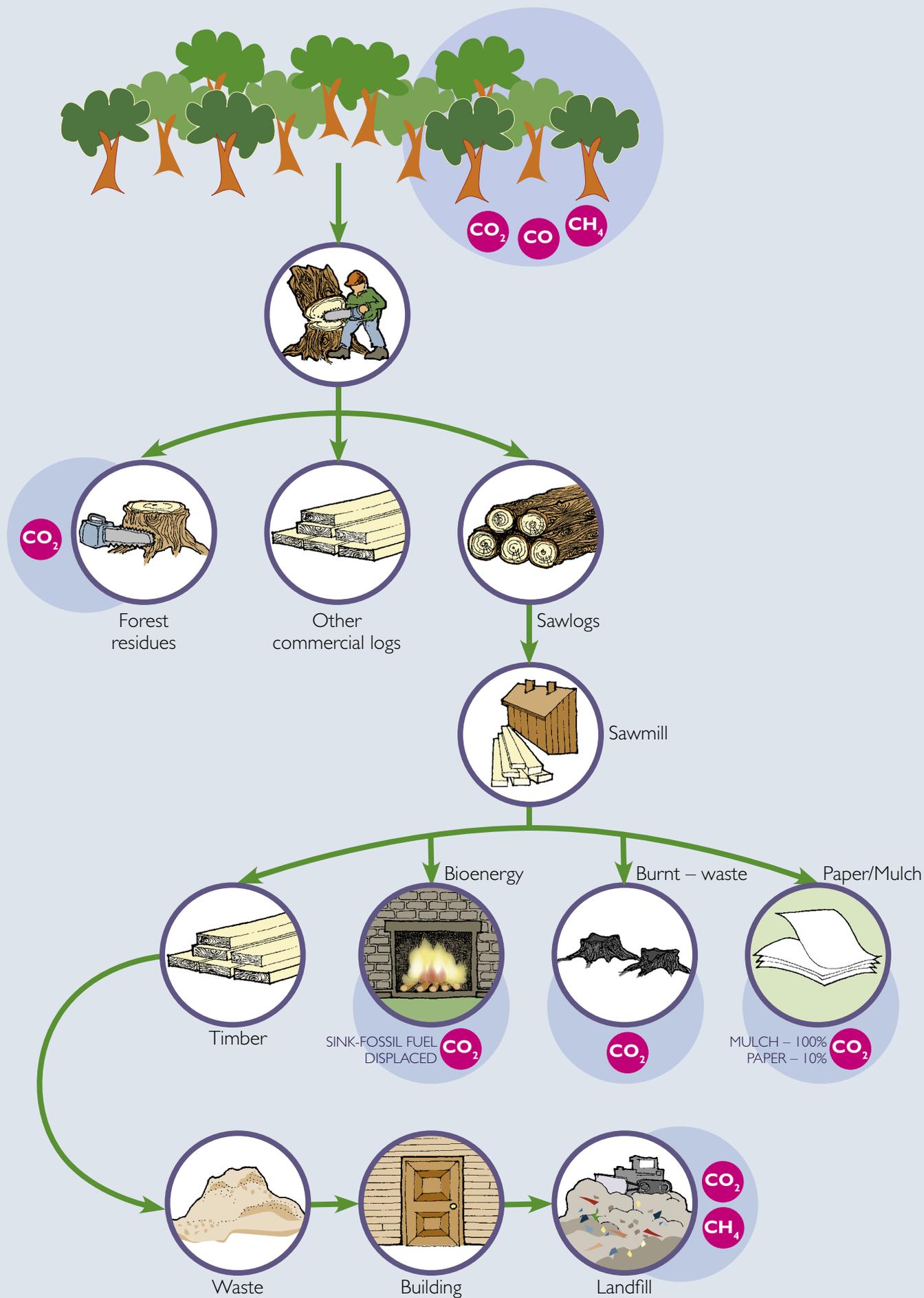


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Figure 1 Life cycle of carbon in forests and wood products



Introduction

The world's forests and forest soils are an integral part of the global carbon cycle. The carbon cycle has been substantially altered by human activity, population growth and urbanisation, including the burning of fossil fuels and deforestation. This anthropogenic activity is now accepted as contributing to global climate change.

Growing trees absorb the major greenhouse gas carbon dioxide from the atmosphere through photosynthesis and store the carbon. **About half the dry-weight of a tree or wood product is carbon. One tonne of carbon represents 3.67 tonnes of carbon dioxide.**

In Australia, the net emissions of greenhouse gases from land use, land-use change and forestry in 2004 were 4.3 million tonnes of CO₂-e, as calculated under the United Nations Framework Convention Climate Change National Greenhouse Gas Inventory reporting framework⁵. However, linking forestry with land clearing or other land-use changes does not fairly represent the value of managed forestry and wood-product use in contributing to carbon storage.

Carbon stored in wood is released back to the atmosphere only when the wood or wood product decays or is burnt.

Greenhouse gases, carbon, and carbon dioxide

There are six important greenhouse gases, each measured in carbon dioxide equivalents (CO₂-e) – the amount of each gas that has the equivalent effect on climate as one tonne of carbon dioxide.

This document refers to 'carbon' stored in wood and wood products, and carbon dioxide or carbon dioxide equivalents (CO₂-e) when referring to greenhouse gases.

Simply multiply carbon by 3.67 to calculate how much carbon dioxide is represented by an amount of carbon.

The world's forests and soils store more than one trillion tonnes of carbon, twice as much as is in the atmosphere¹. Forests have the potential to absorb about 10 to 20 per cent of total global emissions projected for the first half of this century^{2, 3, 4}.

Uncertainties of new science

The analysis of carbon flows and the carbon balance between the atmosphere, forests, and wood and paper products is a new branch of science. It necessarily involves estimates, assumptions, and the use of models to simulate carbon fluxes over time. There are uncertainties in each stage of the process. Numbers presented here are the best available current estimates drawn from various sources based on realistic assumptions. Further research is required to refine the estimates and the understandings underpinning the assumptions.



BELOW: Rare Books Room in the Queensland Supreme Court Library (photo C McLeod)



Carbon in Australian Forests

Defining the forests

'Plantations' and 'Plantation forests' are used in this booklet to describe areas of managed forest where the trees have been planted, rather than being the result of natural regeneration⁶.

'Commercial forests' is used to describe native forests which are managed for wood production.

'Conservation forests' is used to describe native forests in which no harvesting takes place.

Forests (plantations, commercial forests and conservation forests) cover about 21 per cent of Australia⁷, and store an estimated 10.5 billion tonnes of carbon (excluding soil carbon)⁸. The carbon was derived from almost 38.5 billion tonnes of carbon dioxide – about 70 times Australia's net annual greenhouse gas emissions – removed from the atmosphere.

The vast majority of the carbon (99.2 per cent) in Australian forests is in natural, mainly native hardwood, forests (both commercial and conservation forests), with the balance in plantations⁷.

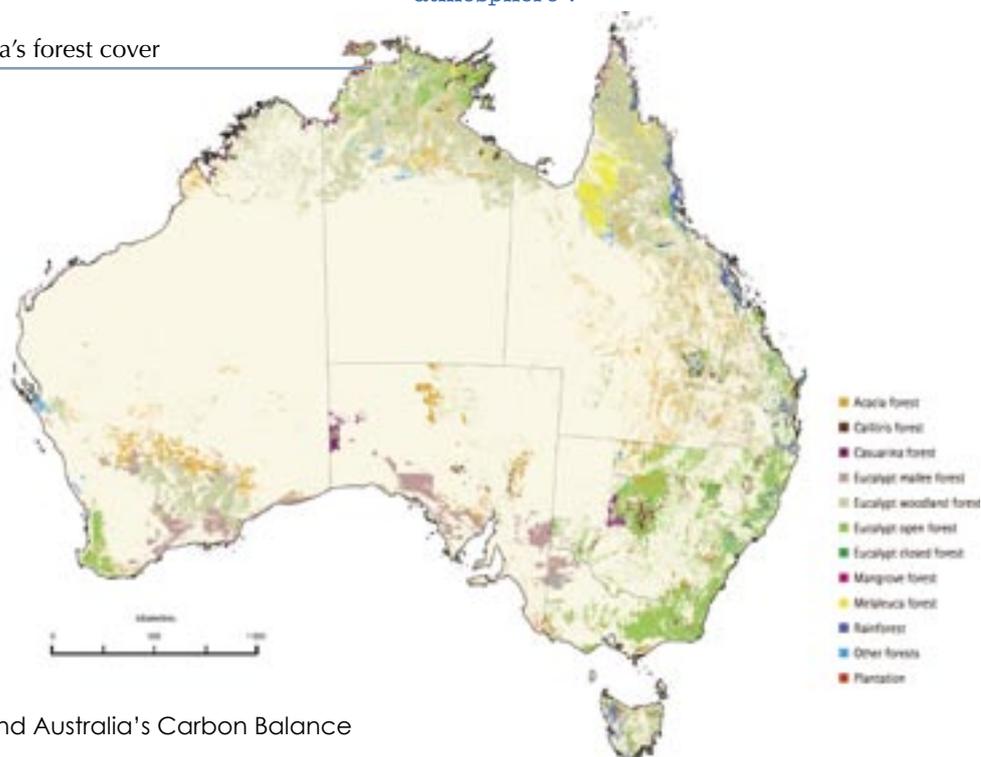
The growth of trees in plantations and commercial forests in Australia removed about 89.2 million tonnes (net) of carbon dioxide from the atmosphere in 2004⁵, after taking into account the decay of slash. The harvesting of trees for wood and fibre production removes about 8 million tonnes of carbon from the forests each year⁹, and wood burnt through prescribed burning and wildfire and for energy removes a further 4.4 million tonnes of carbon, resulting in the calculated net sink of 11.9 million tonnes of carbon in 2004¹⁰. About three-quarters of the net carbon sink is in commercial forests, and the rest is in plantations.

The rate and extent of root decomposition has a critical impact on both carbon stocks in forests and greenhouse gas emissions. About 24 per cent of forest biomass is in roots, and 21 per cent is in woody debris on the forest floor⁷. Australia's National Greenhouse Gas Inventory assumes that roots decay over 10 to 20 years⁵. However, recent research¹¹ has shown that tree roots decay much more slowly, though the decomposition rate is highly species-dependent. For example, the coarse roots of the hardwoods studied remained intact for 25 years after harvest, with up to 50 per cent of the roots still present 85 years after harvest.

The rate and extent to which trees sequester carbon is influenced by many factors including species, site-quality, climate and management. Trees sequester carbon more rapidly during their peak growing years, generally early in their life cycle. For example, a 100-year-old native regrowth forest could be expected to have absorbed about 60 per cent of its expected total carbon in the first 50 years.

[Australian plantations and commercial forests are a carbon sink: in 2004 they removed a net 43.7 million tonnes of carbon dioxide from the atmosphere⁵.](#)

Figure 2 Australia's forest cover



Wood and paper products in service

In 2004-2005, Australians used 7.1 million cubic metres of sawn wood and panel products and 4.2 million tonnes of paper products⁹. Most of the wood products are used in residential buildings and furniture.

Residues are produced at each stage of wood and wood-product processing. Typically 40 to 60 per cent of log biomass is lost to residues during processing to green rough sawn boards. A large proportion of sawmill residues are used for paper and panel-board manufacturing, while in the large-scale softwood sawmilling industry in Australia the majority of the remainder is used to produce steam, with very little burnt to waste. Wastage during secondary processing to wood products ranges from 5 per cent of the board mass in the manufacture of truss, frame and flooring to 35 per cent in the manufacture of shopfitting products¹².

The type of residues generated and their fate are important to the greenhouse impact of wood products. For example, if the sawdust is burnt to waste, the carbon is emitted back into the atmosphere without any benefits. However, if the sawdust is burnt to produce heat for a drying kiln, for example, the energy generated typically avoids the use of fossil fuel energy.

[If log processing residues are burnt for energy, they are usually displacing the use of fossil fuels, permanently eliminating atmospheric emissions that would otherwise have resulted.](#)

Australia's *National Greenhouse Gas Inventory* accounts for emissions from all wood products within Australia (including imported material). Emissions from exported wood products (including woodchips) are reported in the national inventory of the importing country.

Wood and paper products produced in Australia in 2004 stored a net 5.3 million tonnes of carbon. After accounting for emissions from wood products manufactured in previous years (from 1944 onwards), the new wood products produced in 2004 added an estimated 1.44 million tonnes to the net store of carbon in wood products in service in Australia¹³

[The Australian Greenhouse Office estimates that wood products in service in Australia \(produced from 1944 onwards\) are storing about 95.6 million tonnes of carbon⁵.](#)

In comparison, about 335 million tonnes of carbon is estimated to be stored in wood products in service in Germany¹⁴.

Wood products have important environmental advantages over alternative building materials in addition to storing carbon from the atmosphere:

- ▶ Wood is a renewable resource;
- ▶ Comparatively small amounts of energy are used in the manufacture of most wood products;
- ▶ The residues generated during the manufacture and processing of wood products can be used in several forms, including replacing fossil fuels to generate energy; and
- ▶ About 31 per cent of the energy used by the pulp and paper sector comes from renewable sources¹⁵.

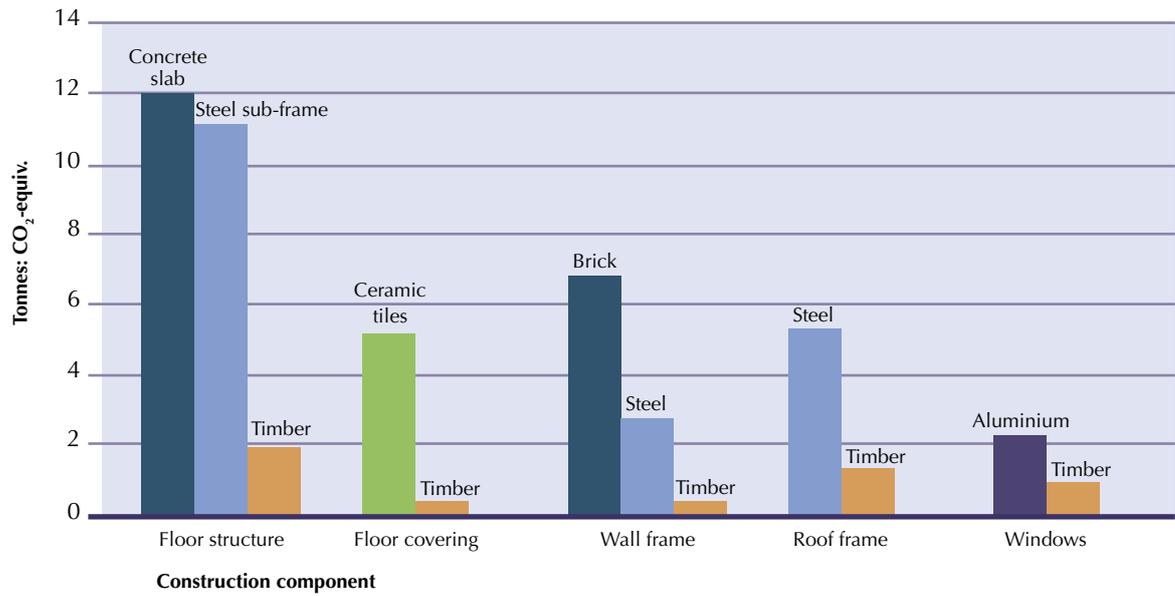
[The use of wood products results in overall lower greenhouse gas emissions than most alternatives.](#)

By choosing wood products wherever possible in house construction, greenhouse gas emissions equivalent to up to 25 tonnes of carbon dioxide per house could be saved in Australia¹². In the United States, the CORRIM project has demonstrated through a series of life-cycle assessments that the use of wood products is consistently more greenhouse-friendly than alternative materials¹⁶. In New Zealand, use of wood in new buildings has been shown to reduce emissions of greenhouse gases due to the manufacture of materials by 30 to 85 per cent¹⁷.

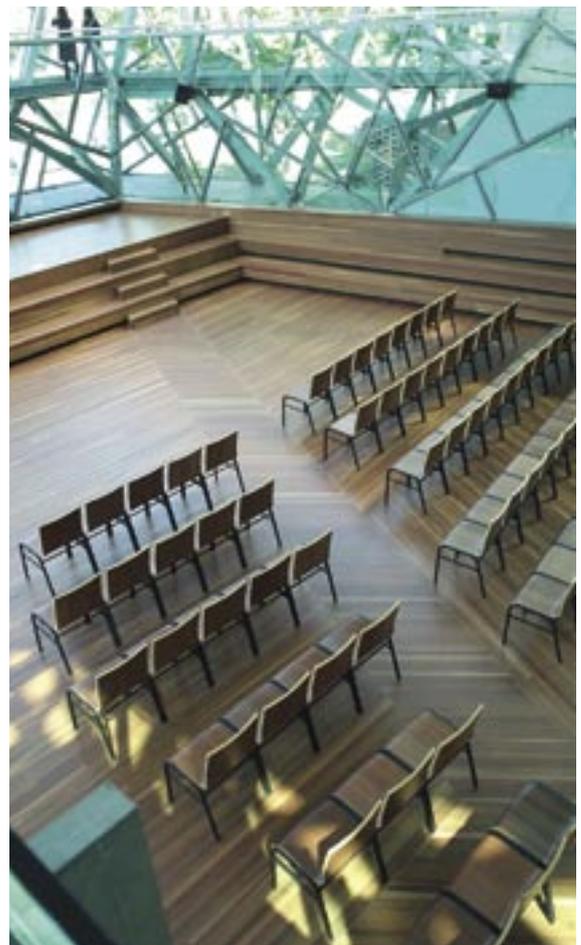
Construction materials such as aluminium, cement and plastic products require large energy inputs, usually from fossil fuels, during manufacture. The manufacture of wood products typically requires less energy than competing materials (Figure 3).



Figure 3 Greenhouse gases emitted in the manufacture of building materials used in a range of construction components for a single storey house in Sydney, Australia
Source: Modified from *InWood International Magazine* ¹⁸



Beauty in carbon storage - curved beam and lining in the corridor of Dismal Swamp Visitors' Centre owned by Forestry Tasmania in Smithton, Tasmania



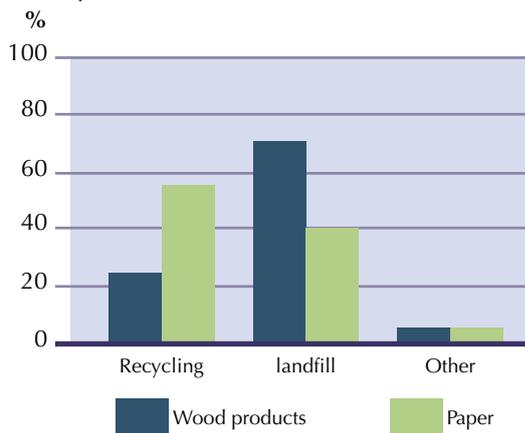
BMW Edge Theatre in the Federation Square complex, Melbourne, Victoria

Carbon in wood and paper products after disposal

At the end of their service life, most wood products in Australia are disposed of in landfill. About 1.3 million to 2.0 million tonnes of wood products¹⁹ and 2.0 million tonnes of paper products are placed in landfill in Australia each year²⁰. In addition, about 300,000 tonnes of waste from the papermaking process are disposed of in landfills each year²¹. This is despite increasing levels of paper recycling; 48.4 per cent of the paper produced in Australia is made from recycled fibre and 52.9 per cent of the paper consumed in Australia is recycled²², levels among the highest in the world.

The extent of wood-product recycling is less clear. In NSW, the Environment Protection Authority estimates that about 30 per cent of solid timber waste from the commercial, construction and demolition sectors is recycled²³. Burning the wood to waste or to generate energy is almost exclusively restricted to processing residues.

Figure 4 Fate of redundant wood and paper products in Australia

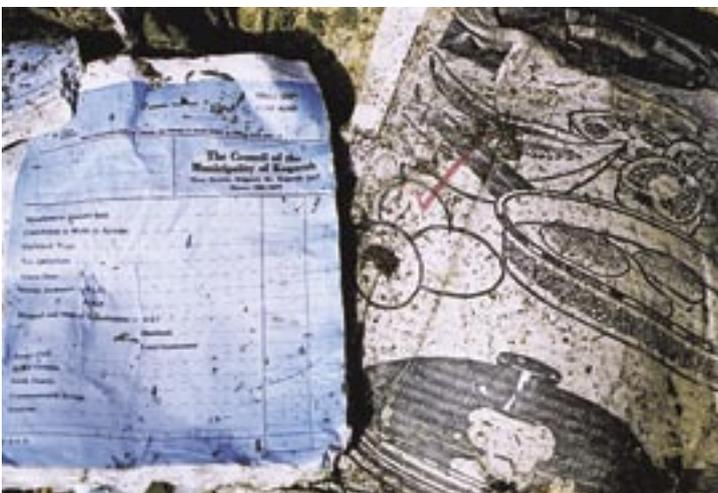


Each disposal option (recycling, use for energy, and consigning to landfill) has merit from a carbon-storage perspective. If the product is recycled, its service life is extended and it reduces the need to manufacture a similar product from virgin material (the net carbon benefit may depend on the energy intensiveness of the pulping process). If the product is burnt to generate energy, in Australia it is most likely that it will displace the use of fossil fuel. The decay of wood products in landfill is much lower than previously thought²⁴, resulting in relatively small emissions. While the decay of wood and paper in landfill results in carbon dioxide and methane emissions, which may be captured and burnt for energy, recent research shows that more than 95 per cent of the carbon in wood remains stored even after up to 30 years in landfill²⁴.

The *Australian National Greenhouse Gas Inventory 2004* estimates that 87.8 million tonnes of carbon is stored in wood and paper products in landfills⁵. Using the newly identified decay rates, it is estimated that about 136 million tonnes of carbon was accumulated in wood and paper products in Australian landfills by 2004¹³.

[Wood products in landfill represent an important long-term carbon store.](#)

This is 45 per cent more than the estimated storage in wood and paper products in service. Of the 1.6 million tonnes increase in carbon stored in wood and paper products in landfill during 2004¹³, more than 90 per cent of it was in paper products. The estimated accumulated emissions since 1944 from wood and paper products in landfills by 2004 were 4 million tonnes of carbon dioxide, or about 70,000 tonnes a year¹³.



Paper samples after 20 years in Lucas Heights landfill (photo David Gardner)



Sorting waste during a waste audit of construction materials at a project-built house (photo David Gardner)

Modelling carbon in wood products

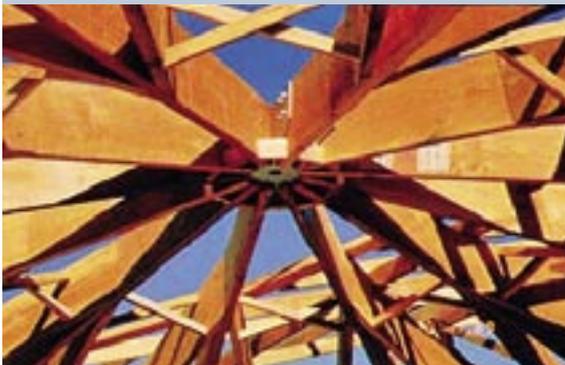
Australian Greenhouse Office National Wood Products Model

In a collaborative effort through the National Carbon Accounting System, the Australian Greenhouse Office has developed a national wood products carbon accounting model¹³ that tracks the flow of carbon and contributes to the *Australian National Greenhouse Gas Inventory*.

The model uses available statistics on log flows from the forest and estimates the carbon content of the various wood products processed (e.g. sawn timber, plywood, pulp and paper and woodchips) to determine carbon inputs to wood products. Estimates of the decay period of each class of wood product have been made and methods developed for estimating the pool of carbon in wood products. Import and export quantities of wood products are also considered in the model.

Wood products that are in use are assigned to young, medium and old age-pools. The loss of wood products from their service life is simulated as partial losses from each pool. Material leaving the service life may be either used for bio-energy, added to landfill, recycled or emitted to the atmosphere. Losses of carbon can also occur from the landfill pool.

Model output options include: all emissions assumed to occur at time of harvest (i.e. no wood products pool developed); life-cycle flow-analysis based on Australian wood production no matter in which country product is at time of emission (presuming a life-cycle treatment the same as for products in Australia); and life-cycle flow-analysis based on wood products in Australia, no matter where they originated.



Timbercam (Timber Carbon Accounting Model)

Various models have been developed to predict the amount of carbon that is sequestered in growing forests. Less attention has been given to the fate of carbon stored in wood products and residues after the harvest of commercial forests. *TimberCAM* tracks the fate of carbon sequestered in commercial forests through their harvesting, conversion to wood products, use and end-of-life options. The model begins the simulation when the forest is harvested, and then follows all the main stages in the life cycle of wood products. *TimberCAM* also tracks the disposal of all products and residues generated along the way.

TimberCAM was designed to model the effect on carbon storage of different forest harvesting scenarios for a range of different wood products. There are many factors that influence the carbon storage of wood products, including recovery rates, fate of residues, service life and disposal options.

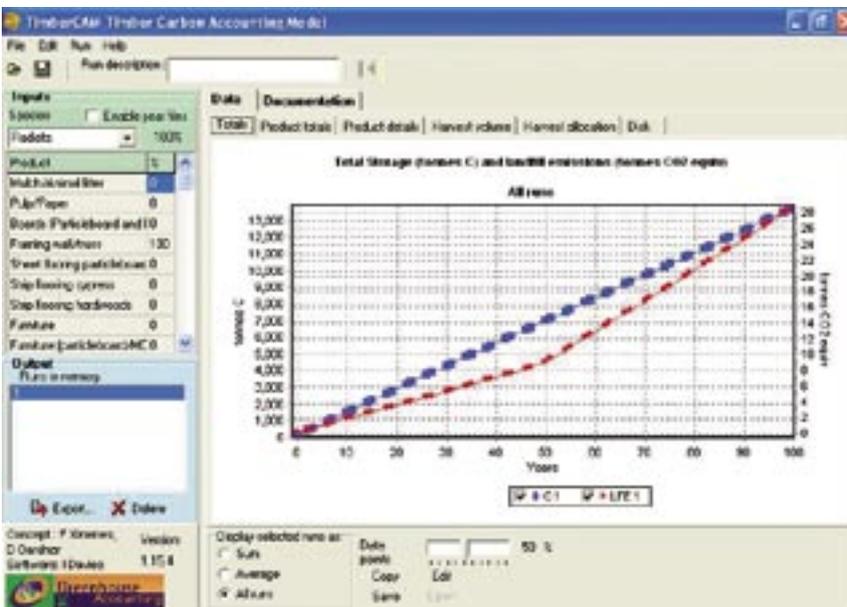
TimberCAM acknowledges the benefits of fossil-fuel displacement through the use of processing residues for energy generation. If the residues are used in lieu of fossil fuels to generate energy, *TimberCAM* accounts for the carbon in avoided fossil-fuel emissions. *TimberCAM* tracks the fate of carbon stored in wood products in landfills, therefore expanding the term of storage of carbon in wood products beyond their service life.

The obvious use for *TimberCAM* is, as its name suggests, for carbon accounting. *TimberCAM* and its users' guide are available for download (free of charge) for research purposes from the Cooperative Research Centre for Greenhouse Accounting website at:

- ▶ <http://www.greenhouse.crc.org.au/calculators/timbercam/>



Figure 5 TimberCAM's opening interface



Net effect of forests and wood products on Australia's carbon balance

The combination of carbon sequestration in growing trees and the long-term carbon storage in wood products represents a significant net sink and store of carbon. In 2004 alone, carbon stored in Australian plantations and commercial forests increased 11.9 million tonnes, all of which was the result of removal of carbon dioxide from the atmosphere⁵. Carbon in wood products in service grew by a further 1.44 million tonnes in the same year. The increase in carbon stored in wood and paper products in landfill was 1.6 million tonnes of carbon⁵.

In 2004, a net 14.9 million tonnes of carbon were removed from the atmosphere through sustainable forestry and the increase in carbon stored in wood products. This growing store of carbon in wood products (both in service and in landfill) combines with carbon sequestration in commercial forests and plantations to offset emissions – reducing by about 10 per cent Australia's annual net greenhouse gas emissions of 565 million tonnes of carbon dioxide equivalents.

The accumulated storage in Australia's forest plantations, wood products in service and in landfills is about 323 million tonnes of carbon (Figure 6). This is equivalent to all of Australia's greenhouse gas emissions for 2003 and 2004 combined.

There are no published estimates of carbon stored in the 15 million hectares²⁵ of commercial forests in Australia. However, based on the published estimate of carbon stored in Australia's conservation forests⁸, it is conservatively estimated that commercial forests potentially contain around 1 billion tonnes of carbon.

Further carbon benefits accrue where wood is used to generate energy, displacing the use of fossil fuels. Firewood and residues from processing wood and wood products are estimated to contribute about 2.5 per cent of Australia's energy use²⁶.

Substitution of wood products for more energy-intensive building materials adds further to the greenhouse benefits of forestry because wood products typically require less energy in their manufacture than alternative materials. Full life-cycle analysis of both the wood product and material displaced is required to assess the actual impact on Australia's carbon balance.

“True low-energy building design will consider this important aspect [embodied energy] and take a broader life-cycle approach to energy assessment. Merely looking at the energy used to operate the building is not really acceptable.”²⁷

Ignoring the benefits of carbon storage in wood products and the impact of non-wood substitution results in misleading building guidelines and unintended environmental consequences²⁹.

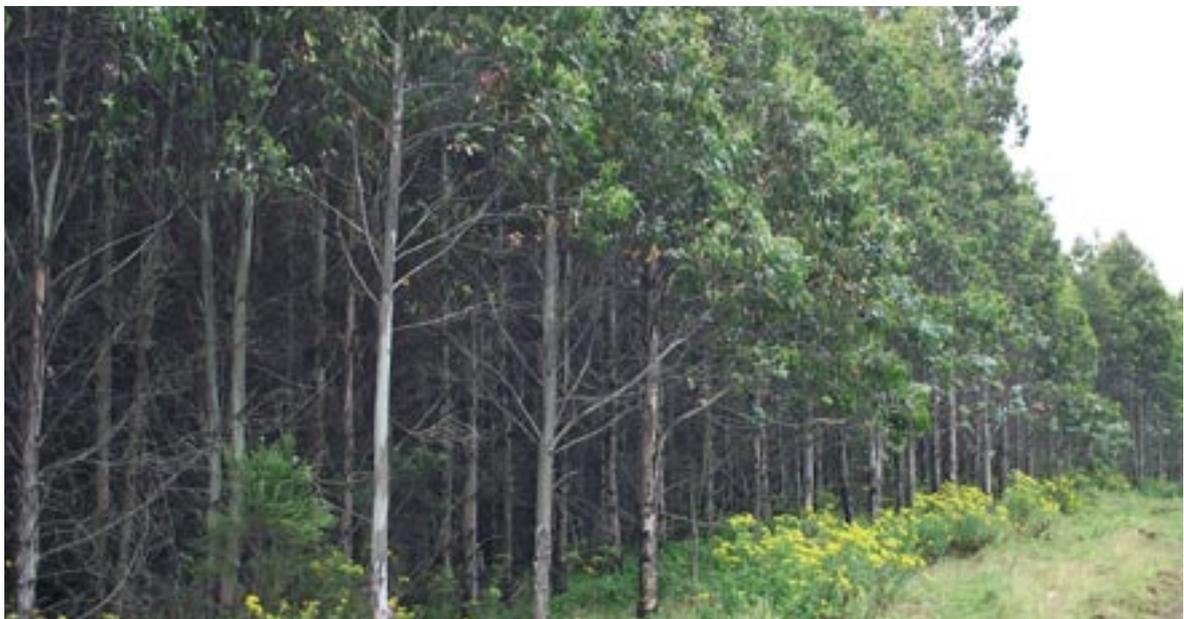


Figure 6 Net carbon storage in wood and paper products in service and landfills in Australia

Source: Australian Greenhouse Office Wood Products Model with data input from the CRCGA, ABARE and input from industry and experts



Figure 7 Net carbon storage in commercial forests and wood products in Australia in 2004

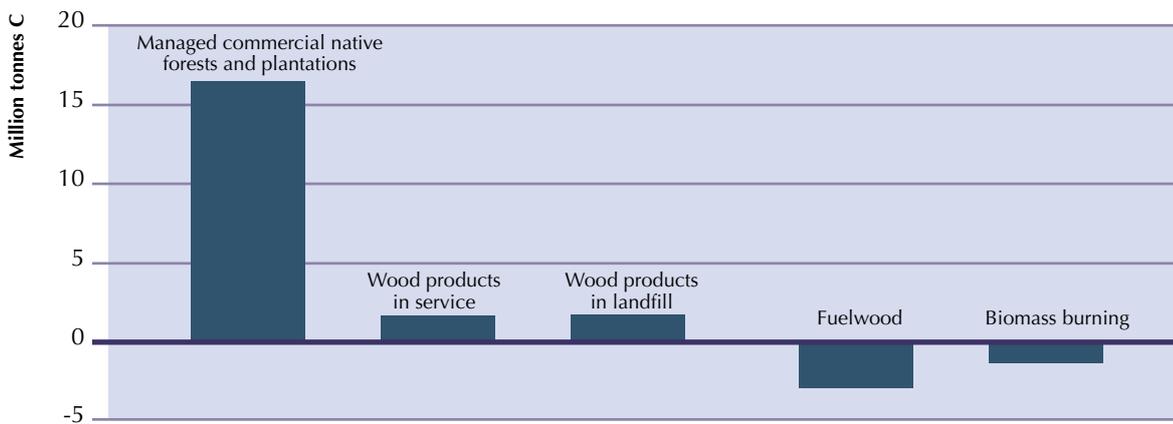
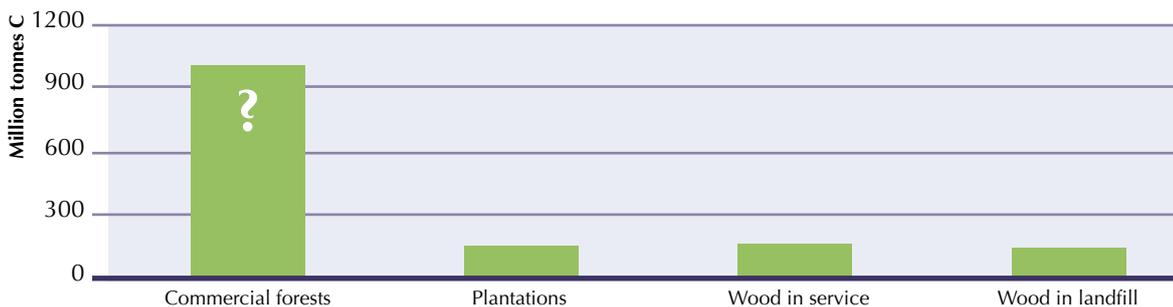


Figure 8 Estimates of cumulative carbon stored in commercial forests, plantations and in wood products in service and landfill from 1944 to 2004

Source: Australian Greenhouse Office National Wood Products Model; Australia's State of the Forests Report 2003⁸. The figures represent an estimate of the total cumulative carbon stocks in managed native forests, plantations and wood products in Australia



Opportunities

Forestry is one of the most greenhouse-friendly sectors of the Australian economy; it uses a renewable raw material, generates and uses renewable energy through burning of residues, and wood products generally require less energy to make than competing materials. There are opportunities for the industry to improve its greenhouse credentials by increasing its contribution to emissions reduction and by maximising its carbon sequestration and storage potential.

Bioenergy

Wood can be combusted to produce heat (residential use, cooking) and to generate steam. When wood is used to generate energy, it can replace fossil fuels such as coal, oil and natural gas. Use of fossil fuel releases carbon from a very-long-term store that cannot be replenished in less than geological timescales. Provided the forest is regrown, the use of wood for energy production results in relatively little net carbon emissions (when emissions from fossil fuels used in the harvesting, transport and processing of the wood are considered). The use of sustainably harvested wood to generate energy thus eliminates greenhouse gas emissions that would have resulted from the use of fossil fuels. Net carbon dioxide emissions from the generation of electricity using biomass are typically only 5 per cent to 10 per cent those from fossil-fuel-based electricity generation²⁹.

The forestry sector is a large user of renewable energy, most notably through the production of firewood (from

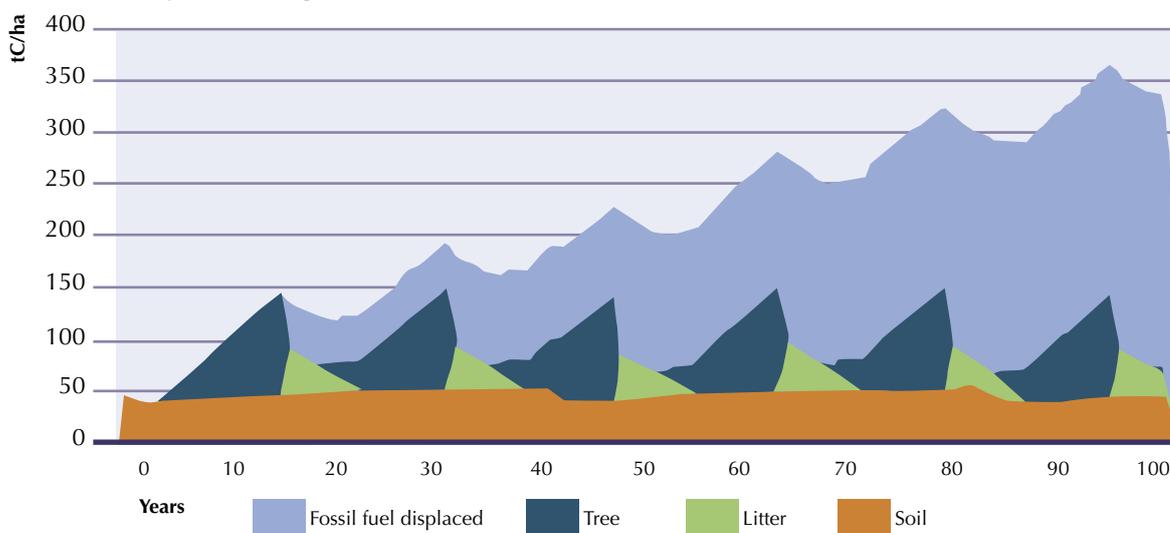
hardwood forests and from residues generated during processing of timber) and the use of residues from wood processing as a source of energy in processing plants and factories.

The Australian Government introduced in 2001 Mandatory Renewable Energy Targets (MRET) requiring the generation of 9,500 gigawatt hours of extra renewable electricity per year by 2010 (equivalent to an additional 2 percentage points of total generation coming from renewable fuels). It is estimated that 5 million cubic metres of residues are generated from commercial forest harvest operations each year. If an extra 4 million cubic metres of that residue was used for generating electricity, 30 per cent of the MRET target would be met³⁰. However, wood residues accounted for only 4 per cent of MRET certificates created by 2003 (mostly through the use of biomass in power stations to generate electricity)³¹.

The use of planted forests as 'bioenergy crops' and the increased use of existing harvest residues from managed native forests could reduce Australia's use of fossil fuels. The associated economic impacts and greenhouse benefits will depend largely on transport distances, renewable energy technology, type of fossil fuel displaced and government incentives.

Forests can also produce greenhouse benefits through the use of alternative technologies, such as use of wood for the production of liquid fuels (ethanol and methanol), gasification and fast pyrolysis.

Figure 9 Eucalyptus plantation growing at 18 cubic centimetres per hectare per annum, 100km biomass transport, co-firing, combust wet



The fossil-fuel displacement benefits that can be obtained for a Eucalyptus plantation (15 years rotation) in northern NSW. The harvested biomass is used for bioenergy, and the effect of fossil-fuel displacement increases with each rotation, becoming the dominant pool of carbon after the second rotation.

Source: Adapted from IEA Bioenergy Task³⁸

Carbon or emissions trading

The development of emissions/carbon trading schemes around the world is an opportunity for the forest industry to advance its environmental credentials and benefit from market-based mechanisms. Many schemes, including the *Kyoto Protocol*, allow greenhouse gas emissions to be offset by carbon sequestered in eligible planted forests. Although Australia has not ratified the *Kyoto Protocol*, interest in carbon trading is growing. The States and Territories have established a National Emissions Trading Taskforce to consider the development of a national emissions trading scheme with a possible starting date of 2010.

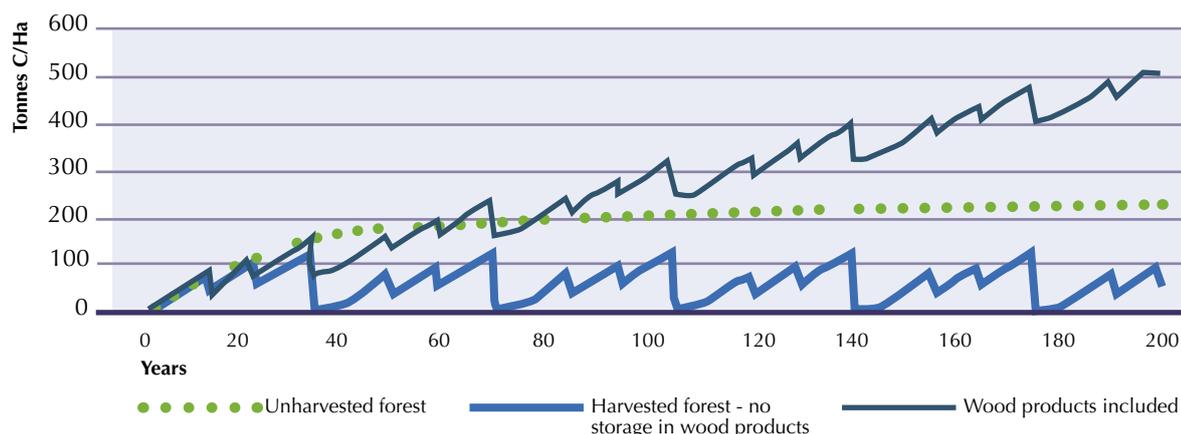
There are currently a number of both mandatory and voluntary carbon trading initiatives in Australia. The biggest and world's first mandatory scheme is the New South Wales Greenhouse Gas Abatement Scheme (NSWGGAS)³³. It imposes mandatory greenhouse gas emission benchmarks on NSW electricity retailers, aimed at reducing per capita emissions from electricity generation (the 2006 penalty is \$11 per tonne of additional carbon dioxide emitted). The price currently paid for greenhouse abatement certificates under the NSWGGAS is about \$13.50 per tonne of carbon dioxide. Under the current rules of the Scheme, carbon sequestration in forests can be traded as abatement certificates. Eligible forestry projects must have been established on cleared land since 1990, and the sequestered carbon must be stored for 100 years. Large

end-users of electricity (including wood-processing plants) can also participate in the scheme and claim non-tradable credits for reductions in on-site emissions not related to electricity consumption.

The long-term storage of carbon in wood products is not currently recognised in the NSWGGAS or other trading schemes. The continuing long-term storage of carbon in wood products is a more-secure way of locking up the carbon than retaining it in permanent forests, as forests may be periodically affected by fire, pests and tree mortality caused by drought, storm damage, competition and natural senescence. The higher the number of rotations, the more carbon is stored in wood products, and after only a few rotations the combined pool of carbon becomes larger than that in the unharvested forest (Figure 10) The recognition of long-term storage in wood products in trading schemes has the potential to:

- ▶ increase the value of carbon sequestration in forests, as the penalty currently paid due to harvest would be greatly reduced;
- ▶ encourage the establishment of more plantations for carbon sequestration, providing greater incentives for smaller growers to participate; and
- ▶ increase the use of wood products, with overall beneficial impacts on climate and to the wood-products industry as a whole.

Figure 10 Carbon storage in harvested and unharvested forests



Carbon storage in a forest that is unharvested, harvested (35 year rotation) with no storage in wood products and harvested with carbon storage in wood products recognised. After 200 years, the carbon stored in the “wood products included” option (about 500 t C / ha) was more than double the carbon stored if the forest had been left unharvested for the same period of time. If the forest is harvested and storage in wood products is not recognised, then by year 200 the carbon stored in that forest is only about 50 t / ha or 10% of the “wood products included” option.

However, commercial harvest of forests is considered an immediate emission of greenhouse gases under the current rules of most schemes, with no recognition of the role of wood products in long-term storage of carbon. Failure to account for the long-term storage of carbon in wood-based products could have overestimated worldwide carbon dioxide emissions by at least 10 per cent .

This simulation does not take into account any carbon storage in soil and emissions due to slash decay are assumed to occur at the year of harvest. Carbon storage values for the unharvested forest kindly provided by Mr Rob Waterworth (AGO).

Wood products in life-cycle assessments (LCAs) and energy rating schemes

Wood products are currently competitively disadvantaged, as the energy required to extract, transport and manufacture different building materials and their whole-of-life greenhouse impacts are generally not taken into consideration in energy rating schemes that guide the design and selection of construction materials in Australia. For example, the 5-star energy efficiency rating of the Australian Building Codes Board for housing does not take into account the whole-of-life impacts of different materials. The use of full-life-cycle-assessment tools could ensure that a true comparison between materials is made. The consequential increased use of wood products would reduce the greenhouse footprint of buildings, a positive outcome for the forests, the forestry industry and the environment.

However, improvements can also be made to the treatment of wood products in life-cycle-assessment tools and procedures, as they generally do not recognise carbon storage in wood products. Life-cycle assessments generally treat carbon dioxide emissions as a burden, but the storage of the carbon in trees and its long-term storage in wood products are not acknowledged. Life-cycle assessments and tools need to be modified to acknowledge the reality of carbon being stored in wood and wood products to ensure a fair comparison between building materials.



ABOVE: Sacred Heart Catholic Church, Croydon, Victoria

BELOW: Wood products after 20 years in landfill (photo David Gardner)



Conclusions

Forestry and wood products make a significant positive contribution to Australia's carbon balance. This contribution is expressed in part in the Australian National Greenhouse Gas Inventory, where the annual net sink in forests and wood products is shown to be equivalent to almost 10 per cent of Australia's annual net greenhouse gas emissions of 565 million tonnes of carbon dioxide equivalents.

The true contribution of the sector is much greater. Many wood products have long service-lives where little or no carbon is released to the atmosphere. Even after their service life, the rate of release of carbon is generally slow.

While various policies and schemes around the world acknowledge the role trees play in sequestering carbon, they do not recognise the role of wood products in storing the carbon for the long term. Recognition of the carbon stored in wood products, both in use and after disposal in landfill, would highlight wood's environmental credentials, increase revenues for forestry from emissions trading, and provide further incentive for sustainable forestry.

Wood products are also advantageous when the relative environmental performance of competing materials is considered. The greenhouse benefits of wood compared to other materials are yet to be recognised in life-cycle assessments and building energy-rating schemes.

To maximise opportunities from the environmental credentials of wood, the challenge for the industry is to:

- 1 Ensure that the positive contribution that forestry and wood products makes to the carbon balance in Australia is fully recognised in a range of fora; and
- 2 Manage the carbon pool in forests and wood products so that the carbon uptake and storage and the resulting positive effects on climate change are optimised.

Authors

- ▶ **Fabiano Ximenes**
- ▶ **Michael Robinson**
- ▶ **Bruce Wright**

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- ▶ Dr John Raison – Ensis
- ▶ Dr. Gary Richards and Mr Rob Waterworth – Australian Greenhouse Office
- ▶ Dr. Richard Stanton and Mr. Miles Prosser – Australian Plantation Products and Paper Industry Council

References

- 1 Food and Agriculture Organization of the United Nations 2006 (<http://www.fao.org/newsroom/en/focus/2006/1000247/index.html>)
- 2 Food and Agriculture Organization of the United Nations 2006 (<http://www.fao.org/forestry/site/17827/en>)
- 3 Nilsson and Schopfhauser, 1995 *The carbon-sequestration potential of a global afforestation program* *Climatic Change* 30: 267-293
- 4 IPCC 2000 *IPCC Special Report on Land Use, Land-Use Change and Forestry* (http://www.grida.no/climate/ipcc/land_use/151.htm)
- 5 *2004 Australian National Greenhouse Gas Inventory*, Australian Greenhouse Office 2006
- 6 *Consistent with Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2004 Land Use, Land Use Change and Forestry National Greenhouse Gas Inventory*, Australian Greenhouse Office 2006
- 7 Department of Agriculture, Fisheries and Forestry, *Australia's Forests at a Glance 2005*
- 8 *Australia's State of the Forests Report 2003*
- 9 Australian Bureau of Agricultural and Resource Economics, Australian Forest and Wood Product Statistics September and December Quarters (2005)
- 10 Australian Greenhouse Emissions Information System. (<http://www.ageis.greenhouse.gov.au>)
- 11 Ximenes, F.A. and Gardner, W.D. (2006) *The decay of coarse woody roots following harvest in a range of forest type*, National Carbon Accounting System Technical Report No. 49, Australian Greenhouse Office, Canberra.
- 12 Cooperative Research Centre for Greenhouse Accounting <http://www.greenhouse.crc.org.au/Research/a3.cfm>
- 13 Richards, G.P., Borough, C., Evans, D., Reddin, A., Ximenes, F. and Gardner, D (submitted to Australian Forestry) *Australia's National Wood Products Carbon Account*
- 14 Frühwald and Scharai-Rad 2001. <http://www.efi.fi/coste21/report/2001-04-26.html>
- 15 *A3P Sustainability Action Plan*, May 2006
- 16 *Wood and Fiber Science 2005*, Vol.37. Special Issue
- 17 Buchanan and Honey 1994 *Energy and carbon dioxide implications of building construction. Energy and Building* 20, 205-217
- 18 *InWood International Magazine* – Issue 55 – February-March 2004
- 19 Taylor et al 2005, *Recycling and End-of Life Disposal of Timber Products*, FWPRDC Project No. PN05.1017; National Inventory Report 2004, Vol. 2 – Waste, AGO; ABARE, Australian Forest and Wood Product Statistics September and December Quarters (2005); AGO Waste Sector – Greenhouse Gas Emissions Projections (2004)
- 20 ABARE, Australian Forest and Wood Product Statistics September and December Quarters (2005); AGO Waste Sector – Greenhouse Gas Emissions Projections (2004)
- 21 *A3P Sustainability Action Plan*, May 2006
- 22 A3P – Paper Industry Statistics 2004-05 – www.a3p.asn.au
- 23 *Waste Avoidance and Resource Recovery in NSW: A progress report* (2004)
- 24 Gardner et al. 2002. *The Third Australian Conference on Life Cycle Assessment*
- 25 BRS Land Use Map of Australia vers. 2.0
- 26 Fung et al. 2002. *Biomass and Bioenergy* 22; 223-236
- 27 Milne, G. and Reardon, C. 2001, *Embodied Energy*, in Reardon, C., *Your Home: Design for Lifestyle and the Future*: Technical manual, Australian Greenhouse Office, <<http://www.greenhouse.gov.au/yourhome/technical/pdf/fs31.pdf>>
- 28 Bruce Lippke, *California Forests*, Winter 2006, Vol. 10. No.1
- 29 International Energy Agency Bioenergy Task 38 – *Answers to ten frequently asked questions about bioenergy, carbon sinks and their role in global climate change*
- 30 NAFI submission to the Renewable Energy (Electricity) Amendment Bill 2002
- 31 *Renewable Opportunities – A Review of the Operation of the Renewable Energy (Electricity) Act 2000*. 2003
- 32 *Greenhouse gas balance of bioenergy systems based on integrated plantation forestry in North East New South Wales, Australia*. <http://www.joanneum.at/iea-bioenergy-task38>
- 33 NSW Greenhouse Gas Abatement Scheme, www.greenhousegas.nsw.gov.au
- 34 Kenneth Green, *California Forests*, Winter 2006, Vol. 10. No.1



FURTHER INFORMATION

Forest and Wood Products Research and
Development Corporation

Phone (03) 9614 7544

Email info@fwprdc.org.au

Web <http://www.fwprdc.org.au>



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