

FINAL REPORT

Global Climate Change and the Tasmanian Forest Products Sector

Prepared for

Forests and Forest Industry Council

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10 March 2009

42807449

The logo for URS, consisting of the letters 'URS' in a bold, blue, sans-serif font.

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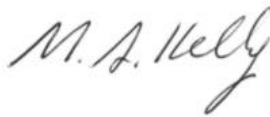


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Date: 10 March 2009
Reference: 42807449
Status: Final report

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List of Abbreviations

Term	Definition
A3P	Australian Plantation Products and Paper Industry Council
ABARE	Australian Bureau of Agricultural and Resource Economics
ACT	Australian Capital Territory
AFOLU	Agriculture, Forestry and Other Land Uses
CCBS	Climate, Community & Biodiversity Standards
CCX	Chicago Climate Exchange
CDM	Clean Development Mechanism
CER	Certified Emission Reduction, 1 t CO ₂ e under the CDM
CFS	CarbonFix Standard
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
COAG	Council of Australian Governments
COP	Conference of Parties to the UNFCCC
CPRS	Carbon Pollution Reduction Scheme
CRC	Cooperative Research Centre
DCC	Department of Climate Change
EITE	Energy intensive trade exposed
ETS	Emissions Trading Scheme
FFIC	Forests and Forest Industry Council of Tasmania
FT	Forestry Tasmania
GGAS	NSW Greenhouse Gas Reduction Scheme
GHG	Greenhouse Gas
Gt	Gigatonnes, 1,000,000,000 tonnes
ha	hectares
IET	International Emissions Trade
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation
LCA	Life Cycle Analysis
LULUCF	Land Use, Land Use Change and Forestry
m ³	Cubic metres
MIS	Managed Investment Scheme
MRET	Mandatory Renewable Energy Target
Mt	Megatonne, 1,000,000 tonnes
MW	Mega Watts
NAFI	National Association of Forest Industries
NCAS	National Carbon Accounting Scheme
NGAC	NSW Greenhouse Abatement Certificate
NGER Act	<i>National Greenhouse and Energy Reporting Act 2007</i>
NGGI	National Greenhouse Gas Inventory
NPP	Net primary productivity
NSW	New South Wales

List of Abbreviations

Term	Definition
OSCAR	Online System for Comprehensive Activity Reporting
pa	Per annum
QLD	Queensland
REC	Renewable Energy Certificate
SA	South Australia
TAS	Tasmania
TFACC	Tasmanian Framework for Action on Climate Change
UNFCCC	United Nations Framework Convention on Climate Change
VIC	Victoria
VCS	Voluntary Carbon Standard
WA	Western Australia

Executive Summary

It is clear that global climate change and associated government and community responses, particularly through the introduction of the Carbon Pollution Reduction Scheme (CPRS), will have range of impacts on the Tasmanian forest products sector. This review, undertaken by URS Forestry for the Forests and Forest Industry Council, considers the bio-physical impacts of global change on forests as well as the impacts of developing international and domestic policy frameworks for carbon. In particular, it considers the implications of the Federal government's recently released White Paper on the CPRS and the potential opportunities and needs arising for the forest products sector.

The bio-physical impacts of climate change indicate shifts in average rainfall and average temperatures which vary across Tasmania. For instance, rainfall is predicted to increase in the central and west of the state but to decrease in the north east. Temperatures are forecast to increase across the state but more so in the east. These climatic changes will impact on forests through higher risks of wildfire and higher incidence of pests and diseases. Increased atmospheric CO₂ concentration is also expected to affect forest growth, sequestration and water use efficiency. It is generally expected that native forests will be more resilient to changes in natural conditions than plantations.

The forest sector is the only sector in Australia that can currently be considered a carbon sink. The potential for new forest plantations to store more carbon is clear. However, recently there has been some disagreement amongst scientists over the sequestration potential of harvested versus non-harvested native forests. While Tasmania's native forests provide an important store of carbon, it is not clear that stopping logging would deliver significant carbon storage benefits. Further, there is a need for additional research to address uncertainty surrounding the impacts of natural disturbance and the potential for climate change to lead to increased threats from bushfire on the potential for native forests to store carbon. In the circumstances, the approach of the White Paper to exclude native forests from the CPRS appears reasonable.

Tasmania has relatively low emissions compared to other Australian states but has relatively large areas of forests. Carbon is stored in forests that are grown and managed for production and in the wood products produced. MBAC (2007) estimated total carbon sequestration in forests managed by Forestry Tasmania was 539 Mt CO_{2-e} (comprising 207.9 Mt CO_{2-e} in commercial forests and 331.1 Mt CO_{2-e} in non-commercial forests) and around 16.2 Mt CO_{2-e} in plantations (comprising 11.4 Mt CO_{2-e} in softwood and 4.8 Mt CO_{2-e} in hardwood). In comparison, Australia's net greenhouse gas emissions in 2006 were 576 Mt CO₂ and Tasmania's net emissions were only 8.5 Mt CO₂.

To join global efforts to address climate change, Australia ratified the Kyoto Protocol in December 2007 and in doing so committed to limiting its national greenhouse gas emissions to 8% above 1990 levels over the period 2008-2012. Subsequently, the Australian Government has set out its plans for the CPRS which will incorporate an emissions trading scheme that captures most sectors of the economy. Through the CPRS and related initiatives, the government now proposes to reduce emissions by 5-15% below 2000 levels by 2020 (short-medium term target) and 60% below 2000 levels by 2050 (long term target).

Forests are expected to play a major role in efforts to achieve these targets. While a significant proportion of existing plantations in Tasmania will not qualify for inclusion in the CPRS as they were not established on land cleared prior to 1990, Treasury modelling of the effect of the CPRS (Treasury 2008) suggests that Tasmania has the greatest potential of all Australian states to expand its commercial plantation base as a result of the CPRS. In particular, the 'CPRS-5' model which is broadly consistent with the White Paper, indicates that the introduction of a carbon price at over \$20/t CO_{2-e} would increase the area of commercial timber plantations in Tasmania by 651,000 ha between 2007 and 2050. However, it appears that a number of socio-economic

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constraints on plantation development were not considered in the modelling and it is therefore possible that it overestimates the increase in plantation areas, including for Tasmania.

The introduction of the CPRS will impose a 'carbon cost' on most sectors of the economy and establish a national regulated market with linkages to international markets, notably the scope for importing emissions permits (carbon credits). The Treasury modelling of the impacts of the CPRS suggested that a substantial volume of carbon emissions permits used in Australia will be purchased internationally. While there are some risks associated with the cost impacts of the CPRS, in general it provides opportunities for the forest products sector both in terms of potential to generate additional investment in forest resources and to enhance the competitive position of wood products compared to other more emissions intensive competitor products.

A summary of key impacts and opportunities for the Tasmanian forest products sector is set out in Table ES-1. URS' analysis indicates that key issues for the Tasmanian forest products sector will include:

- All companies will face increasing cost pressures, including input costs and production (operating) costs, in line with energy use and emissions intensity. Firms with domestic customers may be able to pass costs on through the demand chain, as the CPRS has broad coverage across the economy, but this may be constrained by import competition. Similarly, firms with heavy reliance on export markets may face constraints in passing on higher costs. However, industry participants classified as emissions intensive and trade exposed ('EITE'), principally the pulp and paper companies, will be eligible for short term assistance under the proposed CPRS arrangements.
- There will be an increase in pressure on segments within the wood fibre demand chain to absorb higher harvest and haulage (transport) costs. The extent to which the increase in costs is borne by the forest grower/manager, the harvest and haulage contractors or the processor/customer will depend on their respective responses and the negotiated outcomes.
- Firms that can become more efficient by reducing their energy inputs and emissions intensity will become increasingly competitive. While increasing costs create a burden or challenge for commercial enterprises, it also represents an opportunity for the most efficient and progressive firms to create a sustainable competitive advantage, within markets that can be expected to seek greater differentiation on the basis of emission footprints.
- The pulp and paper industry is likely to be the only component of existing forest product manufacturers in Tasmania that will be required to participate in the CPRS. While not definite at this stage, it is likely that the pulp and paper companies in Tasmania will be eligible for assistance provided to Emission Intensive Trade Exposed (EITE) industries. If eligible for assistance it is likely that pulp and paper producers will receive free carbon permits for 60% of their requirements.
- CPRS recognition and credits for reforestation and afforestation could stimulate further plantation development in Tasmania. However, the extent to which the plantation base increases will be constrained by key factors including:
 - Emissions liability on harvest of commercial plantations - while forest growers/managers may be able to claim credits for eligible forest growth (afforestation/reforestation activities), they will also be liable for emissions recognised on harvest of the same forests. The economic profit in carbon sequestration will depend in part on the movement in carbon price relative to the enterprise's discount rate for investment.
 - Sequestration potential of existing forests relative to the baseline year - the White Paper and associated guidance on coverage of reforestation presents a baseline year (2008), and credits will only be

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recognised for carbon sequestration above the baseline year. The scope to claim credits for reforestation will depend on the age class distribution of eligible forests relative to the baseline year, and also the productivity and management regime for plantations managed for sequestration beyond the baseline. The establishment of a significant proportion of plantations in Tasmania over the last decade on land that was not cleared in 1990 will restrict the scope for existing plantations to contribute to carbon emission reduction targets.

- Availability of suitable land in Tasmania for further expansion of commercial plantations and environmental plantings. Tasmania's plantation base expanded rapidly in recent years, with an average increase of 12,700 ha pa over the last five years. This expansion generally occurred on land considered most suitable for plantation growth and proximity to markets for wood products. There will be bio-physical constraints and market constraints on the suitability of additional cleared agricultural land for conversion to plantations. There are also important social dimensions to land availability and community support for further plantation expansion in Tasmania which were generally not considered as part of the Treasury's modelling.

The combination of increased energy costs under the CPRS and the Mandatory Renewable Energy Target (MRET) of 20% by 2020 is expected to lead to increased development of bioenergy by existing wood product processors. It may also create opportunities for dedicated bioenergy production to supply the national electricity grid or smaller, remote towns. In the longer term increases in carbon prices are also expected to create opportunities for emerging products including biofuels and industrial carbon.

Through proactive response measures, Tasmania's forest products sector has the opportunity to meet the challenges of climate change and CPRS obligations. In broad terms, the means to realising these opportunities are entirely consistent with sustainable forest management practices and key enterprise imperatives of increasing efficiency and innovation. Some specific areas of research and development that would assist the forest products sector to understand and develop responses to climate change and introduction of the CPRS are:

- **Socio-economic influences on plantation investment** – while Treasury modelling suggests that there could be between 0.65 and 1.1 million ha of additional plantations respectively under a 5% and 15% target for reduction of greenhouse gas emissions by 2020, it appears the modelling has not considered a range of socio-economic factors influencing plantation investment. There would be benefit in clarifying the scope for further expansion of commercial and environmental planting in Tasmania by investigating social and economic factors important to plantation investment.
- **Carbon stored in native forests** – while there has been considerable knowledge developed on the carbon carrying capacity of native forests, there would be benefit in undertaking independent research to clarify recent disagreements amongst scientists. There is also a need to obtain more accurate estimates of the potential for private native forests to increase stores of carbon.
- **Carbon stored in wood products** – while the CPRS will exclude forest products, it is likely that there will be considerable debate about the impacts and feasibility of including changes in carbon stored in wood products for a global post-Kyoto carbon emission reduction arrangement. There is scope to further the develop knowledge on carbon stored in wood products in the context of the Tasmanian forest products sector and this could complement research being undertaken at the national level.
- **Bioenergy and other emerging markets** – there are significant opportunities in the potential for increasing bioenergy production utilising wood. This could include wood pellet production for export as well

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as direct energy generation to meet Tasmania's current shortfall in electricity generation which it buys from the national grid, as well as the potential for sale of renewable energy to the national grid. Similarly, in the longer term there are opportunities for biofuel production and products such a biochar. Research and development to further explore the viability of resources in Tasmania for these potential uses including potential support for pilot plants (in association with commercial investors) would help position Tasmania to take advantage of these potentially large opportunities.

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Table ES-I: Summary of climate change impacts and opportunities for the Tasmanian forest products sector

Sector	Scale in Tasmania	Potential impacts	Opportunities
Forestry			
<ul style="list-style-type: none"> Native forests, managed for commercial timber production 	<ul style="list-style-type: none"> Public - 1,026,000 ha Private - 885,000 ha Annual harvest volume – 5 million m³ 	<ul style="list-style-type: none"> Growth response will depend on complex interaction of climate change impacts over time. In addition to changes to rainfall and evaporation, this includes: <ul style="list-style-type: none"> Higher risk from wildfire Higher risk of pest and disease incidence and severity However, natural forests expected to show resilience based on genetic, taxonomic and functional biodiversity Increase in public scrutiny of forest management practices, incorporating carbon pollution reduction initiatives NGER compliance and reporting costs Increased pressure to absorb higher harvest/haul costs Potentially higher log prices arising from carbon value of forests 	<ul style="list-style-type: none"> Nil recognition under CPRS, but potential to participate in voluntary carbon markets and recognition of the role that native forests play in global carbon balance Greater market recognition of relatively low emissions intensity of wood products forecast to generate increased demand for forest products Greater scope for bio-energy markets for forest residues Potential to investigate emerging markets for biofuels and other carbon related products such as activated carbon, industrial carbon and biochar.
<ul style="list-style-type: none"> Commercial plantations 	<ul style="list-style-type: none"> Hardwood – 200,000 ha <ul style="list-style-type: none"> Annual harvest volume – 1.1 million m³ Softwood - 75,000 ha <ul style="list-style-type: none"> Annual harvest volume – 1.1 million m³ 	<ul style="list-style-type: none"> Net impacts on growth will depend on complex interactions at regional level over time <ul style="list-style-type: none"> In general, plantations are likely to be less resilient than natural forests to the potential for increased incidence and severity of pests and disease, and changing climate conditions. However, it is possible that in some cases plantation species may be better adapted to 	<ul style="list-style-type: none"> Established plantation managers can 'opt in' for CPRS reforestation credits, however, commercial benefit may be constrained by emissions liability on harvest Afforestation on cleared agricultural land can opt-in for CPRS carbon credits over first rotation Conversion of pulpwood to longer

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Sector	Scale in Tasmania	Potential impacts	Opportunities
		<ul style="list-style-type: none"> specific conditions <ul style="list-style-type: none"> ○ resilience will depend on range of factors including genetics, age class distribution and management practices • NGER compliance and reporting costs • Increased pressure to absorb higher harvest/haul costs • Potentially higher log prices arising from carbon value of forest products 	<ul style="list-style-type: none"> sawlog rotations after harvest could increase sequestration above 2008 baseline • Greater scope for bioenergy markets for forest residues
Harvesting & Haulage	<ul style="list-style-type: none"> • Around 130 harvesting and haulage contractors 	<ul style="list-style-type: none"> • Higher fuel costs, however transition assistance available to fuel refiners until 2013 • NGER compliance and reporting costs – regulatory reporting may be through contracting entities rather than direct reporting • Potential increase in commercial plantation base due to CPRS 	<ul style="list-style-type: none"> • Increased demand for plantations and forest products in a carbon constrained economy may underpin growth in production levels • Companies that can reduce fuel/energy requirements and emissions intensity will become more competitive over time
Processing			
<ul style="list-style-type: none"> • Sawmills 	<ul style="list-style-type: none"> • Hardwood: <ul style="list-style-type: none"> ○ 15 sawmills, annual output – 180,000 m³ • Softwood: <ul style="list-style-type: none"> ○ 3 sawmills, annual output - 180,000 m³ 	<ul style="list-style-type: none"> • Increase in energy costs • NGER compliance and reporting costs • Increased pressure to absorb higher delivered log costs • Forecast increase in demand for timber due to relatively low emissions intensity compared to steel and aluminium 	<ul style="list-style-type: none"> • Potential to expand production to meet increased demand from greater market recognition of the low emissions status of wood products • Rationalisation or relocation of facilities to reduce haulage distances and transport costs • Greater scope for cost efficient use of residues for bio-energy

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Sector	Scale in Tasmania	Potential impacts	Opportunities
<ul style="list-style-type: none"> Veneer mills 	<ul style="list-style-type: none"> 4 mills (2 rotary and 2 sliced) Annual output of 125,000+ m³ 	<ul style="list-style-type: none"> NGER compliance and reporting costs Increased pressure to absorb higher delivered log costs Trade exposed, export markets may be vulnerable to competition from other producers without increased costs associated with carbon pricing 	<ul style="list-style-type: none"> Greater scope for cost efficient use of residues for bioenergy
<ul style="list-style-type: none"> Panel board mills 	<ul style="list-style-type: none"> 1 particleboard mill Annual output ~20,000 t 	<ul style="list-style-type: none"> NGER compliance and reporting costs Higher input costs, notably chemicals / glues that have high emissions intensity Increased pressure to absorb higher delivered log costs 	<ul style="list-style-type: none"> Increased costs of production may provide incentive for expanding scale of production
<ul style="list-style-type: none"> Pulp & paper mills 	<ul style="list-style-type: none"> 2 printing and communication paper mills and 1 newsprint mill Annual output 295,000 t 	<ul style="list-style-type: none"> Increased costs of production due to increased costs of energy and chemical inputs, and costs of carbon emission permits. However, EITE assistance will provide transitional support in short-medium term NGER compliance and reporting costs Increased pressure to absorb higher delivered log costs 	<ul style="list-style-type: none"> Energy self sufficiency provides added incentive for development of a kraft pulp mill
<ul style="list-style-type: none"> Woodchip exports 	<ul style="list-style-type: none"> Hardwood: <ul style="list-style-type: none"> Annual export volume – 2.3 million bdmt Softwood: <ul style="list-style-type: none"> Annual export volume – 140,000 bdmt 	<ul style="list-style-type: none"> Increased pressure to absorb higher delivered log costs Higher supply chain costs may not be absorbed by export customers, which sit outside Australia's 'CPRS-economy' 	<ul style="list-style-type: none"> Domestic processing for pulp and paper may become relatively more attractive due to increased shipping costs
Bioenergy	<ul style="list-style-type: none"> Some on-site boiler fuel projects Some dedicated facility projects proposed across the state 	<ul style="list-style-type: none"> Positive stimulus for biomass energy production, both on-site and at dedicated facilities, through MRET and CPRS policy 	<ul style="list-style-type: none"> Greater scope in development and production of bioenergy production, both on-site and at dedicated facilities

The Forests and Forest Industry Council (FFIC) has engaged URS Forestry to undertake an analysis of the implications of global climate change on the Tasmanian forest products sector. The analysis considers the biophysical impacts of global change on forests as well as the impacts of developing international and domestic policy frameworks for carbon. In particular, it considers the implications of the recently released Federal government white paper on Australia's Carbon Pollution Reduction Scheme (CPRS).

Some background on the nature of climate change, greenhouse gas emissions and implications for forest products are provided in Section 2 and Section 3. The International policy framework is then examined in more detail in Section 4. Section 5 outlines the development of Australia's approaches to climate change.

Section 6 examines the impacts of climate change on the Australian economy and on the forest products sector in particular. Section 7 analyses the potential opportunities and needs arising for forest products from climate change and associated policies.

Section 2

Background

This section sets out the physical and biological impacts of climate change both at an international level and at the state level in Tasmania.

2.1 Emergence of climate change

In 2007, the International Panel on Climate Change (IPCC) released its fourth working assessment report, synthesising the latest data on patterns in the global climate. The IPCC (2007) stated that the warming of the climate system is now unequivocal and that *“most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations”*.

Most of the observed increase in greenhouse gas (GHG) concentrations has been attributed to the combustion of fossil fuels and land use change brought about by human activities since 1750. Particularly over the last three decades, GHG emissions have had a discernible influence at the global scale on physical and biological systems (IPCC 2007). The IPCC predicts that cumulative GHG emissions will increase over the next 100 years but the rate at which emissions increase will depend strongly on international efforts to reduce these emissions¹.

GHGs are so-called because they can absorb heat from solar radiation. The accumulation of GHGs in the earth's atmosphere has resulted in an increasing amount of heat retained in the atmosphere. The most direct result of this is an increase in the mean temperature of the atmosphere. However, the IPCC (2007) has observed increases in other climatic indicators including the frequency of temperature extremes and changes in wind and rainfall patterns.

2.2 Climate change in Australia

While the global impacts of climate change are increasingly well understood, regional and local scale impacts on industries and local economies are less well researched and substantial uncertainties remain.

According to the IPCC (2007), all of Australia is likely to warm over this century at around the global average. Less warming is expected in the south of the country, with a relatively lower increase in temperatures during the winter period. An increased frequency of extreme high daily temperatures is expected, with a corresponding but slightly less likely decrease in the frequency of cold temperature extremes. Precipitation is expected to decrease in southern Australia particularly during the winter and spring periods.

CSIRO has published projections of the Australian climate under three future GHG emission profiles. A summary of key climate variables is presented in Table 2-1. The lower end of the range represents projected conditions under a low emissions scenario and the upper end represents a high emissions scenario. While the projections are best estimates under a range of scenarios, they incorporate significant uncertainty.

¹ Detailed GHG emissions projections using a number of international emissions scenarios can be found in IPCC (2000)

Table 2-1 Summary of climate change projections for Australia

Climatic variable		Impact
Temperature	Average annual ^a	0.6 to 1.5 °C warmer by 2030 0.8 to 2.8 °C warmer by 2050 1.0 to 5.0 °C warmer by 2070
Rainfall	Average annual ^b	0 to -10% by 2030 0 to -20% by 2050 (best estimate -5% to -7.5%) -30% to +5% by 2070 (best estimate -10%)
	Intensity (rain per rain day)	Increase in the north and decrease in the south.
Relative humidity	Average annual	-2 to +0.5% (best estimate -1%) by 2030
Potential evapotranspiration	Annual potential	+2 to +8% (best estimate +6%) ^b
Wind	Average wind speed	+2-5% in most coastal areas by 2030

Source: CSIRO (2007) ^aBest estimate for Australia. ^bEstimates for Southern Australia.

2.2.1 Climate change in Tasmania

Like other parts of Australia, Tasmania is expected to experience warmer conditions under various climate change scenarios (CSIRO 2007). There is expected to be an increase in extreme temperatures with a slight increase in the number of days over 35 degrees predicted for Hobart (DCC 2007). There will be a decrease in the number of days with temperatures below zero in Launceston. While Tasmania will likely experience an overall increase in rainfall, the corresponding increase in evaporation may offset this increase and the net effect on run-off into rivers is uncertain.

Climate modelling conducted by CSIRO, Hydro Tasmania and the Tasmanian Partnership for Advanced Computing produced detailed climate estimates under a high emissions scenario out to 2040. Table 2-2 summarises these estimates.

Table 2-2 Summary of climate change projections in Tasmania to 2040

Climatic variable		Impact to 2040
Temperature	Average annual	+0.7% in maximum temperatures in east +0.5% in minimum temperatures across the State
Rainfall	Average annual	+7-11% in the West and Central areas -8% in the north east
Evaporation	Annual potential	Increases expected across all areas except the west coast and adjacent highlands where there will be a small decrease.
Wind	Average wind speed	Increasing marginally

Source: DCC (2007) McIntosh *et al.* (2005)

2.3 Australia's greenhouse gas emissions

The latest National Greenhouse Gas Inventory (NGGI) published in 2006, showed Australia's net greenhouse gas emissions using the Kyoto Protocol accounting provisions were 576 million tonnes of CO₂-equivalent (Mt CO_{2-e}). This represented an increase of 4.2% from 1990 emissions of 552 million tonnes of CO_{2-e}.

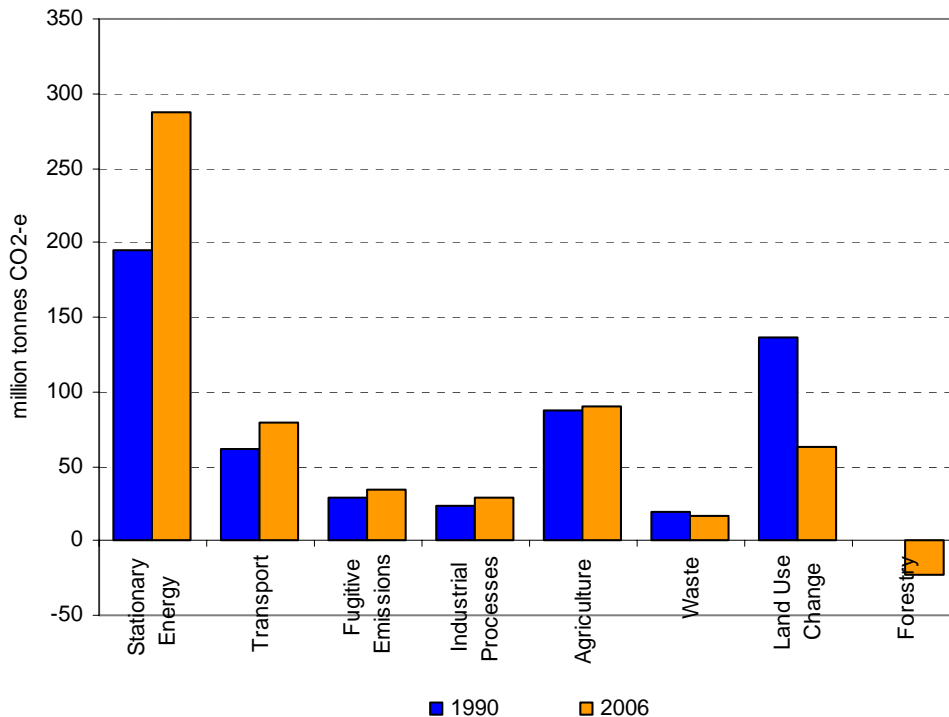
Australia's emission profile is heavily influenced by emissions from electricity generation (stationary energy), transport, agriculture and land use change. The sectoral breakdown of 1990 and 2006 GHG emissions is

Section 2

Background

shown in Figure 2-1 below. The stationary energy sector was the largest source of greenhouse gas emissions, contributing 50% (287 Mt CO_{2-e}) of emissions. This proportion is less than in many countries, due to the relatively large contribution from agriculture (15.6%) and net contribution from land use, land use change and forestry (LULUCF) (6.9%) to the NGGI. The industrial processes (4.9%) and waste (2.9%) sectors make smaller contributions to this overall national inventory. In 2006, carbon sequestration associated with eligible reforestation (plantations established since 1990) was estimated to be approximately 23 Mt of CO_{2-e} (DCC 2008a).

Figure 2-1 Australia's GHG emissions by sector, 2006

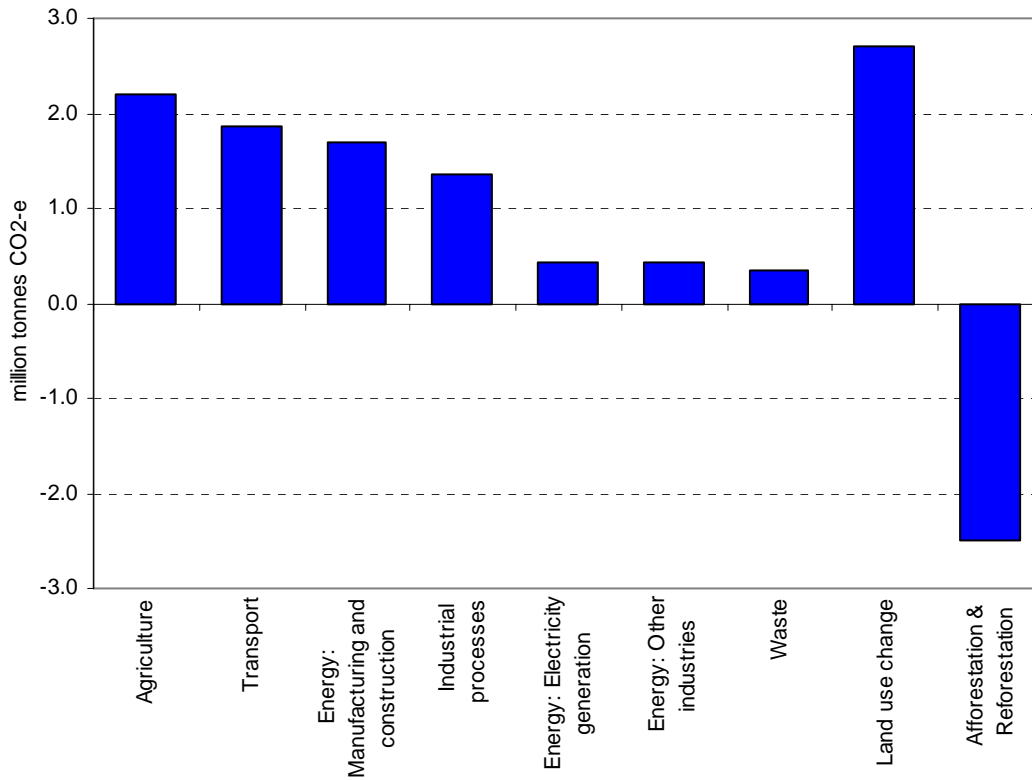


Source: DCC (2008a)

2.3.1 Tasmania's greenhouse gas emissions

In 2006, Tasmania emitted 8.5 million tonnes of CO_{2-e} into the atmosphere, accounting for only 1.4% of Australia's total GHG emissions (DCC 2008b). Figure 2-2 shows Tasmania's emissions by sector in 2006. Part of the reason for Tasmania's low GHG emissions relative to other states is extensive development of and reliance on hydro electricity generation, which has the capacity to supply up to 90% of the state's electricity supply (Tasmanian Climate Change Office 2008). The result means that emissions from electricity production account for only 5% of emissions in Tasmania, whereas nationally this sector accounts for 50% of total GHG emissions. Land use change is the largest source of emissions in Tasmania accounting for 32% of total emissions. Agriculture is the second largest accounting for 26%.

Figure 2-2 Tasmania's GHG emissions by sector, 2006



Source: DCC (2008b)

Section 3

Climate Change and Forest Products

This section provides background on role that forests and forest products play on carbon storage. The forests and forest products sector is the only sector in Australia that can currently be considered a carbon sink. Carbon is stored in both the forests that are grown and managed for production, and in the wood and paper products produced by this sector.

3.1 Carbon sequestration in forests

At the global level forests play a crucial role in the sequestration and storage of carbon dioxide. The world's forests are estimated to store 638 gigatonnes (Gt) of carbon, of which 283 Gt are in the forest biomass alone. To put this in perspective, the atmosphere contains around 720 Gt of carbon.

The IPCC (2007) reports that carbon dioxide emissions from forestry (predominantly emissions from tropical deforestation) make up 17% of global emissions. Stern (2007) reached similar conclusions and also proposed that curbing deforestation presented a highly cost effective way of reducing GHG emissions. Similarly, in Australia, the Garnaut Review (2008) concluded: *“There is significant global potential for emissions removal (or carbon sequestration) through revegetation of previously cleared land and increasing the stock of carbon in forests, wooded land and soils. Management of existing forests for ecosystem services rather than simply for fibre production would significantly reduce emissions from degradation and deforestation.”*

While the UNFCCC acknowledges the role that forests play in the global climate, the Kyoto Protocol provided less recognition of the role of forestry in meeting targets to reduce GHG emissions. This reflects the outcomes of international negotiations in establishing the Protocol, and concerns that focusing on offsets may have led to less focus on efforts to reduce emissions from the use of fossil fuels (Streck *et al* 2008). This led to the limited approach to carbon offsets allowed under the Protocol, although some flexibility mechanisms were supported, such as the Clean Development Mechanism (see Section 4.2).

However, recognition of the importance of forests and their potential to provide low cost emissions reductions, has led to increasing interest in the potential for forestry to be included in post-Kyoto international climate change arrangements. The experience with crediting carbon from afforestation and reforestation projects has also helped to create a better understanding of dealing with the role of forests in reducing GHG emissions. In particular, the development of approaches to reduced emissions from deforestation and degradation (REDD), which arose from UNFCCC annual meetings from 2005 onwards and formalised at the Bali meeting in 2007 are now providing a framework for demonstration projects in REDD.

3.1.1 Forests and carbon sequestration in Australia

The Garnaut Review pointed out that Australia has relatively large areas of forested land suitable for carbon removal (carbon sequestration) and deforested land suitable for revegetation (Garnaut Review 2008).

Australia's National Greenhouse Accounts show that in 2006, removals associated with reforestation activities (sequestration of carbon dioxide in plantations established since 1990) were estimated to be approximately 23.0 Mt of CO_{2-e} (DCC 2008b). Strictly speaking, credits for reforestation sinks enter the account only over the period 2008–2012, however, they were included in the 2006 Inventory to assist the understanding of Australia's emissions trends in relation to its Kyoto Protocol target.

Australia's State of the Forests Report 2008 notes that total tree biomass in native forests (i.e. above ground woody biomass plus roots and including forests in conservation reserves but excluding soil carbon) held an estimated 6.56 billion tonnes of carbon in 2004. This is equivalent to keeping 24 billion tonnes of carbon dioxide out of the atmosphere, or 46 years of Australia's current total emissions from all sources (BRS, 2008).

Climate Change and Forest Products

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Harvesting from managed² native forests averaged around 11.8 million m³ of roundwood per annum in the period from 2001 to 2005. About 3.8 million tonnes of carbon – equivalent to about 0.06% of the total carbon stored in native forests and 14.1 million tonnes of CO₂ – was removed (BRS, 2008). This relatively small removal was exceeded by new growth: about 43.5 million tonnes of CO₂, equivalent to about 11.9 million tonnes of carbon, was estimated to have been sequestered in native forests in 2005 after taking into account the decay of slash produced during harvesting. Therefore, yearly sequestration of carbon in 2005 was about three times yearly emissions and removals arising from managed native forests subject to harvest and regrowth from prior harvest.

Table 3-1 Estimates of carbon stocks and sequestration in Australia's forests

	Carbon stock (Mt carbon)	Net sequestration (Mt CO ₂ -e per annum)
Plantations	84 ⁽¹⁾	23 ⁽³⁾
Native forests	6,560 ⁽²⁾	43.5 ⁽⁴⁾

Notes:

- (1) Total tree biomass estimate for plantations in 2004 (BRS 2008)
- (2) Total tree biomass in native forests, including conservation reserves, in 2004 (BRS 2008)
- (3) Removals associated with reforestation activities in 2006 (DCC 2008b)
- (4) Sequestration in managed native forests (that is, forests subject to harvest and regrowth from prior harvest) in 2005 (BRS 2008)

The DCC predicts that the net sink capacity of Australia's plantations will decrease in the future, with the commencement of harvesting of the large area of short rotation plantations established in recent years (DCC 2008c). The DCC also predicts removals of CO₂ from managed native forests will be maintained for some time into the future; however this excludes emissions and regrowth from fire (DCC 2008d).

The rate of carbon sequestration in forests is related to the growth rate of forests – the rate at which atmospheric carbon dioxide is converted to biomass. Young, actively growing forests sequester carbon at a faster rate than older forests but have a considerably lower total carbon store. When forests reach maturity their growth rate slows and eventually they sequester no more carbon, although they continue to store previously sequestered carbon³.

While the potential for new forest plantations to store more carbon is clear, there is some disagreement in Australia over the potential for Australia's native forests to store increased volumes of carbon, particularly in relation to the temperate forests of south east Australia.

The IPCC default values for temperate forests suggests that they typically contain a carbon stock of 217 tonnes per ha (biomass plus soil carbon), 96 tonnes of biomass carbon per ha (living and dead biomass) and a net primary productivity of 7 tonnes carbon per ha per annum. Mackey *et al* (2008) have examined the carbon carrying potential of eucalypt forests of south east Australia and concluded that they have potential to store significantly higher amounts of carbon. They estimate the carbon stock for unlogged forests to be around 640 tonnes of carbon per ha with 360 tonnes of biomass carbon per ha and a net primary productivity of 12 tonnes of carbon per ha per annum. Mackey *et al* reported that these estimates have wide variances with many sites having a lower biomass for a given net primary productivity (NPP). They also identified the highest biomass carbon stocks as being more than 1,500 tonnes of carbon per ha but only in very small areas.

² 'Managed' native forests are forests outside conservation reserves that are periodically harvested under a sustainable forest management plan.

³ As a rule of thumb, approximately half the dry weight of forest biomass is carbon.

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Mackey *et al* use their estimates to conclude there is significant potential to increase carbon stored in forests by protecting native forests from logging. The authors state that: “*If logging was halted, the carbon stored in the intact forests would be protected and the degraded forests would be able to grow to their natural carbon carrying capacity. ... the carbon sequestration potential of the logged forests area is 2 Gt C*”. They also conclude that the current focus of international negotiations concerning REDD on developing countries needs to be expanded to developed countries including Australia.

These figures are disputed by some other forest scientists e.g. Adams (2008) questioned the difference between these estimates and estimates for other forests provided by a range of researchers. Polglase (2008; see Appendix B), which reviews the Mackey *et al* (2008) paper, points out a number of incorrect assumptions. In particular, an incorrect interpretation of data from Roxburgh *et al* (2006) leads to a significant over-estimate of the difference in carbon stored in logged and unlogged forests. Polglase considers a more realistic estimate of the difference between carbon storages in harvested versus non-harvested forests is likely to be much smaller. He also pointed out that Mackey *et al* (2008) oversimplifies the natural role that fire plays in lowering native forest carbon storage and changing forest age structure. The likely increase in the incidence of forest fires in Australia as a result of climate change is likely to broadly lower the sequestration of all forests.

Based on the available literature it is concluded that while native forests provide an important store of carbon, there is disagreement amongst scientists over the sequestration potential of harvested versus non-harvested native forests. In particular, it is not clear that stopping logging would deliver significant carbon storage benefits. Given the relatively small areas of forests subject to logging there is a need for additional research to better estimate the size of the gain that might be available from changed management practices in native forests. There is also a need for additional research to better understand the uncertainty surrounding the impacts of natural disturbance and the potential for climate change to lead to increased threats from bushfire on the potential for native forests to store carbon. In the circumstances, the approach of the White Paper to exclude native forests from the CPRS appears reasonable.

3.1.2 Tasmania's forests

Public native forests in Tasmania total almost 2.5 million ha with around 1.6 million ha of public forests classified as conservation reserves. Of the Forest Tasmania estate around 0.6 million ha of native forest is available for commercial production and around 0.8 million ha is native forest outside production areas, formal reserves and informal reserves. There are around 885,000 ha of private native forests in Tasmania which may be harvested by land owners subject to State and local government forest regulations.

Tasmania also has a significant plantation resource of around 275,000 ha with of which around 73% are hardwood species and 27% softwood. Around 45,000 ha of Tasmania's softwood plantations are managed on behalf of Taswood Growers, which is a 50:50 joint venture between Forestry Tasmania and GMO Renewable Resource Ltd. These plantations are managed by an independent third party, Timberlands Pacific Pty Ltd. Norske Skog also manages around 20,000 ha of softwood plantations (if which it owns around half). The majority of the softwood plantations are radiata pine and around three quarters of softwood plantations are on public land. Forestry Tasmania also has around 50,000 ha of hardwood plantations. Private hardwood and softwood plantation owners in Tasmania include Gunns, Norske Skog, and FEA.

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Table 3-2 Tasmanian forest area by tenure and type

Forest type			Area (ha)
Public native forest	Forestry Tasmania	Commercial	592,700
		Native forest outside of wood production areas	293,400
	Forestry Tasmania	Conservation reserves and non-commercial ^a	517,800
	Other conservation reserves ^b		1,045,000
Private native forest			885,000
Public plantations	Forestry Tasmania	Hardwood	53,000
	Forestry Tasmania	Softwood	53,000
Private plantations		Hardwood	151,000
		Softwood	21,000

a - Includes formal and informal reserves

b – Includes reserves under Nature Conservation Act, Crown Lands Act and reserves on other public land

Source: BRS (2008); Forestry Tasmania (2008); Private Forests Tasmania (2008)

Information on carbon storage in Tasmania's commercial and non-commercial forest resources is only available for Forestry Tasmania. The carbon position of Forestry Tasmania has recently been assessed by MBAC (2007) covering all forest resources owned and managed by the organisation. This assessment estimated carbon stored in native forests managed by Forestry Tasmania of 539 Mt CO_{2-e} (207.9 Mt CO_{2-e} in commercial forests and 331.1 Mt CO_{2-e} in non-commercial forests) and around 16.2 Mt CO_{2-e} in plantations (11.4 Mt CO_{2-e} in softwood and 4.8 Mt CO_{2-e} in hardwood).

3.2 Carbon storage in wood products

Carbon sequestered by forests is stored in 'carbon pools', including the stem wood which can be harvested and processed into wood products. Depending on the type of product manufactured and how it is disposed at the end of its service life, the carbon is "locked up" in the product often for many decades. The proportion of carbon stored in logs that remains in finished products depends on a number of factors including species, site condition, harvesting techniques, log grading and efficiency of conversion (Ximenes 2006). Ongoing storage is dependent on how the product is used.

The CRC for Greenhouse Accounting developed the TimberCAM model which tracks the fate of carbon stored in wood products through their life cycle from harvest through to manufacture, service and disposal. The model allocates harvested logs to various wood product categories, which have an estimated time in use. The products are then allocated to an end use category such as landfill, recycle, reuse, burning or energy production. The estimated service life and decay rate of various product categories adopted in TimberCAM are summarised in Table 3-3.

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Table 3-3 TimberCAM wood product service life and decay rates

Product	Service life (years)	Loss of carbon during service life (%)
Mulch/sawdust – cogeneration	1	100
Pulp/Paper	3	20
Boards	30	0
Framing/ wall truss	50	5
Sheet flooring particleboard	50	0
Strip flooring hardwoods	50	0
Furniture	50	0
Furniture (particleboard MDF)	30	0
Kitchen Furniture	30	0
Windows/doors	40	0
Fencing	20	30
Decking	10	30
Shop fitting	20	0
Poles	40	10
Horticultural posts	10	30
Pallets and crates	3	10

Source: CRC for Greenhouse Accounting (2004).

From a national perspective, Australia’s National Greenhouse Gas Inventory (NGGI) estimated that the total amount of carbon storage in wood products ‘in-use’ in Australia in 2005 was 354 Mt CO_{2-e}. This pool is estimated to be increasing at a rate of 18.3 Mt CO_{2-e} annually (George 2008). In addition to carbon storage in use, the total CO_{2-e} storage in wood products in landfills was estimated to be approximately 499 Mt CO_{2-e} in 2004, and this pool was found to have increased at a rate of 5.9 Mt CO_{2-e} during 2004 (FWRDC, 2006). In total the CRC for Greenhouse Accounting estimated annual storage of carbon in wood products as 24.2 Mt CO_{2-e} per annum. MBAC (2007) estimated that were around 26 Mt CO_{2-e} currently stored in range of wood products manufactured from the different types of logs sold by Forestry Tasmania. There are no publicly available estimates of the amount of carbon stored in forest products produced from other forest owners/managers in Tasmania.

This section provides background to the development of international frameworks for responding to climate change and key implications for Australia.

4.1 United Nations Framework Convention on Climate Change

International concern about the potentially adverse effects of increased atmospheric concentrations of GHGs on the global climate system resulted in the development of the United Nations Framework Convention on Climate Change (UNFCCC) in 1994. The UNFCCC establishes an overarching framework for intergovernmental cooperation for tackling climate change. It recognises that the global climate is a shared resource whose stability can be adversely affected by all countries through GHG emissions. Several key principles were agreed on as part of the ratification process:

- Acknowledgement that climate change is real and caused by human activities;
- Acceptance of the Precautionary Principle⁴ as a basis for action; and
- Commitment to action on stabilising atmospheric GHG concentrations through mitigation and adaptation⁵.

As a result of the UNFCCC, a foundation was established for parties to:

- Gather information on greenhouse gas emissions and undertake national emissions and UNFCCC implementation reporting to the Council of the Parties ('COP');
- Share national policies and best practice initiatives between nations;
- Launch national strategies for reducing GHG emissions and adapting to expected impacts;
- Provide financial and technological support to developing countries; and
- Cooperate in preparing for adaptation to the impacts of climate change.

Ratification of the UNFCCC in 1994 meant that Australia was required to develop a detailed emissions reporting system for annual feedback to the UNFCCC COP process. The following section describes the development of Australia's National Carbon Accounting System and how it functions.

4.1.1 Australia's National Carbon Accounting System

While stationary energy is clearly the major source of Australian GHG emissions (50%), around 27% of Australia's GHG emissions derive from land based sources such as livestock and crop production, land clearing and forestry (DCC 2008b). Forestry also forms an important carbon sink that requires regular quantification. The nature of these extensive and dispersed sectors means that a sophisticated monitoring and reporting system must be in place to enable Australia to report these net emissions accurately.

⁴ The 'Precautionary Principle' is founded on the condition that scientific uncertainty should not be the basis for policy inaction on environmental issues.

⁵ 'Mitigation' refers to reducing greenhouse gas emissions. 'Adaptation' refers to taking action to adapt to the impacts of climate change (e.g. improvements in drought-tolerant species for forestry, improved forest fire management practices).

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The National Carbon Accounting System (NCAS) was established in 1998. It accounts for GHG emissions and sequestration from land based activities to meet national and international (UNFCCC) reporting requirements⁶. The NCAS accounting and prediction systems are based on data obtained from (DCC 2008e):

- Remotely sensed land cover change (satellite-based images);
- Land use and management data;
- Climate and soil data;
- Greenhouse gas accounting tools; and
- Spatial and temporal ecosystem modeling.

The NCAS is regarded as one of the leading emissions accounting systems in the world. It has been developed by the DCC in partnership with CSIRO. As a result of its success, the Australian government and the Clinton Climate Initiative have formed a partnership to develop the NCAS as a Global Carbon Monitoring System (GCMS) to help other governments monitor deforestation and forest degradation (DCC 2008f). This will improve the capacity of all countries to make robust forest assessments and monitor and manage land use change. Ultimately the system is intended to be linked with carbon trading markets to better establish a system of incentives for reducing deforestation⁷.

4.2 Kyoto Protocol

The Kyoto Protocol is an international agreement established under the UNFCCC. It was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005 once a threshold number of countries had ratified the agreement. Out of the 192 nations which are parties to the UNFCCC, 183 nations have ratified the Kyoto Protocol to date. Where the UNFCCC is a framework for action and cooperation on climate change, the Protocol sets out legally binding targets for emissions reduction through to 2012.

Recognising that developed countries are principally responsible for the historic increase in GHG emissions over the last 150 years, the Kyoto Protocol places a heavier burden on these nations (termed Annex 1⁸ nations). A total of 37 Annex 1 countries and the European Community negotiated targets that resulted in an average 5 % reduction in GHG emissions against 1990 emission levels. The emissions reduction targets must be met over the five year period from 2008-2012, either through direct reductions in national emissions or – recognising that climate change is a global problem – through reductions achieved via the flexibility mechanisms included in the Protocol (outlined below in Section 4.2).

Australia ratified the Kyoto Protocol in December 2007 and in doing so committed to limiting its national GHG emissions to 8 % above 1990 levels over the period 2008-2012.

Current analysis projects Australia's greenhouse gas emissions at 108% of the 1990 emissions level over the period 2008-12, which is equal to Australia's Kyoto target (DCC 2008g). Among industrialised countries, 16 are

⁶ www.climatechange.gov.au/ncas/index.html

⁷ www.climatechange.gov.au/ncas/factsheets/fs-gcms.html

⁸ Annex I of the UNFCCC lists countries identified as 'developed' or 'economies in transition' which relates to Annex B of the Kyoto Protocol where these countries are mandated with emission reduction targets. Australia is listed as an Annex 1 country.

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on target to meet their Kyoto obligations including France, Greece and Hungary. However, 20 countries are lagging including Canada, Germany, Ireland, Italy, Japan, New Zealand and Spain. Nations that miss their Kyoto target in 2012 will face a penalty of a 33% higher emissions reduction to the target they agree under a post-Kyoto agreement (Adam 2008).

4.2.1 Flexibility mechanisms

The Kyoto Protocol established flexibility mechanisms to help countries to meet their emissions reduction targets in the most cost-effective manner. The flexibility mechanisms allow Annex 1 countries to access international abatement or offset opportunities via Joint Implementation (JI), the Clean Development Mechanism (CDM) and International Emissions Trading (IET). In broad terms, the three mechanisms comprise:

- JI, defined in Article 6 of the Kyoto Protocol, allows Annex I parties to supplement their domestic GHG reduction activities with emission reduction or sink enhancement activities conducted in other countries;
- CDM, defined in Article 12 of the Kyoto Protocol is a project based mechanism whereby the Annex I country receives Certified Emission Reductions (CERs) from implementation of a sustainable development project to reduce emissions in a developing country, in exchange for project funding; and
- IET, defined in Article 17 of the Kyoto Protocol - emissions trading enables a party to purchase or sell the right to emit a specified amount of GHGs from another Annex I party.

Under both JI and CDM, only afforestation and reforestation projects are eligible for investing in forest carbon offsets. The projects must also demonstrate the project activity is additional to business-as-usual activity (the 'additionality' principle). Farm forestry projects are an example of an exception to this additionality requirement.

The inclusion of project activities from the land use, land use change, and forestry (LULUCF) sector into the CDM and JI frameworks has been the source of some controversy (Streck *et al* 2006). Concerns relating to the loss of temporarily stored carbon (the 'permanence' problem), the accounting of real emissions removals (the 'additionality, leakage, measurement and monitoring' problems), and the loss of biodiversity and livelihood (the 'sustainable development' problem), have triggered significant debate. In addition to this, the regulatory limitations on forestry in developing countries have restricted its attractiveness for CDM investment (Locatelli *et al* 2008).

4.2.2 Afforestation and reforestation

Article 3.3 of the Kyoto Protocol allows carbon sequestered by new forests to be used by Annex 1 countries to meet their emissions reductions targets. For forestry projects to be eligible to obtain offsets under Article 3.3, the forest must (UNFCCC 1997):

- Have been planted on land that was previously non-forest (i.e. meet the definition of 'afforestation'⁹ or 'reforestation'¹⁰);

⁹ "Afforestation" is the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources.

¹⁰ "Reforestation" is the direct human induced conversion of non forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989.

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- Have been planted on or after 1 January 1990;
- Have minimum tree crown cover of between 10 and 30 percent;
- Have minimum tree height of between 2 and 5 metres; and
- Have a minimum area of between 0.05 and 1 hectares.

Under Article 3.3, plantations are not required to be established in addition to business-as-usual activity, as long as they meet the above specifications. Therefore commercial forest plantations are potentially eligible. The Kyoto Protocol requires that once forestry offsets are registered under Article 3.3, changes in forest carbon stock should be accounted for in perpetuity.

Accounting methodologies under Article 3.3 assume that if a forest is harvested for timber production, all carbon that has been sequestered is emitted in the year of harvest. Therefore it does not account for carbon storage in harvested wood products. This significantly reduces the net amount of carbon that can be claimed in commercial plantations under the conditions of the Kyoto Protocol.

4.2.3 Other forest management activities

Article 3.4 of the Kyoto Protocol specifies that carbon sequestration due to 'additional forest management activities' in existing managed forests could be used to meet emission reduction targets. Kyoto signatory countries were required to indicate whether or not they would account for carbon storage in their managed forests for the first commitment period. The Australian, New Zealand and Canadian Governments all elected not to account for additional forest management activities, either because there were concerns that managed forests may be a source of emissions (particularly due to forest fire) or because the cost of measurement exceeded the benefits.

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Since the Kyoto Protocol was ratified by the Australian government in 2007 a focussed policy development process has been in place to move towards the establishment of an emissions trading system (ETS) in Australia. The following sections outline the development of Australia's domestic policy including the recently released Commonwealth Government White Paper (DCC 2008j) outlining its policy on the domestic Carbon Pollution Reduction Scheme (CPRS). This analysis includes the treatment of the forest products sector in the CPRS.

5.1 National Greenhouse and Energy Reporting

The *National Greenhouse and Energy Reporting (NGER) Act 2007* was enacted in September 2007. The legislation was developed to standardise GHG reporting methodologies across all States and Territories in Australia. By establishing a framework for national emissions reporting and monitoring it provided a basis for development of a domestic ETS.

Under the NGER system, participating companies are required to provide annual reports on GHG emissions using a nationally consistent set of methodologies. Emissions will be reported to a publicly available database, the Online System for Comprehensive Activity Reporting (OSCAR).

Reporting under the NGER commenced on 1 July 2008, where all corporations with emissions or energy use above the mandated threshold were obliged to report on GHG emissions, abatement actions and energy production and consumption.

The thresholds for mandatory registering and reporting under the NGER take into account Scope 1 (direct) and Scope 2 (indirect) emissions, which means that they consider direct emissions from their own activities as well as emissions associated with upstream inputs, particularly energy production. For 2008/09 the thresholds are either:

- **Facility level:** Operational control of a facility that emits in excess of 25,000 tonnes CO_{2-e} pa, or produces or consumes in excess of 100 terajoules of energy pa or
- **Corporation level:** A corporate group which emits in excess of 125,000 tonnes CO_{2-e} pa, or produces or consumes in excess of 500 terajoules of energy pa.

Lower thresholds for corporate groups will be phased in by 2010/11. The final threshold for corporate groups will be emissions of more than 50,000 t CO_{2-e} pa or production or consumption of more than 200 terajoules pa of energy. Figure 5-1 outlines the reporting timeline and thresholds for the NGER Act.

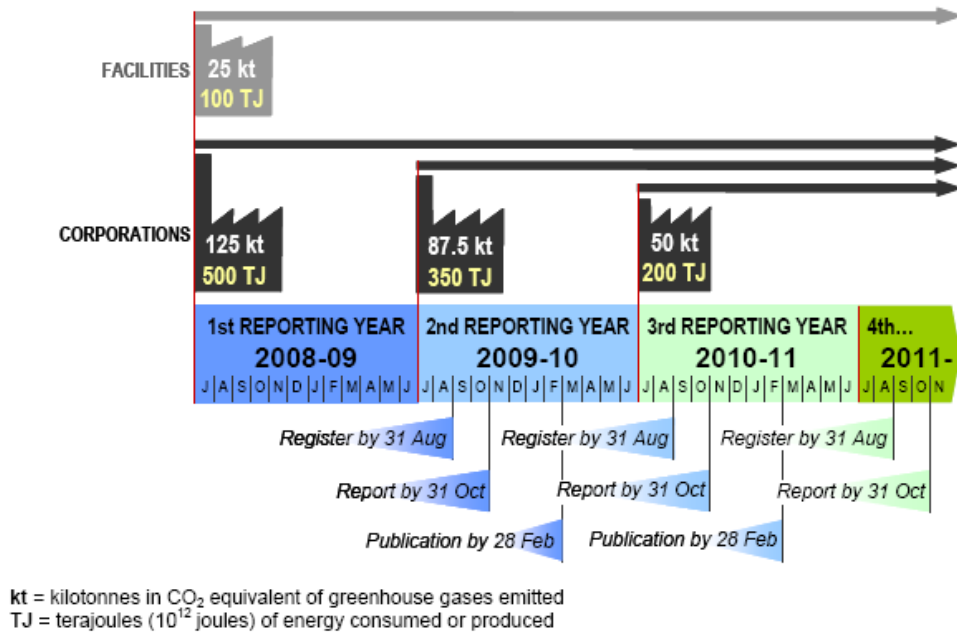
It is estimated the scheme will ultimately cover approximately 700 medium and large companies across Australia (DCC 2008h). There is insufficient information currently available on company emissions outputs in Tasmania to determine how many businesses will be obliged to report under the NGER. Given that 700 companies across all Australian sectors will be eligible, and typical carbon dioxide emissions profiles for forest product processors, it is expected that only a few forest product companies in Tasmania will be impacted by the scheme.

The NGER Act includes provisions for voluntary reporting of offsets under Section 10 and 21. It provides that offsets should be reported alongside a company's gross emissions to calculate net emissions, but should not be deducted from gross estimates of GHG emissions; energy production; and energy consumption.

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Figure 5-1 Timeline for mandatory reporting of emissions under the NGER Act



Source: DCC (2008h)

5.2 Development of emissions trading system

The current Federal government elected in November 2007 has a policy commitment to reduce Australia’s GHG emissions by 60 per cent of 2000 levels by 2050. This commitment formed the basis for the ratification on the Kyoto Protocol in December 2007 and the formation of the Department of Climate Change (DCC) to coordinate approaches to climate change.

5.2.1 The Garnaut Review

In April 2007 the State and Territory governments commissioned the Garnaut Review, which became a key policy guide for the current government’s development of the CPRS. The review specifically aimed to investigate “the impacts of climate change on the Australian economy, and ... the medium to long term policies and policy frameworks to improve the prospects for sustainable prosperity” (Garnaut Review 2008).

The Garnaut Review released a draft report in February 2008 (Garnaut, 2008b) and final report in October 2008. Key recommendations of the Garnaut Review included:

- The development of ‘cap and trade’ system rather than a carbon tax;
- Ambitious emissions reduction targets under international agreement of either 450 parts per million (ppm) of CO₂ by 2050 (90% of 2000 level emissions by 2050) or 550 ppm by 2050 (80% of 2000 level emissions by 2050).
- Sectoral coverage should be as wide as possible and should include forestry and agriculture. Both forestry and agriculture were seen to provide potentially valuable sources of offsets, which could help lighten the reduction burden of emissions intensive sectors under the ETS.

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While the Garnaut Review confirmed that Australia's economy could remain strong notwithstanding the introduction of the ETS, the report reinforced the need to provide initial assistance to Emission Intensive Trade Exposed (EITE) Industries (e.g. steel, aluminium smelting and cement manufacture). Garnaut considered such support necessary because the trade exposure of such industries could seem them pressured to relocate offshore to avoid the large costs associated with their national emissions liability.

5.2.2 The White Paper

In July 2008 the government released a Green Paper (DCC 2008i) that outlined its policy and design approach for a whole of economy response to climate change – the Carbon Pollution Reduction Scheme (CPRS). Following public consultation on the Green Paper, the Government released its White Paper (DCC 2008j) on 15 December 2008. The White Paper contained the government's firm policy position on the design of the CPRS and its emissions reduction targets which will be the basis of legislation to be developed in the first half of 2009.

The CPRS operates by obliging all parties covered under the scheme to surrender permits for the amount of carbon emissions they are responsible for. Within the CPRS, permits are limited to a 'cap' or fixed level of supply based on the national emissions target. The permits are distributed to participants annually and surrendered by participants at the end of the reporting period in line with their emissions.

As supply is steadily reduced under the cap, emissions permits will become increasingly scarce and valuable. Some participants will be able to reduce their emissions at a lower cost than others. For those that can abate more cheaply than the going cost of a permit, it will be in their interests to abate and sell their permits to those with higher abatement costs, for a net financial gain. Ultimately, market forces will work to ensure permits are distributed to those with the highest costs of abatement ensuring that the emissions cap is met via the lowest cost of abatement. Over time the government will reduce the cap to meet its stated target of 60% emissions reduction by 2050. The price of emissions permits will gradually rise over time in response to this reduction in permit supply.

The White Paper identified the medium term climate change target as 5% below 2000 levels by 2020, with a condition that if a broader international agreement was reached on emissions reduction, the target could be expanded to 15% below 2000 levels. The long term target of 60% reduction by 2050 was confirmed. In general, the White Paper confirmed much of the CPRS design details published in the Green Paper, with some changes to thresholds for assistance to EITE industries.

Key elements of the White Paper are:

- Maximum alignment with the Kyoto Protocol in the design of the ETS, including a 'cap and trade' system, acceptance of six GHG types, and acceptance of international flexibility mechanisms;
- A transitional price cap for the first five years of the CPRS (\$40 per tonne of CO₂ from scheme commencement, increasing at 5% pa above inflation);
- Broad sectoral coverage, with agriculture expected to be included in 2013;
- Participation threshold for businesses with direct GHG emissions greater than 25,000 t CO_{2-e} pa (see Table 5-1);
- Auctioning of the majority of permits on an annual basis;
- Allocation of a proportion of permits to significantly impacted EITE industries over early stages of the CPRS including:

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- 90% of required carbon permits for companies with an emissions intensity of at least 6,000 tonnes of CO_{2-e} per million dollars of value-added (or 2,000 tonnes of CO_{2-e} per million dollars of revenue);
- 60% of required carbon permits for companies with an emissions intensity of 3,000-5,999 tonnes of CO_{2-e} per million dollars of value-added (or 1,000-1,999 tonnes of CO_{2-e} per million dollars of revenue);
- The data period to establish qualifying for EITE assistance for revenue/value-added is 4.5 years (2004/05-2008/09);
- Unlimited emissions permit banking, which should reduce permit price volatility and allow businesses to operate with longer term emissions strategies;
- Limited permit borrowing arrangements are also proposed as part of the scheme;
- Inclusion of forestry under CPRS on a voluntary basis. Eligible forestry includes ‘afforestation and reforestation since 1990 on previously uncleared land’ – in line with the Article 3.3 of the Kyoto Protocol (see Section 5.2.3); and
- Exclusion of carbon storage in wood products. Storage in wood products is currently not recognised under the Kyoto Protocol and consequently wood products were not proposed to be covered under the CPRS.

Table 5-1 Facility thresholds under CPRS and NGER System

CPRS	NGER System
In general, direct CPRS obligations will apply to entities with a facility that has direct (Scope 1) emissions of 25,000 tonnes of CO _{2-e} a year or more.	In general, NGER reporting obligations will apply to entities with a facility with 25,000 tonnes or more of CO _{2-e} a year of direct (Scope 1) and indirect (Scope 2) emissions

Source: DCC 2008i

Allocation of permits to EITE industries is reported in the White Paper to total around 25% of total permits initially, rising to 45% by 2020. It also confirmed that revenue generated by the auctioning of permits estimated to be \$12 billion would be redistributed to households (\$4 billion), fuel tax adjustments (\$2 billion), EITE industries (\$2 billion) and other forms of assistance.

The timeframe for developing the CPRS through to implementation is outlined in Table 5-2.

Table 5-2 Timetable for the development and implementation of the CPRS

Timeline	Tasks
December 2008 – February 2009	Consultation on White Paper
March 2009	Bill introduced into Parliament
Mid-2009	Aim for Bill to be passed by Parliament
During 2009	Consultation on CPRS regulations
3rd quarter 2009	Act enters into force; scheme regulator established
2010	CPRS commences

Source: DCC (2008j)

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5.2.3 Forestry in the CPRS

Afforestation and reforestation that meets the Article 3.3 definition of the Kyoto Protocol (see Section 4.2.2) is eligible to be included in the CPRS. Plantations established prior to 1990 (or otherwise outside of the Article 3.3) and managed native forests are not eligible to participate in the CPRS. The key CPRS design details for forestry are:

- **Voluntary participation for eligible plantations** - forest owners may 'opt-in' to the CPRS and account, report and be liable for net carbon emissions under the scheme. CPRS registration will commence in late 2009 prior to the commencement of the CPRS.
- **Participants must submit an initial emissions estimation plan** and supply details of forest management data. An emissions estimation report will then be required at least once every five years but no more often than on an annual basis (DCC 2008i).
- **Average crediting for forest carbon accounting** – average crediting is considered preferable to full crediting as it will reduce the risks of non-compliance and compliance costs. This will mean that growers will not bear the full marginal carbon costs of their actions. The effect of average crediting is that forest entities would receive permits during the growing phase up to the permit limit, after which permits would generally only be required to be surrendered if forested land was converted to non-forest land use.
- **Baseline year of 2008** – permits will be issued from 2010 for net carbon sequestration in excess of 2008 sequestration levels for each forest stand.
- **'Risk of Reversal' buffer to manage bio-physical risk** – a buffer on carbon claimed to be stored in a plantation may be included in the permit limit to take account of natural disturbances such as fire, insect attack, storm or drought which could affect carbon stocks in the forest. Reversal buffers will be considered by the scheme regulator and determined based on project specific risk factors such as number of permits issued, forest location, grower management record.
- **Growers will not be required to surrender more permits than have been issued for a stand** - obligations will be capped on the basis of the so-called 'harvest sub-rule'. Obligations will be enforced for a defined period yet to be determined.
- **Five years notice of changes** – the government will provide five years advanced notice of changes to forest carbon accounting rules within the CPRS.

Where the amount of carbon sequestered by the plantation exceeds emissions over a given time period, forest owners will be allocated permits in line with this sequestration. However, if the emissions of a plantation (including plantation operations, fire, stand mortality and harvest) are greater than its sequestration over a given period forest owners will be liable to surrender permits in line with their total carbon emissions. Once a forest owner opts-in to the CPRS, any decision to change land use at the plantation site will be liable for all emissions resulting from permanent clearing and redevelopment.

The DCC has noted that *"scheme participation would not be beneficial for all forest landholders...the benefits of scheme participation would be greatest for landholders of new forests (which have the greatest sequestration potential) who intend to maintain them, as those forests can provide ongoing carbon sequestration"* (DCC, 2008h).

Further the White Paper noted that *"the benefits for harvest or plantation forests will depend on the flexibility of harvest schedules, future forest log prices and future carbon prices...scheme participation might not be*

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beneficial for single rotation plantations such as those owned through managed investment schemes, because of the risk that the costs of obligations under the scheme for harvest emissions would exceed the value of permits received for sequestration” (DCC 2008i).

5.3 Other Australian climate change initiatives

A range of policies and strategies have been developed by both Federal and State governments to help foster lower emissions. The following section sets out some of the major Federal and Tasmanian government initiatives.

5.3.1 Mandatory Renewable Energy Target

The Australian energy sector is predominantly based on coal fired generation. This low cost source of electricity is well established and is a major barrier to the establishment of the higher cost renewable energy sector. To address this issue, the Federal government introduced the Mandatory Renewable Energy Target (MRET) in 2001. In 2007, the Federal government committed to ensuring that 20% of Australia’s electricity supply comes from renewable energy sources by 2020. The current target requires that 9,500 GWh of renewable energy are purchased by electricity retailers across Australia. The MRET target is proposed to increase from 9,500 GWh of renewable energy per annum to 45,000 GWh per annum by 2020.

As electricity is distributed through a national grid system where renewable energy cannot be identified, the government has formed a ‘baseline and credit’ market for reaching the MRET target. Renewable energy providers accrue renewable energy certificates (RECs) for the electricity they produce, equivalent to one REC per MWh. Energy retailers are obliged to purchase a minimum quota of RECs from a RECs provider. Retailer quotas are directly linked to the national MRET target. Liable parties can acquire and surrender RECs to demonstrate compliance or opt to pay a \$40/MWh non-compliance charge.

As renewable energy producers supply their electricity to the open market, the value of a REC is equal to the difference in the cost of producing the renewable energy and the average wholesale price of electricity (Garnaut Review 2008). Market forces for RECs ultimately favour the lowest cost renewable energy technologies. To date, the largest growth in renewable energy generation has been experienced in wind power.

This will lead to a higher REC price and higher electricity prices for consumers. The 20% renewables target is expected to promote significant expansion of higher cost renewable energy sources and ‘increase the viability of more marginal business cases for conventional renewable energy’ (e.g. wind energy generation in more remote locations) (Garnaut Review 2008).

Both the CPRS and the MRET have an effect on the competitiveness of Australia’s existing energy producers. Both schemes will act to encourage the development of renewable energy technologies to complement fossil fuel energy generation. It is expected that once the renewable energy sector has become well established that the CPRS will effectively drive renewable energy development. On this basis the government proposes to phase out the MRET scheme from 2025, terminating by 2030 (DCC 2008j).

The MRET scheme currently allows native forest biomass as an eligible fuel subject to this biomass being a harvest residue or processing waste, with further conditions around the harvesting operation. By contrast, native forest harvesting residue is excluded under the Victorian and NSW renewable energy target schemes.

5.3.2 NSW Greenhouse Gas Reduction Scheme

The NSW Greenhouse Gas Reduction Scheme (GGAS) commenced in 2003 and was one of the first regulated GHG emissions trading systems established in the world. The aim of the GGAS was to reduce the GHG

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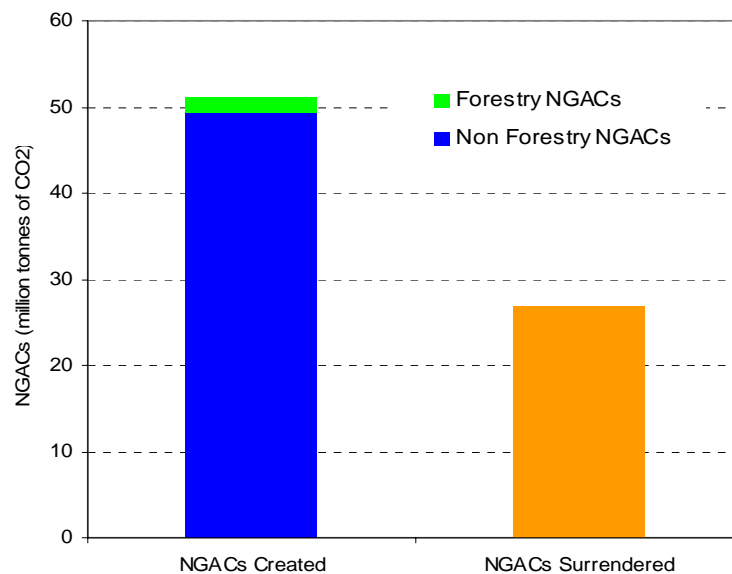
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emissions associated with coal fired electricity production in NSW and as such the coverage of the scheme is limited only to the state's electricity sector. However under the GGAS, abatement certificates (or offsets) are accepted from project based emissions reduction activities.

Accounting rules were adapted from the rules of the Kyoto Protocol and forestry projects are accepted that meet the Article 3.3 specifications of the Protocol. In 2007, a total of six forest offset providers were registered under the scheme, although most of the forestry offsets created have been from a single supplier – Forests NSW. Small forest growers have generally not participated in the scheme, as the administrative costs associated with establishing carbon sequestration rights for small projects have been prohibitive.

The unit of trade in the GGAS is the NSW Greenhouse Abatement Certificate (NGAC), which is equivalent to 1 t CO_{2-e}. The market has been characterised by an oversupply of NGACs, with the number of NGACs created exceeding the number of NGACs surrendered (Figure 5-2). Figure 5-2 also shows the relatively low contribution of forestry to the scheme, relative to other types of NGACs created. The reason for oversupply of NGACs in the market is the large number of NGACs created from demand side abatement activities (e.g. distribution of low emission light bulbs to customers). Some have also argued that the targets under the scheme were not stringent enough.

Figure 5-2 Summary of GGAS market activity 2003-2007



Source: NSW GGAS Registry Trade Statistics

The GGAS is to be integrated into the CPRS when it becomes operational, although the process by which the transition will occur is unclear at this stage.

5.3.3 Greenhouse Friendly

Greenhouse Friendly is a voluntary GHG certification program run by the Department of Climate Change (DCC). Under the program, products, services, individuals or businesses can be independently certified as 'carbon-neutral', meaning that all GHG emissions associated with the certified product or service have been eliminated or offset. The program provides independent verification of offsets from 'forestry abatement projects', and allows these offsets to be used to assist emitters to become carbon neutral.

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Like the GGAS scheme in NSW, eligibility for carbon sequestration in forests under the Greenhouse Friendly scheme is assessed in a similar way to Article 3.3 of the Kyoto Protocol and the project must result in GHG reductions or sequestration that are additional to 'business-as-usual' practices.

The inclusion of an additionality requirement under the Greenhouse Friendly scheme has effectively precluded commercial forest growers from participation. This is because commercial forests have been or would be planted under 'business as usual' conditions. Forest offset providers who have become accredited under the scheme are generally those that undertake environmental biodiversity plantings (with no harvesting); and/or plantings in marginal areas. The exception to commercial plantations meeting the additionality requirement would be if the carbon payment itself made the plantation development viable.

The future of the Greenhouse Friendly scheme under the CPRS is unclear. Most of the interest in Greenhouse Friendly certification has been the result of businesses wanting to contribute to lowering their emissions. As the CPRS will limit emissions over the whole economy it is expected that the demand for offsets outside of this scheme will reduce substantially. However, it would still provide an avenue for voluntary reductions of GHGs (see section 5.4).

5.3.4 Tasmanian Framework for Action on Climate Change

The Tasmanian Framework for Action on Climate Change (TFACC) was released in July 2008. The aims of the framework are to:

- 1) Reduce Tasmania's emissions to 60% below 1990 levels by 2050 (a furthering of the national target);
- 2) Adapt to the changes in the climate;
- 3) Capture new social, economic and environmental opportunities; and
- 4) demonstrate national and international leadership.

The framework states that early action will be rewarded by placing Tasmania in a position to respond to new opportunities. This is based on the principle that investment will flow to Tasmania if it positions itself as an innovator in an increasingly carbon constrained world.

The TFACC proposes a series of actions to increase Tasmania's contribution toward meeting the challenges of climate change. In relation to the forest and forest products sector, the TFACC proposes actions around 'protecting Tasmania's natural carbon stores', and creating a 'renewable energy state' including:

- **Natural carbon stores** - expanding the available data on the best practice for management of natural carbon stores by collaborating with international partners, sponsoring research projects and developing a risk mapping database of Tasmania's carbon stores; and
- **Renewable energy** - release of a discussion paper on options for providing minimum feed-in tariffs to support households and small energy consumers that use renewable energy. This includes: develop new forms of support for renewable energy industry; encourage on-site renewable energy generation for buildings and industry; and promote Tasmania as a centre for research and commercialisation of renewable energy technologies.

The TFACC states that by the end of 2009, Tasmania will make informed decisions on sectoral and interim targets on the most effective actions to achieve emissions reduction targets.

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5.4 Voluntary carbon markets

Voluntary carbon markets exist in parallel with the CPRS and other regulatory or compliance based markets. Under voluntary markets, carbon sequestration (including forestry projects) and emissions abatement projects can receive emissions credits that can be sold to organisations interested in reducing their emissions. For countries that have not ratified the Kyoto Protocol, voluntary markets are a means to participate in emissions trading without being part of a highly regulated, sectoral scheme such as that proposed for the CPRS. They can also provide an option for generating offsets outside of the CPRS.

Demand for voluntary carbon offsets is driven by an effort to demonstrate corporate social responsibility in the business world. Organisations that purchase offsets may choose to cover a portion of their emissions, or all emissions, where they can be considered 'carbon neutral'. In recent years global demand for forest carbon in voluntary markets has been strong, with approximately 23.7 Mt CO_{2-e} traded in 2006 (Hamilton *et al* 2007).

All voluntary carbon markets have different eligibility criteria for supplying forest carbon offsets. A number of standards have developed to provide confidence for investors in voluntary forest offset projects. Table 5-3 presents a summary of leading voluntary carbon standards. Prices paid for forestry offsets in voluntary markets vary significantly, partly due to variation in perceived quality of the credits. Forestry offsets tend to attract a premium in the market if they have been independently verified; and where the buyer assumes less risk. The future of voluntary markets in Australia beyond the introduction of the CPRS is unclear.

Table 5-3 Summary of international voluntary carbon standards

Standard	Forestation ¹¹	Improved Forest Management	Issue carbon credits	Additionality	Eligibility
Climate, Community & Biodiversity Standards (CCBS)	Yes	Yes	No	Yes	No restrictions
CarbonFix Standard (CFS)	Yes	No	Ex-ante	Yes	10 years, no forest prior to project
Plan Vivo System and Standards	Yes	Yes	Ex-ante, Ex-post	Yes	No restrictions
Voluntary Carbon Standard (VCS AFOLU)	Yes	Yes	Ex-post	Yes	10 years, no forest prior to project

Source: Merger (2008)

¹¹ Forestation comprises afforestation and reforestation and includes agroforestry

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This section addresses the likely impacts of climate change and the CPRS on the Australian economy and in particular, on the Tasmanian forest products sector.

6.1 Impacts on the Australian economy

The Federal Department of Treasury has undertaken analysis and modelling of the impacts of the CPRS (Treasury 2008) on the Australian economy. The study used economic models to assess the macroeconomic, sectoral and household impacts of the CPRS carbon price, under four scenarios and a reference case extending from 2007 to 2050.

The findings of the Treasury modelling demonstrate that Australia can continue to grow robustly into the future even as emissions fall to meet long term targets. Results of the modelling demonstrate that while some loss in economic growth is expected it is likely to be only small, in the order of 0.1% pa. Table 6-1 shows the forecast change in Gross National Product (GNP) over time under the CPRS. At the household level, income is projected to increase in real terms over time although the increased costs of electricity and gas supplies will take up an increasing share of household expenditure.

Table 6-1 Forecast growth in Gross National Product (GNP) under CPRS

	Average annual	Increase by 2020	Increase by 2050
Policy scenarios (averaged)	1.1%	9%	55-57%
Reference scenarios	1.2%	11%	66%

Source: Treasury (2008)

The scenarios investigated in the study were informed by different long term emissions reduction targets. Both the CPRS-5 and the CPRS-15 scenarios use a long term emissions target of 60% below 2000 levels by 2050. However, the CPRS-5 scenario assumes a slower start of 5% reduction below 2000 levels by 2020 in line with the White Paper. On the other hand, the CPRS-15 scenario assumes a greater 15% reduction below 2000 levels by 2020 which is the maximum reduction that could be adopted under the White Paper pending international actions. [Appendix A](#) provides further details on the scenarios used in the study.

The significance of the different targets is the nature and magnitude of the emissions reduction trajectory over time. The nature of the emissions reduction trajectory signifies the emissions permit price and the rate of increase of the price over time.

6.1.1 Growth in the Australian forestry and wood products sectors

The Treasury modelling included an analysis of the impact of the CPRS by sector, which included an assessment of the impact of the CPRS on forestry and on the wood products industry. Table 6-2 summarises the results of modelling of the CPRS-5 and CPRS-15 scenarios on the forestry industry. The results predict that there will be an increase in commercial plantations across Australia between 2007 and 2050 of around 3 million ha under the CPRS-5 scenario and 4.5 million ha under the CPRS15 scenario. The modelling results did not publish areas of softwood and hardwood.

Growth in the commercial forest estate is projected to be driven by substantial increases in the competitiveness of forest products compared to substitute goods in the carbon constrained future of

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the Australian economy. It is also facilitated by increasing returns to plantation investments compared to alternative land uses making forestry investment relatively more attractive.

Under both scenarios Tasmania is predicted to have the largest increase in forest area. In the reference scenario (no CPRS; not presented), growth in the commercial timber estate was forecast at 26,000 ha (compared to 651,000 ha under CPRS-5 and 1,076,000 ha under CPRS-15). Under the CPRS-5 scenario the carbon prices commences at \$20.88/t CO_{2-e} and increases by 4% pa to 2100.

Table 6-2 Projected growth in the Australia's commercial forest estate, 2007-2050

	CPRS-5	CPRS-15
	'000 ha	'000 ha
AUSTRALIA	3,047	4,514
NSW	293	464
VIC	491	950
QLD	447	293
SA	619	1,031
WA	546	700
TAS	651	1,076
NT	0	0

Source: Treasury (2008)

The increase in commercial plantations under the CPRS-5 scenario suggests that the existing plantation estate in Tasmania would increase 2.4 times by 2050. This suggests an average increase of around 15,500 ha pa over this 43 year period. Over the last 5 years Tasmania's plantation estate has expanded at around 12,700 ha pa, but there is considerable doubt over whether this rate could be maintained given competing demands on land resources. Tasmania's total land area is 6.8 million ha¹². Given there are 1.6 million ha of agricultural land currently in the state, it seems unrealistic that commercial forestry plantations might occupy up to two-thirds of this land by 2050.

Treasury also forecast areas of environmental (carbon sequestration) plantings under various CPRS scenarios (Table 6-3). For Australia as a whole these plantations areas are considerably larger for the CPRS-15 scenario (around 22 million ha by 2050) but similar (around 3 million ha) for the CPRS-5 scenario. As land prices and alternate agricultural industries in Tasmania are strong the relative attractiveness of environmental plantings is low compared to other states, with only 1,000 ha of environmental plantings predicted under each scenario. Polglase *et al.* (2008) conducted an assessment of the potential for carbon sequestration plantings which suggested that there could be up to 1 million ha of land in Tasmania on which environmental plantings could provide profitable returns. This assessment was based on an examination of regional plans as well as potential profitability and did not predict actual areas likely to be converted from existing land uses. It is thus not inconsistent with the Treasury modelling, and the combined analyses suggest that although there are opportunities in Tasmania, under each of the CPRS-5 and CPRS-15 scenarios there is likely to be relatively little investment in carbon only plantations in the state.

¹² http://www.iris.tas.gov.au/resource_industry/agriculture/supply

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Table 6-3 Projected growth in Australian environmental plantations, 2007-2050

	CPRS-5 '000 ha	CPRS-15 '000 ha
AUSTRALIA	2,740	21,812
NSW	456	7,945
VIC	9	84
QLD	1,527	10,591
SA	19	481
WA	35	1,308
TAS	1	1
NT	692	1,400

Source: Treasury (2008)

The Treasury modelling illustrates that forestry is at the core of the Federal government’s strategy for dealing with climate change. If plantations are not established as predicted, other things being equal the cost to the Australian economy will increase. It is also noteworthy that the Treasury modelling predicts that Australia will purchase a significant quantity of emission permits overseas (the modelling capped imported permits at 50%) of the total requirements. However, there are a number of assumptions on which the modelling has been based that call into question the likelihood of the size and rate of the forecast expansion in plantations (commercial and environmental).

The Treasury modelling was based work completed by ABARE (Lawson *et al.* 2008) to assess the potential increase in reforestation activity on agricultural land under various carbon pricing scenarios. In considering the impacts of the CPRS on the domestic forestry sector, the assumptions underlying the ABARE modelling do not consider a range of factors that will, in practice, strongly influence the establishment of new plantations. The forest industry has expressed concern that the assumptions contained in the ABARE modelling are unrealistic and likely to lead to an overestimate of the areas of plantations (A3P 2009). The key modelling assumptions that appear to be inadequately accounted for in the modelling include:

- **Forest owners can claim 100% of the total carbon sequestered in all stores** – the ABARE modelling assumes that forest owners will claim all of the carbon sequestered in plant roots, trunks and branches. However, arrangements for claiming carbon are not clear and it is likely that significant buffers will be included e.g. to allow for risks of fire and other damage. It is also likely that carbon sequestered in below ground biomass (roots) will be excluded from the CPRS. The potential costs associated with registering and claiming carbon sequestered in plantations is also excluded from the analysis.
- **Differences in cash flow between the returns to agriculture and forestry are assumed to not affect land use change behaviour** – this is a function of the approach adopted in the ABARE modelling whereby land use decisions are based on relative net present value (NPV) of forestry and agriculture investments and that carbon returns are received by landholders on an annual basis. Thus land switches from agriculture to forestry as long as forestry provides a higher NPV. This assumption means that the modelling fails to take account of the full range of factors that influence land use decisions such as landholder understanding, expertise, access to capital and relative risk perceptions. It also excluded the important influence of socio-economic factors on land use decisions.

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- **No ongoing management costs for environmental plantings** – while management costs of environmental plantings are likely to be less than for commercial plantations, there will be ongoing management costs such as fire and pest management associated with environmental plantings.
- **Timber processing industries will accommodate the forecast increase in wood production** – this assumption ignores that the significant increases in wood production will require large scale investment in new timber processing mills. Such investments would be subject to investment decisions and development of timber markets and may not necessarily result in capacity to absorb all of the additional production.
- **Potential effects of forestry on other environmental services are not considered** – other potential effects of large scale plantation expansion on factors such as water availability are not considered in the analysis. This is similar to the lack of consideration of socio-economic impacts beyond NPV.
- **Single prices for logs** – returns from plantations are based on single estimates of mill door value of prices for hardwood and softwood logs receive in each state. While the prices used may represent a reasonable average price received at the current time, this assumption fails to recognise the difference in prices the may be received in various plantation regions/

6.1.2 Gross output by sector

The Treasury modelling indicates that the gross output¹³ is expected to increase across all forestry and forest product sectors assessed. Table 6-4 shows gross output estimates under the two relevant CPRS scenarios. The expansion of forestry output is estimated to increase between 150%-585%. The wood products and paper products sectors will increase by 9%-12% and by around 3%, respectively. Paper products are forecast to have a relatively smaller increase which reflects the sector's higher emissions status compared to many other wood products producers. However, both the wood and paper products sectors are forecast to outperform cement and iron & steel in the future.

Table 6-4 Projected change in gross output by sector under CPRS scenarios, 2050

	CPRS-5 % change	CPRS-15 % change
Forestry	150.1	584.5
Wood products	8.8	11.9
Paper products	3.1	2.6
Cement	-6.0	-6.4
Iron and steel	0.7	-0.2

Source: Department of Treasury 2008

¹³ Gross output consists of the goods or services produced within an establishment that become available for use outside the establishment, plus any goods and services produced for own final use.

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6.2 Impacts on the Tasmanian forest products sector

Climate change will influence the forest products sector in Tasmania through changing climatic conditions and through the impact of the CPRS. The bio-physical impacts of climate change will predominantly occur on the forest resource and are addressed in Section 6.2.1 below. The following sub sections consider the potential impacts on major industry sectors.

6.2.1 Impacts on forests

The impacts of climate change on the forest products sector are diverse and not well understood. Cowie *et al.* (2007) state that potential impacts can be considered in terms of physiological, wildfire and forest health.

Physiology

Key physiological impacts of climate change on forests include:

- **Water stress** - moisture availability is generally considered to be the key limiting factor for forest growth in Australia (particularly plantations) and the most sensitive variable affected by climate change. Rainfall is forecast to decrease in the north east and increase in the west and central regions of Tasmania. Plantations developed in more marginal conditions where rainfall reductions are experienced will be impacted most heavily by water stress. A reduction in commercial forest productivity due to water stress is likely to reduce net revenue from existing forests and make plantation expansion into new areas less likely.
- **'CO₂ fertilisation effect'** – this refers to the potential for increased growth as a result of an increase in carbon dioxide in the atmosphere due to greenhouse gas emissions. Kirschbaum (1999) stated that the productivity of exotic softwood and native hardwood plantations is likely to increase under climate change as a result of carbon dioxide fertilisation. Research has shown that a doubling of CO₂ concentrations increases plant growth by 10%–25% under experimental conditions (Nowak 2004). However, increased forest growth as a result of CO₂ fertilisation is likely to be limited by nutrient and water availability. Much of the research on carbon fertilisation has been based in the northern hemisphere under different conditions to Australia.
- **Water-use efficiency** – elevated CO₂ concentrations may also affect the water use efficiency of forests. With higher CO₂ availability plants reduce stomatal conductance and evapotranspiration decreases leading to increased water use efficiency. However, depending on changes to soil water availability the leaf area of a plant may change, counteracting any change in stomatal conductance (Raison *et al.* 2007). The full extent of this issue is only partly understood at this stage and requires significant further investigation (Raison *et al.* 2007).

Wildfire

Cowie *et al.* (2007) state that climate change is likely to increase wildfire risk, largely through its impact on climate extremes rather than gradual changes in average temperature and rainfall occurring over decades. There is likely to be increases in the frequency and intensity of bushfires which will result in increased forest damage (and associated GHG emissions) and a decline in forest biodiversity.

Studies on south eastern Australia (Lucas *et al.* 2007; Hennessey *et al.* 2005) suggest the frequency of very high and extreme fire danger is likely to increase substantially. Table 6-5 outlines the expected

changes in the number of fire-weather days in south eastern Australia. Tasmania is the only exception to this projection however, showing little increase.

Table 6-5 Projections of the number of days with ‘very high’ and ‘extreme’ fire-weather, 2020-2050

	2020		2050	
	Low global warming (0.4°C)	High global warming (1°C)	Low global warming (0.7°C)	High global warming (2.9°C)
Very high	+2-13%	+10-30%	+5-23%	+20-100%
Extreme	+5-25%	+15-65%	+10-50%	+100-300%

Source: Lucas *et al.* (2007)

In the longer term, changes in the distribution of flora as a result of climate change will also impact fire risk in native forests e.g. replacement of cool temperate rainforest with sclerophyllous forest would increase flammability (Bushfire CRC 2006). Fire danger is predicted to increase in spring, summer and autumn, so periods suitable for prescribed burning are likely to be restricted, affecting forest management (Hennessy *et al* 2005).

Forest health - pests & diseases

Another major impact of climate change on forests will be a likely increase in the incidence and severity of pest and disease outbreaks in native forests and plantations. Cowie *et al* (2007) note that changes in average or extreme values of climate variables can affect the life cycles of pest populations and the severity of disease. Increased summer temperatures are likely to accelerate the development rate and reproductive potential of insect pests, while warmer winters will increase over-winter survival (Old & Stone 2005). This may cause forest damage, a decline in forest biodiversity and a reduction in forest productivity.

Climate change may also extend the geographic distribution of pests and pathogens, affecting forest communities not previously at risk. Effects of climate change on the host plant may increase its susceptibility to insect pests and diseases, or its ability to tolerate and recover from grazing. For example, elevated CO₂ concentration affects the nutritional quality of foliage, largely due to a decline in leaf nitrogen concentration (Ainsworth & Long 2005). The resultant change in the carbon nitrogen ratio may result in increased foliage consumption by some species tolerant of low nitrogen availability, while others will be inhibited (Old & Stone 2005). It is, therefore, difficult to predict the impact of climate change on defoliation.

In their review of the likely impacts of climate change on pests and pathogens of Australian forests, Old & Stone (2005) concluded that the diversity of Australia’s native forests gives them a strong resistance to pests and pathogens, but that climatic variability due to climate change – particularly an increase in drought frequency – could increase the impact of pest and pathogen attack, thereby compromising the health, and hence the carbon stocks, of Australia’s forests.

Impacts of the CPRS on forests

The projected increases in plantation establishment under the CPRS clearly have implications for the forest products sector in Tasmania. Section 7.1.2 considers opportunities for plantation investment in more detail. As the CPRS excludes native forests, it will have few direct impacts on that sector.

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However, all forest growers are likely to face some of the indirect costs of the CPRS, with particular impacts being:

- **Fuel costs** - forest production is likely to be impacted primarily by increases in the price of fuel which will gradually increase the price of harvest and haul services. The nature of fuel increase is addressed in the following section.
- **NGER reporting** - Those plantations that breach the threshold for reporting emissions under the NGER (25,000 tonnes CO_{2-e} of Scope 2 emissions) will be required to annually report their CO_{2-e} emissions. This applies to those plantation owners who have not opted into the CPRS. In the case of NGER reporting, plantation owners will need to establish an emissions accounting procedure.

6.2.2 Impacts on harvest and haulage

Harvest and haulage businesses are not likely to exceed the 25,000 t CO_{2-e} of Scope 1 emissions threshold to require participation in the CPRS. The major source of harvest and haulage emissions – vehicle fuel – is currently proposed to be covered under the CPRS at the ‘upstream supplier’ stage of the fuel supply chain where fuel excise and excise-equivalent customs duties are paid (DCC 2008i). This is the most administratively simple location to apply the CPRS given the wide ranging and dispersed number of fuel users downstream. The costs of emissions for upstream suppliers are expected to be fully passed on to retail users.

The largest impact that is expected to be felt in the Tasmanian harvest and haulage sector is therefore expected to arise through increased fuel costs. While the government proposes to shield consumers from higher fuel costs for the first 3 years by altering the excise tax rate (see Box 1 below), exposing the fuel market to the emissions price in the long term is seen as inevitable. There is uncertainty around exactly what increase in fuel price should be expected as a result of the CPRS. Caltex has stated that at \$40/tCO₂, petrol prices would be around 10c/l higher than usual (Murphy and Miletic 2008). Box 1 outlines Treasury’s projections of the CPRS’ impact on fuel prices.

Although haulage companies may not breach the threshold for participating in the CPRS some companies are likely to be required to report their emissions under the NGER (25,000 tonnes CO_{2-e} of Scope 2 emissions). Those that are required to submit an annual emissions report are likely to face some ongoing extra costs in operating a carbon accounting system.

Box 1: Fuel cost increases from the CPRS

Under the CPRS, fuel prices are expected to increase over the medium to long term. Fuel and vehicle products are expected to adjust in response to this. Fuel types are expected to diversify and increases in fuel efficiency and availability of alternative vehicle systems are expected (e.g. electric hybrids). This is expected to lower the amount of petroleum used per capita across the economy and limit business and household cost increases.

The government will also provide assistance to road transport fuel users for the first three years of the CPRS. Petroleum taxes will be cut on a 'cent-for-cent' basis to offset its initial price impact (DCC White Paper 2008). This will aid with the transition to increased fuel costs through the rising price of GHG emissions permits. The fuel tax reduction will apply from 1 July 2010 for three years, applying to all liquid fuels currently subject to the general 38.143 cents per litre rate. The tax cut will be standardised based on the impact of the CPRS on diesel emissions. In 2013 the assistance policy will be reviewed and a decision will be made on its future.

Under the Treasury (2008) modelling, petroleum remains the dominant fuel to 2050. Diesel overtakes petrol as the dominant fuel source by 2020 and hybrid electric vehicles become increasingly important accounting for 10% of the transport market by 2050. An emissions price makes non-conventional oil sources, such as coal-to-liquid and gas-to-liquid diesel, uncompetitive owing to their high life-cycle emissions. Transport fuels will become increasingly diversified from around 2020, with ethanol, electricity and synthetic forms of diesel. The share of ethanol and petrol blends (E10 to E85) increases around 2020, as technology to extract ethanol from lignocellulosic feedstocks is assumed by the Department of Treasury to become cost effective.

6.2.3 Impacts on processing

Based on the current design of the CPRS, the only emissions that the forest products processing sector will be accountable for will be direct emissions from production (Scope 1 emissions). All emissions due to electricity consumption will be the responsibility of the electricity sector - although these costs will be passed onto consumers. Likewise emissions from fuel use will be accounted for upstream in the fuel supply chains.

The Department of Treasury (2008) has reported that pricing emissions and adopting low-emission technologies will increase the cost of electricity for consumers. The short-term cost of the emission price on existing fossil fuel power plants will feed into wholesale electricity prices. The medium and longer term deployment of more expensive low-emission technologies brought about by the CPRS will cause electricity prices to continue to increase, as low emission technologies increase market share. By 2020 average wholesale prices could be 80%-150% higher, rising to 120%-190% higher by 2050.

The degree to which any individual processing business is affected by the CPRS will be measured by total extra cost incurred, but this will be determined by a number of factors. The factor that will principally impact processors will be energy usage intensity. All sectors of the forest processing industry are likely to be affected by increases in electricity costs. Many processors will also be affected by increased resource costs and increased transport costs (into and out of the facilities).

Sawn timber

Production of sawn timber results in relatively few GHG emissions, with the main emission source being electricity used in processing. Furthermore in the sawn timber sector it is often the case that a portion of the energy requirements are met from use of wood residue, which results in emission savings compared to use of fossil fuel base energy.

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Actual information on energy use of specific Tasmanian sawmills is not readily available. However using data from George (2008), Table 6-6 calculates the estimated GHG emissions of sawn timber in Tasmania for the entire sawn timber industry. As neither the hardwood nor softwood industry meets the 25,000 t, as an aggregate emissions source, no individual entity would likely breach the CPRS threshold.

Table 6-6 Estimated direct GHG emission from Tasmania's sawn timber sector

	Emission per tonne of material (t CO ₂ -e/tonne)	% emissions from electricity	Direct processing emissions	Annual Tasmanian production (m ³ year)	Total emissions (t CO ₂ e)
Hardwood (rough sawn kiln dried)	0.230	50%	0.12	178,800	21,456
Softwood (rough sawn kiln dried)	0.234	64%	0.08	179,100	14,328

Source: George (2008), ABARE (2008)

As most Tasmanian sawmills are unlikely to breach the CPRS threshold the largest impacts are most likely to result from increased electricity, transport and resource costs. One of the advantages for Tasmanian sawmills of not meeting the CPRS threshold may be that larger scale sawmills on the mainland might be required to participate. In this case Tasmanian sawmills would be at a competitive advantage.

The Tasmanian sawn timber industry may experience a disproportionate increase in transportation costs due to its reliance on being able to economically transport product to the mainland. A submission to the Productivity Commission by the Forest Industry Association of Tasmania in 2006 indicated that 60% of kiln dried hardwood timber products and 50% of kiln dried pine timber are sold into the mainland. A further 10% of hardwood products are exported internationally.

However, the Tasmanian freight equalisation scheme will act to ensure that the effects on Tasmanian producers are no worse than producers in other states. On the other hand Tasmanian producers should gain an advantage from the relatively short haulage distance for log inputs and local sales compared to other states.

International air and shipping transport is not currently proposed to be covered under the CPRS, and users will be exempted from the emissions cost through the use of an Obligation Transfer Number (or OTN). However, international emissions are likely to eventually be included in emissions trading under a post-Kyoto framework.

Panel products

The GHG emissions of particleboard are around 0.982 per tonne of material produced (George 2008). No information was available for veneer mills but they would be expected to be similar to that of sawmills (0.2-0.3 t CO₂-e/tonne of material). Based on these estimates, no panel product mills would be likely to breach the threshold requiring participating in the CPRS.

Similar to the indirect impacts on other processors, panel product mills will experience increasing costs of production including higher transport costs. Producers reliant on chemicals and glues for production

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(e.g. particleboard) may also experience increases in this input cost due to passed on fuel prices and from CPRS costs if the product has been produced domestically and the producer breached the threshold. The chemical industry has approximately similar energy intensity to the pulp and paper industry. In 2006, 80% of hardwood veneer produced in Australia was exported to offshore panel producers generally exempt from carbon costs at the present time.

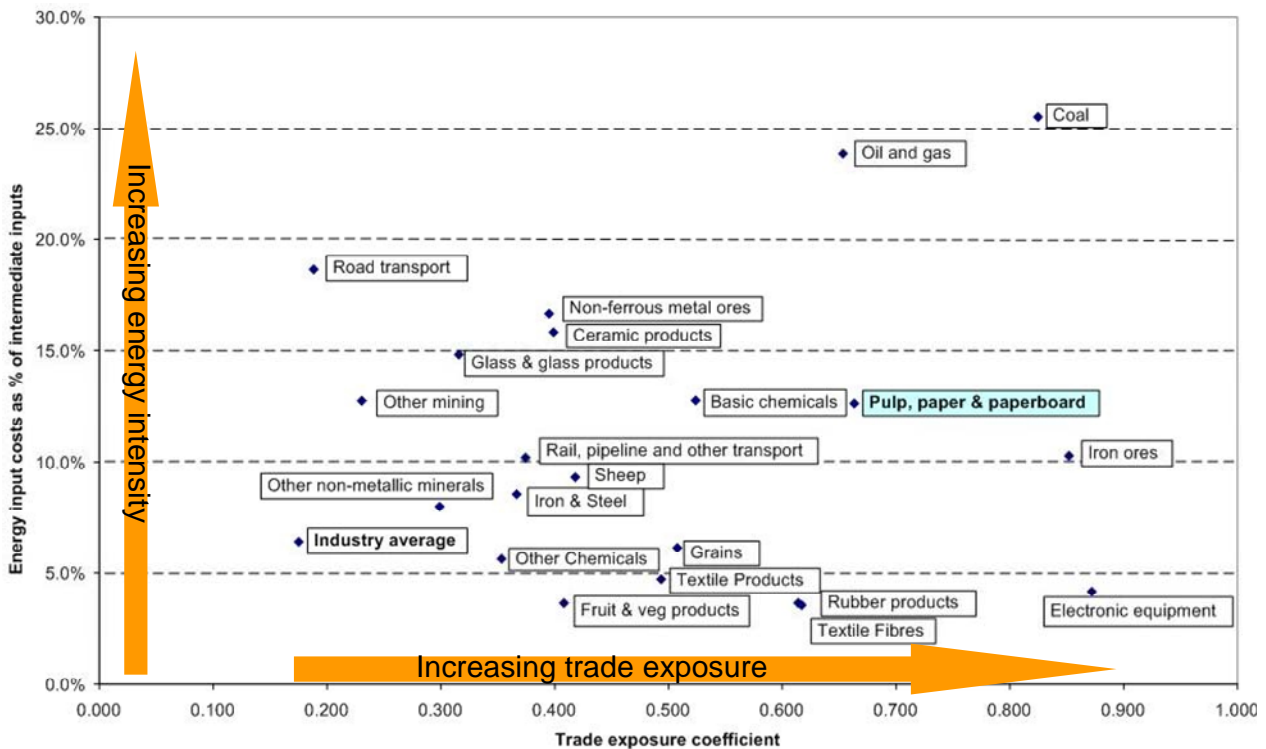
Pulp and paper processing

Pulp and paper producers are generally much more exposed to the direct and indirect costs of the CPRS. Tasmania has three facilities: the Norske-Skog pulp and paper mill using a chemi-mechanical pulping process to produce newsprint; and two PaperlinX paper mills at Wesley Vale and Bernie which mostly rely on imported pulp.

Norske-Skog is the only newsprint manufacturer in Australia, with a portion of the pulp produced feeding mainland based paper making machines. In its sustainability report PaperlinX (2008) identified that in 2007/08 its GHG emissions associated with paper production (across all of its operations) were 0.95 t CO_{2-e}/tonne of paper.

The key difference between the pulp and paper sector and the other processing sectors in Tasmania is their high energy usage intensity. Analysis undertaken by URS Forestry in Figure 6-1 shows the degree to which the pulp and paper industry is exposed both in terms of energy intensiveness and trade exposure. The graph shows that the pulp and paper industry energy intensity is more than twice the industry average.

Figure 6-1 Energy-intensive trade-exposed industries



Source: URS analysis of ABS Input-Output Table 2004-05

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As a result of the high energy usage by the pulp and paper sector, it is likely that each processing facility in Tasmania will have obligations under the CPRS. The DCC previously identified emissions per unit of revenue from the pulp, paper and paperboard industry as 1,133 t CO_{2-e} / \$ million revenue with a minimum threshold for assistance of 1,600 t CO_{2-e} / \$ million revenue (DCC 2008h). Since the White Paper was published, the threshold for EITE industry assistance has lowered substantially making it much more likely that the pulp and paper industry will receive assistance (see Section 5.2.2; DCC 2008i). If eligible for EITE assistance, pulp, paper and paperboard manufacturers are likely to be entitled to 60% allocation of required permits by government. The assistance rate will be set for the first five years of the CPRS being reduced in the long term by 1.3% per annum.

6.3 Summary of impacts on the Tasmanian forest products industry

Regardless of whether Tasmanian forest growers or forest product producers are participants in the CPRS nearly all are likely to experience some impact from the CPRS and its effect on the Australian economy. Many of the impacts likely to be experienced will be similar in nature to the impacts experienced by other non-forest sectors. Table 6-7 summarises the major cost impacts likely to result from the CPRS on the range of forest product sectors in Tasmania. The impacts have been broadly ranked according to how severe the impacts will be on various segments of the supply chain.

Table 6-7 Summary of the cost impacts of the CPRS on the Forest Product supply chain

Sector	Overall ranking of impact	Nature of impact
Forests	Low	<ul style="list-style-type: none"> Some increase in transport costs due to fuel price increases, increases in chemical/fertiliser costs and admin costs (NGER reporting). Stumpage prices also likely to increase where resources also have a carbon value. Growers will aim to pass on increased costs to processors through existing log price adjustment mechanisms.
Harvest and Haul	Medium	<ul style="list-style-type: none"> Increase in fuel costs which generally account for between 15-40% of contractor variable costs. Will aim to pass on increased costs to processors.
Sawmills and rotary veneer mills	Medium	<ul style="list-style-type: none"> Increase in resource, transport and energy costs. While size of cost increases is unclear, these factors typically account the majority of variable processing costs. For larger producers may be some costs associated with NGER reporting. Will aim to pass costs onto wholesalers/retailers
Panel mills	Medium	<ul style="list-style-type: none"> Increase in resource, transport, energy and resin costs. Will aim to pass costs onto wholesalers/retailers. As only small operators in Tasmania, unlikely to require NGER reporting.
Pulp and paper	High	<ul style="list-style-type: none"> Increase in resource, transport and energy costs. Given energy intensity of production expect impacts to be potentially significant. Costs associated with likely participation in CPRS and NGER reporting costs. However, potential assistance under CPRS likely to offset some impacts.
Woodchip export	Low	<ul style="list-style-type: none"> Increases in resource, transport and energy costs. Will attempt to pass onto customers but may be limited due to heavy reliance on international trade.

This section outlines the key opportunities for the Tasmanian forest products sector arising from climate change.

7.1 Forests

The effects of climate change and introduction of the CPRS present a range of needs and opportunities for forests and forest growers/investors. These include research and development to assess the carbon storage capabilities of native forests, carbon accounting practices and the potential for expansion of the plantation estate. Table 7-1 summarises the key opportunities for native forests and plantations and these are further discussed in the following sub-sections.

Table 7-1 Summary of opportunities for the forest as a result of climate change and CPRS

	Natural Forest	Plantations (hardwood/softwood)
Climate change research opportunities	✓	✓
Eligible plantations for the CPRS		✓
Expansion of the forest estate		✓
Voluntary offset possibilities	✓	✓
Forest carbon accounting methods	✓	✓

7.1.1 Climate change research

Increases in temperature and atmospheric CO₂ concentrations are already taking place globally, however the potential bio-physical impacts that may result for native and plantation forests over the next 100 years are complex and subject to considerable uncertainty.

If the demand for forest products increases under the CPRS there will be a need to maximise existing production and expand into new areas. A better understanding of the impacts and potential adaptation options for forestry is required, so that forest managers can effectively adapt to changing physical conditions and maximise productivity. The impact of changing catchment water balances stands out as a major potential issue for forestry (regarding the water use efficiency of forests) and for the wider community.

Examples of potential biological research areas include species selection, promoting pest and disease resistance and management, silvicultural management and breeding programs. There is also a need for more research to better understand the likely changes in forest fire patterns and severity.

7.1.2 Eligible forests in the CPRS

For those plantations that can participate in the CPRS the value of the forest resource is likely to increase over time. While commercial gains are currently constrained by emissions liability on harvest, future changes to the CPRS may result in greater recognition of the forest carbon life cycle, particularly if carbon storage in wood products is part of a longer term international agreement.

To be eligible for coverage under the CPRS, plantations must have been established on or after 1 January 1990 and be on land that was previously cleared of forests. Currently, there is limited information available on the area of eligible plantations in Tasmania. A large proportion of the hardwood pulpwood and sawlog plantations in Tasmania are known to have been established after 1990. An analysis of Forest Practices Authority annual

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reports from 1999 to 2008 reveals that 66% of clearfelled forest on private land was converted to plantations and 58% of clearfelled state forest were converted to plantations (Peter Taylor pers comm.). The inclusion of Tasmania's hardwood plantations in the CPRS will be significantly limited by the proportion of these conversions. Softwood plantations in the Tasmania were mostly established before 1990 and there may be few eligible plantations under the CPRS.

As discussed earlier, under the CPRS natural forests set aside for multiple-use are not eligible to participate. However, there may be opportunities to produce voluntary carbon emissions offsets (see Section 7.1.4).

7.1.3 Expansion of the forest estate

The introduction of the CPRS will open opportunities to expand the forest estate two ways: commercial forest expansion for wood product production and carbon sequestration; and environmental forest plantations for carbon sequestration only. As discussed in Section 6.1.1, land prices and alternate agricultural industries in Tasmania are strong as to the relative attractiveness of environmental plantings is thought to be low relative to other states.

The potential forest expansion in Tasmania as a result of the CPRS will thus likely be predominantly to supply domestic sawlog processors who are likely to experience increased demand for their products by having a competitive advantage over higher emissions intensive products such as cement and steel. The area of plantations required to supply the increase in wood products demand is uncertain and will require further investigation to understand. However, the combination of increased wood product demand and the generation of carbon credits is predicted by Treasury to encourage the expansion of forestry on current agricultural lands.

However, as noted Section 6.1.1 this is subject to a range of assumptions that do not pay due regard to a range of social and economic constraints to plantation expansion. There is scope for government and industry to develop approaches that address such constraints.

Another option to facilitate an increase in carbon storage in existing plantations is the scope for converting existing hardwood pulpwood plantations to sawlog rotations, once existing pulpwood plantations are harvested. It is unlikely that existing pulpwood plantations could be readily converted to sawlog production by changing management practices. While Tasmania already has a large proportion of hardwood sawlog plantations, there are much larger areas of hardwood pulpwood plantations that could be re-established post harvest to produce sawlogs and pulpwood. However, the scope for such changes may also be limited by the proportions of plantations established on land not cleared in 1990. In the absence of adequate plantation expansion to supply increased demand for wood products, their prices are likely to increase, particularly those products in high demand such as structural sawn timber for housing.

7.1.4 Voluntary offsets for native forests

Whilst native forests are ineligible to participate in the CPRS, voluntary carbon markets exist that allow forest owners or managers to participate in emissions trading outside the CPRS. Under international carbon certification schemes (see section 5.4) a range of emissions sources can be abated and recognised, providing these actions are additional to 'business as usual' activities.

Emissions from the forestry sector can result from implementation of forestry operations such as harvesting, fertilisation and site preparation, as well as from fires (e.g. controlled burns, burning of residues after harvest), and from soil disturbance during harvest. Potential emission sources from forestry operations may also include fuel use in machinery and to a lesser extent, from chemical use such as fertilisers and herbicides.

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Under international voluntary carbon certification schemes forest managers can reduce emissions associated with the above sources and gain recognition in the form of tradeable carbon credits. This can be not only a financial benefit for forest owners but also a way of generating public awareness that a commercial forest is reducing its environmental impact. The Garnaut Review (2008) notes development of the CPRS is likely to 'cannibalise' voluntary markets as voluntary activities convert to CPRS activities. However, he also points out that voluntary demand for offsets is likely to continue despite the CPRS most likely by way of the individuals and organisations that are not covered under the scheme. In this regard he recommends the ongoing development of robust standards for voluntary offsets.

There is a long term plan to design an offset scheme for emissions from agricultural soil carbon and savannah burning. The soil carbon and burn off emissions generated from native forestry may be eligible for contributing under these schemes when they are eventually implemented.

7.1.5 Forest carbon accounting methods

As the value of carbon in forests is realised and incorporated into the CPRS, there will be a need to develop increasingly accurate means of measuring, predicting and reporting on carbon stocks. This will include developing more sophisticated models for assessing carbon sequestered in forest estates but also the carbon that is stored in wood products, which is a complex but increasingly important area.

7.2 Harvest and haulage

To adjust to the increased cost of transportation fuel, harvest and haulage companies may need to adjust operations to minimise fuel consumption or invest in alternative fuel or vehicles to increase efficiency. Some of the adjustments that may be possible include:

- Purchasing more fuel efficient vehicles;
- Investigating new fuel technologies over time; and
- Rationalising transportation routes or haulage arrangements, including increasing back loading where possible.

The rate at which operators pursue the above options will depend on the scale of the cost increases under the CPRS.

7.3 Processing

The following sections outline the major opportunities arising for forest processors as a result of climate change and the CPRS. Table 7-2 outlines the opportunities and summarises the relevance by processor type.

Table 7-2 Summary of opportunities for processors as a result of the CPRS

	Sawn timber	Panels	Veneer	Pulp & Paper	Woodchip export
Energy use	✓	✓	✓	✓	
Product competitiveness	✓	✓	✓		
Centralisation/relocation	✓	✓	✓	✓	✓
Bioelectricity	✓	✓	✓	✓	

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7.3.1 Energy use

Because increased electricity costs are likely to be the biggest impact of the CPRS on many forest product producers, there will be a strong incentive for processors to re-assess both the source of their electricity and the efficiency with which it is used at the processing facility.

It is likely that there will be a range of opportunities for addressing under-utilised or wasted electricity in processing facilities, and new investments in more efficient equipment and components may be justified where electricity cost savings outweigh the expenditure on efficiency. There is also the opportunity for increased on-site use of residues for heat and energy consumption.

7.3.2 Product competitiveness

As outlined in the Treasury modelling (Treasury 2008), under the CPRS forest products are likely to experience an increase in cost competitiveness relative to more emissions intensive competitors such as cement and steel. Table 7-3 shows that the GHG emissions intensity of timber production is much lower than that of competitor products such as steel, aluminium and concrete. This means that the increase in production costs for timber arising from the CPRS will be less compared to many competing products. While compensation under the CPRS will narrow this gap for high emissions intensity products in the short term, because these competitor producers will still need to pay some costs for emissions permits their relative costs of production will still increase. The cost advantage for forest products, however, is likely to become greater in the longer term. A greater competitive advantage would be realised for the forest products sector should there be recognition of carbon storage in wood products.

Table 7-3 GHG emissions of a selection of wood and non-wood products

Product	GHG emissions per tonne material (CO ₂ -e/t)	Emissions from electricity (%)
Hardwood (rough sawn kiln dried)	0.23	50
Softwood (rough sawn kiln dried)	0.234	64
MDF	0.726	47
Particle board	0.982	9.9
Aluminium	22.4	83
Steel (blast furnace)	2.55	5.9
Steel (scrap-based electric arc)	1.1	81.8
Cement	0.77	13

Source: George (2008)

A risk of the CPRS is that Tasmanian forest products are likely to become less competitive against producers from countries that do not have an emissions trading scheme. The CPRS will affect segments of the supply chain differently, and the uncertainty of the actual costs imposed on businesses means that the change in competitiveness cannot be readily predicted. The greatest risk is probably with the pulp and paper industry which is characterised by a competition from world scale producers in developing countries that are likely to have less restrictive approaches to carbon pricing than proposed in the CPRS, although the direct assistance that will be provided to EITE industries is aimed at counteracting the effects of such changes. However, it could be expected that producers already close to margins of profitability could be exposed to competitive threats. On the other hand, log exports may experience an increase in competitiveness internationally due to the potential

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benefit from forest carbon credits and the absence of downstream processing costs. However, this is likely to be balanced by an increase in demand for wood products domestically.

The performance of forest products against competitors will not simply be limited to cost competitiveness but also to the marketing strategy of producers. Sustainable forest products are inherently low carbon and hold a considerable advantage over most other products. If the competitiveness changes that result following the CPRS are combined with well targeted marketing of the benefits of forest products, the industry stands to create a competitive advantage beyond the change in product cost structures resulting from the CPRS.

7.3.3 Centralisation or relocation of facilities

There will be a general increase in the price of fuel under the CPRS which will have a wide ranging cost imposition on the processing sector. Higher costs associated with transportation of logs from forests and to markets are likely to encourage efficiency savings by processors particularly around minimising the handling of resources. For any secondary wood product processors, this may provide cost advantages for relocating closer to primary processors, or processors generally locating themselves closer to the forest resource, to reduce log transport distances. This effect could be expected to increase the attractiveness of the development of a kraft pulp mill in Tasmania as the cost of transporting raw materials increases under a carbon constrained global economy.

7.4 Bioelectricity

There are currently no significant sources of bioelectricity¹⁴ production in Tasmania. However, under the CPRS it represents a strong opportunity particularly for forest products processors, who rely on large amounts of electricity in production. The best opportunities are likely to lie in on-site bioelectricity generation to insulate processors from the rising costs of grid supplied (National Electricity Market; NEM) electricity which will be significantly affected by the CPRS. However, there may also be opportunities for bioenergy production to supply the national grid either through co-production for on-site use or through dedicated bioenergy facilities.

Because emissions from harvested forests are accounted for upstream of processors by the forestry industry, bioelectricity is considered a 'carbon neutral' energy source under the CPRS. Because bioelectricity is a renewable energy source it is also entitled to produce RECs under the MRET scheme (see Section 5.3.1). Under the MRET scheme the income produced through generators accruing and selling RECs supplements revenue from grid electricity sales (sold at the NEM spot price) and subsidises the relatively higher production costs of renewable energy sources, ultimately increasing its cost competitiveness.

From 2010 to 2030, the MRET scheme is set to expand and mandate 20% renewables component in wholesale electricity purchases. This is expected to raise the price of RECs substantially and, combined with the CPRS, drive significant investment in the renewable energy sector. According to the Treasury modelling most of the additional renewable energy development over this period will be in wind and biomass which are expected to account respectively for 72% and 14% of the additional renewable capacity in 2020.

A detailed investment analysis would be needed to determine whether there is a net benefit to producing bioelectricity at a particular processing facility over using grid based power. However, several broad factors set an optimistic landscape for bioelectricity investment in Tasmania. In particular:

¹⁴ Bioelectricity refers to the production of renewable electricity based on biomass.

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- Grid based electricity costs are likely to increase significantly over the medium to long term until coal (directly fired, not subjected to carbon capture and storage) becomes less dominant as a production source;
- The technology for bioelectricity generation is currently available and well researched; and
- The development of alternative renewable energy technologies, including solar power and carbon capture and storage are uncertain.

7.5 Emerging products

In addition to bioenergy the development of carbon pricing, particularly as carbon prices increase, is expected to create a range of new product opportunities for the forest products sector. These products have been reviewed in URS Forestry (2008) with the key opportunities identified as:

- **Biofuels** - biofuels involve the production of a liquid fuel from plant biomass for the purposes of transportation, heating and electricity production. There are increasing prospects for the development of second generation lignocellulosic based biofuels. However, the production costs currently are not competitive with first generation feedstocks and further research and development will be required before these costs are lowered. Given Tasmania's abundant forest resources it will be in an advantageous position to take advantage of opportunities in the production of biofuels, although it is likely to be another 5-10 years of technology development to establish commercial viability.
- **Activated carbon** – activated carbon is a highly microporous form of charcoal that is valued for its ability to purify liquids and gases. It is commonly used for water treatment, gold recovery and in the food and beverage industry. A significant proportion of the activated carbon supply in Australia currently is based on imports. If an activated carbon product could be produced from the Tasmanian forest resource while remaining cost competitive, there is good potential to replace some of this supply particularly in the case of the Australian gold industry which relies heavily on imported, high quality activated carbon. However, because the Australian market is relatively small, large scale production based on the extensive resource produced in Tasmanian forests may have a negative effect on prices. Information on the suitability of eucalypt species for activated carbon is limited and Tasmanian hardwood species would need to be researched.
- **Industrial carbon** - the use of coking coal particularly for steel making is well established as a low cost supply source for use in production of steel. However, as the cost of coal increases with the CPRS there is potential for charcoal to become relatively attractive as a source of industrial carbon. There is a relatively large volume of residues available in Tasmania and this may help to create a low cost, high scale industry suitable for charcoal production. Research and development on the viability of charcoal production for use in industrial processes, particularly related to the scale of production required and the costs of production is needed before this market opportunity becomes a high priority for Tasmania.
- **Biochar** – sometimes known as 'agrichar' or 'black carbon sequestration', is the term used to describe small particles of charcoal used as a soil additive to provide a form of carbon sequestration. Biochar has also been shown to improve the structure and fertility of soils (Lehmann 2007). Development of this market would require ongoing research and development.

The emerging products identified are not produced on any large commercial scale, however, trials are underway for some products to explore their commercial potential. Detailed investigations of production technologies,

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production costs, resource availability and markets for the products will all be required before large scale investment in production can be made.

7.6 Implications for future development

It is clear that global climate change and associated government and community responses, particularly through the introduction of the CPRS, will have range of impacts on the Tasmanian forest products sector. Tasmania has relatively low net emissions but the extent of its forest resources means that it plays an important part in Australia's overall carbon balance.

The exclusion of native forests from the CPRS will limit opportunities for Tasmania's native forest sector to play a direct role in meeting future greenhouse gas emissions targets. While a significant proportion of existing plantations in Tasmania will not qualify for inclusion in the CPRS on the basis that they were not established land cleared prior to 1990, Treasury modelling suggests that Tasmania has the greatest potential of all Australian states to expand its commercial plantation due to the effects of the CPRS.

While there are some risks associated with the cost impacts of the CPRS, in general it provides opportunities for the forest products sector both in terms of potential to generate additional investment in forest resources and to enhance the competitive position of wood products compared to other more emissions intensive competitor products. There is also potential for Tasmania to benefit from emerging forest products industries associated with the CPRS and reducing greenhouse gas emissions.

There are many uncertainties associated with quantifying the potential impacts of these developments in Tasmania. The following are suggested as priorities for research and development activities that would assist in understanding and developing approaches to climate change and the CPRS:

- **Potential for plantation expansion** – while Treasury modelling suggests that there could be between 0.65 and 1.1 million ha of additional commercial timber plantations under a 5% and 15% target for greenhouse gas emissions by 2020 respectively, there is considerable uncertainty surrounding whether these estimates can be realised. While Treasury modelling suggested that there is little scope for expansion of environmental plantings in Tasmania, Polglase *et al* (2008) identified significant plans and potential for environmental plantings in Tasmania. There would therefore be benefit in clarifying the scope for further expansion of commercial and environmental planting in Tasmania, in particular the social and economic factors important to plantation investment.
- **Carbon stored in native forests** – while there has been considerable knowledge developed on the carbon carrying capacity of native forests, Section 3.1.1 outlined the divergence of views on the potential for native forests to store carbon. In particular, while Mackey *et al* argue that carbon storage is potentially much higher than generally perceived and there would therefore be significant carbon benefits in stopping logging in native forests, others such as Adams (2008) and Polglase (2008) dispute both basis of that research and its conclusions. While native forests are not included in the CPRS, which in the circumstances appears a reasonable position, there would be benefit in undertaking independent research to clarify this situation. The outcomes of such research will help address a potentially distracting debate over native forests and help inform managers of public native forests and owners on options they may wish to pursue under voluntary carbon schemes. There is also a need to obtain more accurate estimates of the potential for private native forests to increase stores of carbon.
- **Carbon stored in wood products** – estimates indicate that carbon stored in wood products produced from wood harvested from Forestry Tasmania resources could provide an additional 33Mt of CO_{2-e} storage

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between 2007 and 2050. While the CPRS will exclude forest products, it is likely that there will be considerable debate about the impacts and feasibility of including changes in carbon stored in wood products for a global post-Kyoto carbon emission reduction arrangement. There is scope to further the develop knowledge on carbon stored in wood products in the context of the Tasmanian forest products sector and this could complement research being undertaken at the national level.

- **Bioenergy and other emerging markets** – there are significant opportunities in the potential for bioenergy production utilising wood. This could include wood pellet production for export as well as direct energy generation to meet Tasmania’s current shortfall in electricity generation which it buys from the national grid, as well as the potential for sale of renewable energy to the national grid. Similarly, in the longer term there are opportunities for biofuel production and products such a biochar. Research and development to further explore the viability of resources in Tasmania for these potential uses including potential support for pilot plants (in association with commercial investors) would help position Tasmania to take advantage of these potentially large opportunities.

The Tasmanian Framework for Action on Climate Change (TFACC) suggests it will support these types of developments above. It also proposed that by the end of 2009 Tasmania will make informed decisions on sectoral and interim targets and on the most effective actions to achieve emissions reduction targets. It is clear that the forest products sector will be important to any such state specific targets and that it can contribute significantly. It is therefore recommended that the State government consider support in the areas of research and development identified above.

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Definitions of Treasury projection scenarios

The following table outlines the details of each of the scenarios tested in the Department of Treasury's analysis and modelling of the economic effects of the CPRS.

Table A-1 Outline of emissions scenarios used in Treasury projections

	CPRS-5	CPRS-15	Garnaut-10	Garnaut-25
Global emissions target (ppm)	550	510	550	450
Australia				
-2020 target (below 2000 levels)	-5%	-15%	-10%	-25%
-2050 target	-60%	-60%	-80%	-90%
-Commences	2010	2010	2013	2013
-Permit price at commencement	\$20.88	\$29.10	\$25.00	\$45.00
World				
-2020 target (below 2001 levels)	32%	24%	40%	29%
-2050 target	-9%	-18%	-13%	-50%

Source: Department of Treasury 2008

Review of Green Carbon: The role of natural forests in carbon storage

Phil Polglase

22 Dec, 2008

The report by Mackey *et al.* (2008) concludes that not logging forests across about 8 Mha in south-eastern Australia would be the equivalent of avoiding emissions of 136 Mt CO₂ /year for the next 100 years – about 24% of Australia's 2005 net emissions. Their premise is that not logging forests enables them to grow to a maximum carrying capacity and hence store more carbon.

This review examines their assumptions and the scientific basis for drawing this conclusion.

At the outset the authors make a distinction between 'grey' carbon (stored in fossil fuels), 'green' carbon (stored in native forests not logged) and 'brown' carbon (stored in industrial natural and plantation forests and so called because it involves emissions of grey carbon). The distinction is unnecessary and misleading. In terms of global warming impact, the atmosphere does not distinguish between sources of carbon, only the net amount of CO₂ that is accumulated. The emissions associated with forestry operations are small compared with amounts of carbon sequestered in trees – less than 5% for plantations and generally less than 10% in native forests (Paul *et al.* 2006, May *et al.* 2008). For plantations that are established on cleared agricultural land – that is, those which are eligible for sequestration credits under the Kyoto Protocol and as proposed in Australia's Carbon Pollution Reduction Scheme – the overwhelming balance is a net sequestration of carbon. There is significant further benefit if the harvested wood and residues are used for energy production that substitutes for fossil fuel use. Storage of carbon in conventional wood products may also carry further sequestration benefit.

The authors used a combination of data and modelling to estimate the carbon carrying capacity of native forests and then applied that across 14.5 Mha in south-eastern Australia. Of that area, they state that 56% (8.1 mill ha) has been logged in the past and therefore is kept below the maximum carrying capacity for carbon. The authors state that:

'If logging was halted, the carbon stored in the intact forests would be protected and the degraded forests would be able to grow to their natural carbon carrying capacity. ... the carbon sequestration potential of the logged forests area is 2 Gt C'.

The authors consider a 100 year time frame and thus infer that over that period logging would be 'halted' in the 8.1 Mha, giving an average annual rate of logging of 80,000 ha/year for the next 100 years. Table 1 shows recent, average areas of forest logged for south-eastern Australia. The total average is 20,000 ha for NSW, Vic and Tas combined. If those rates were to continue for the next 100 years and no single forest was logged twice, the total would be 2 Mha rather than the 8.1 Mha assumed.

Table 1. Areas logged in south-eastern Australia over recent 5 year periods (BRS, 2008).

State	NSW ¹	Vic ²	Tas ¹	Total
Area logged (ha)	8,357	5,913	5,655	19,926

¹Period 2001-2006

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²Period 1996-2001

The authors calculate that the average carrying capacity of mature forests is 360 t C/ha in the biomass, which includes live vegetation, understorey and dead litter. The numbers are plausible. Grierson *et al.* (1992) estimated carbon content of Victoria's forests using detailed inventory data (Table 2). The numbers are for the above-ground live biomass of the dominant trees only. The average carbon stock for the more productive forests is 229 t C/ha. If amounts of carbon in understorey, roots and litter such as dead trees are included, the number would be greater by 100 t C/ha or more. This would put the estimated C content at +330 t C/ha.

Based on a previous modelling study (Roxburgh *et al.* 2006), the authors assume that logged forests contain 60% of the carbon of a mature forest that is at maximum carrying capacity. Data are scant to verify this assumption and it will depend on the rotation length and age of the logged forest. The data of Grierson *et al.* (1992) are partly based on forests that have been logged. That places the mean C density of logged forests much nearer to the mature state than the 60% assumed by Mackey *et al.*

Table 2. Summary areas and carbon contents in above-ground components only in Victoria's forests in 1992.

Forest type	Area (ha)	Mean C density above-ground (t C/ha)	Total C above-ground (t C)
Alpine ash	311,997	197	61,463,409
Mountain ash	181,989	246	44,769,294
Shining gum	13,057	235	3,068,395
Mountain mixed species	464,761	212	98,529,332
Foothill mixed species	2,639,735	239	630,896,665
Alpine mixed species	203,224	250	50,806,000
Coastal mixed species	404,050	190	76,769,500
Closed rainforest	110	210	23,100
Totals	4,218,923	229	966,325,695

It is apparent that the authors have incorrectly interpreted the paper of Roxburgh *et al.* (2006) from which the 60% number is sourced. Roxburgh *et al.* stated that, for their case study, the amount of carbon in logged forests was 60% of the mature, unlogged forests, *for the above-ground components only* (including dead litter). Mackey *et al.* included soil in their calculation, assuming a difference of 270 t C/ha between the mature and logged forests (Table 3). When the correct interpretation of the Roxburgh *et al.* paper is used, the difference should only be 140 t C/ha. Again, that number is uncertain and is very possibly less than that based on, for example, the data of Grierson *et al.* and the fact that the productive forests of the study are periodically burnt and thus will have a range of age classes – that is, they will not all be in a mature state. The carrying capacity of forests will thus not be the estimated amount for any given patch of mature forest, rather at landscape level it will represent an average (and lower) value reflecting the fire history for the past 200 years or so. Moreover, the extent to which mature, previously unlogged forests are burnt in the future and initiate a new stand also needs to be taken into consideration. The authors acknowledge that they do not know what the age structure is of the

14.5 Mha of their study area. They calculated a maximum carbon carrying capacity for forests and then applied that across the whole area, essentially assuming that whole area had not been burnt for centuries and that all forests has reached a mature state.

Table 3. Summary assumptions in the Mackey *et al.* report. It includes the correct interpretation of the paper of Roxburgh *et al.* (2006) that estimated that the carbon content of logged forests was 60% that of mature forest for above-ground components only.

Assumption	Biomass	Soil	Total
Carrying capacity (a)	360	280	640
Logged forests (Mackey) (b)	90	280	370
Logged forests ('correct' interpretation) (c)	220	280	500
Difference: Carrying capacity – logged (Mackey (b-a))			270
Difference: Carrying capacity – logged ('Correct' (c-a))	140		140

During the period 2001-2006, there were an average of about 683,000 ha/year burnt across NSW, Vic and Tas. This includes the mega fires of 2002/03 but excludes those of 2006/07. Many of these fires were stand replacing and in some cases, will have destroyed the pre-existing ecosystem, especially those burnt by both the 2002/03 and 2006/07 fires. That is, the stands will not regenerate easily to the previous vegetation type. In Australia, it has been predicted that the number of extreme fire danger days could increase by up to 300% by 2050 compared with 1990 levels (Lucas *et al.* 2007). Clearly, a true baseline for the carbon storage potential is that which exists today and includes all past disturbance histories.

Table 4. Average annual areas of forest burnt between 2001 and 2006.

State	NSW	Vic	Tas	Total
Area burnt (ha/yr)	398,529	263,115	21,062	682,706

The authors also use in their calculations an 'equivalence factor' to account for the benefit of carbon stored in trees being kept out of the atmosphere for a 100 year period – as opposed to releasing a pulse of the entire emission up front. This factor multiplies their calculated sequestration potential by 1.8. This seems unjustified, it is not how the accounting rules work and in any case, it assumes that all of the emissions would be stored in a single year up front – the inverse of emitting stored carbon in the first year.

Conclusions

The report by Mackey *et al.* (2008) contains a number of flaws and assumptions which obviate their main conclusion. They are right to point out that Australia has some of the most productive forests in the world and

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which are a large store of carbon. An increased frequency of mega fires, drought and associated stresses represent by far the most significant threat to that store of carbon. Those issues require urgent attention.

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