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The case for renewed development in plantations Identifying forest values and the constraints to attainment – Stage one

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The case for renewed development in plantations Identifying forest values and the constraints to attainment – Stage one

Prepared for

Forest & Wood Products Australia

by

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Executive Summary

The Centre for International Economics (CIE) has been commissioned by Forest and Wood Products Australia to assess the case for investment in wood fibre, from long rotation forestry (Stage 1) and, provided this case is sufficient, to develop options for policies and initiatives to help realise these values (Stage 2). The underpinning rationale for the project was that the economics of investing in long rotation plantations, unviable under the status quo, could be improved if impediments to the operation of efficient markets were alleviated including through placing a value on 'externalities' provided by plantations.

With the assistance of Rob de Fégely, the CIE has concluded the first phase of the research with the findings discussed in this report. The first phase has confirmed there is a case for renewed investment in wood fibre, principally through policy intervention. The research in this phase focuses on identifying:

- the evidence for the existence and importance of values from plantation forestry; and
- the factors that are currently constraining these from being realised.

The 'problem'

Preliminary research suggests that payments of between $20 and $50 per tonne CO_2–e would be required in order for the area of plantations to expand. Thus, without substantial payments for environmental services, such as through a carbon price or the alleviation of other substantial constraints, the expansion of the area of plantations will be unviable. At the same time, there is expected to be a significant retraction of the area of plantations established under the MIS scheme.

This report confirms that the existence of market failures or other impediments in the domestic context (as well as internationally) are impacting the efficiency of markets for forestry. The level of investment in trees in Australia could be below the economically-efficient level. The most significant constraints recognised are in relation to:

- 'externalities' whereby the free market does not fully take into account the benefits from the production and consumption of *environmental* services provided by plantations;
- other policy-induced circumstances whereby policies to correct market failures may not be conducive to efficient forestry markets; and
- technical and commercial hurdles in relation to the development of bioenergy, biofuels and biochar and risk in the development of new products and markets including high value hardwoods and wood fibre in low rainfall areas. R&D is required to overcome such risks and hurdles; there may be a rationale for government investment on the basis of positive social outcomes from reducing risk in forestry investments and reducing reliance on native forest harvesting, as well as the increased level of public benefits from externalities derived by trees and forest biomass.

The key message from our research is that, due to the unique position of the government in facilitating reform to 'correct' for market failures and as the principle (potential) customer of environmental services provided by plantations, the future of investment in long rotation

plantations is dependent on governmental recognition of the benefits associated with the removal of impediments.

Other types of constraints identified in this report which may involve more industry-driven strategies include:

- coordination issues — including between industry and potential customers of environmental services (such as CMAs) and among industry. Improved coordination could facilitate better access to customers including for salinity credits, whereby opportunities for salinity payments are highly fragmented, and/or improved access to investors including through strategies to improve price transparency and competition.
- perceptions of forestry and community or political persuasions against forestry. Negative perceptions of forestry can expose the industry to unbalanced policy development and prevent the necessary reform to 'realise' values including environmental values such as carbon.

Table 1 shows key values and constraints associated with plantation forestry. It also summarises our assessment of the 'weight of evidence' for the existence of these values and the scope of the opportunities offered by removing the constraint/s.

The 'scope' is a function of both the weight of evidence and the nature of the identified constraints in terms of CIE expectations of the extent to which constraints may be alleviated through government or industry responses. Time frame has not been taken into account, however, generally where there are significant research and development hurdles, as in the case of bioenergy, biofuels and biochar, or there is a need for more rigorous scientific evidence, as in the case of biodiversity, there would be a longer time frame involved in attaining values.

1 **Environmental, economic and social values of long rotation forestry**

		Values	Evidence of value	Constraints to realisation of value	Scope
ENVIRONMENTAL-ECONOMIC	1.	Carbon sequestered in trees	Strong	Domestic market non-existent, carbon legislation prevents recognition of values - political rather than scientific constraints	√√√
	2.	Carbon sequestered in wood and soil	Strong	Excluded from international framework	√√
	3.	Low carbon emissions intensity relative to alternative land uses	Strong	Emissions from major alternative land use (agriculture) excluded from policy framework	√
	3.	Salinity mitigation including water quality improvements	Strong	Highly fragmented exchanges, non-existent markets Opportunities are in low and medium rainfall areas, which are less commercially viable than higher rainfall areas Demand from CMAs in medium rainfall area less consistent, coordination difficulties for industry Significant R&D challenges in low rainfall area	√√
	4.	Biodiversity from commercial plantations	Mixed	Lack of consensus in scientific literature of biodiversity value	√
	4a)	General biodiversity value compared to alternative land uses	Mixed	Some consensus that biodiversity values better than agricultural land uses, but community preferences for expenditure on protection of more mature natural assets	√
	4b)	Biodiversity corridors and landscape-scale networks or other specific biodiversity management strategies	Some evidence	Valuation techniques still developing. R&D required on role of plantations in broader landscape	√
	5.	Public benefits from farm forestry (salinity mitigation, biodiversity)	Some evidence	Landholder reluctance to plant trees due to commercial reasons, alternative competing uses for trees involving alternate or limited management of trees, resistance to grant rights to harvest to companies, fragmented and small resource pockets	√√
	6.	Environmental benefits from trees in SMZ (water quality improvements, aquatic and biodiversity benefits)	Strong	Regulations may be unnecessarily prescriptive or impose excessive constraints on harvesting in SMZ due to low risks shown in research from harvesting in riparian areas	√
	7.	Future productive capacity and biodiversity in private native forests (avoidance of degradation to private native forests)	Evidence of forest degradation. Linkages with biodiversity values less well defined.	Regulations contain uncertainty around future rights to harvest, depending on jurisdiction. Incentive framework does not reward sustainable forest management and biodiversity	√√
	8.	Bioenergy as a low emissions alternative to other energy sources	Strong	R&D needed to improve commercial viability, established markets on a knife edge in terms of viability, significant challenge to secure the necessary resource to ensure viability due to cost of transporting the resource, bioenergy markets cannot compete with woodchip for export markets	√√√
	9.	Second generation biofuels as an alternative, less energy intensive fuel to first generation biofuels and reduce GHG emissions relative to liquid fossil fuels	Strong		√√√

(Continued next page)

1 **Environmental, economic and social values of long rotation forestry** (Continued)

	Values		Evidence of value	Constraints to realisation of value	Scope
ECONOMIC	10.	Biochar (soil productivity and carbon storage benefits)	Uncertain	R&D barriers still high, limited data for model verification purposes, too many unknowns to develop GHG accounting methodology, pyrolysis plant used to produce biochar only viable if other products are developed	√√
	11.	Removal of market and pricing distortions (impact on risk, pricing, transparency, market access)	Significant documentation issue, but extent of impact difficult to assess	State forestry agencies need further reform to improve price transparency and promote competitiveness and transparency Industry solutions required to broaden and deepen markets, particularly in low rainfall areas and for low value product	√√
	12.	High value markets	Some evidence	No significant resource base or processing capability for high quality hardwood plantation resource R&D required for tree and wood quality improvement	√√
			Evidence that taxation rates overseas have played a significant role in investment level and structure	Hidden taxation and superannuation barriers: taxation discriminates against long term savings — not all investors can access superannuation, superannuation funds do not typically invest in Greenfields (alignment issue between tax structure and investor needs), small holders and private individuals not always in a position to deduct income up front, lumpy returns impose higher tax rates than other more steady income	√√
SOCIAL	13.	Reduced risks associated with investment in forestry and reliance on native forest harvesting	Evidence that these factors affect social values	Risks associated with growing long rotation trees are substantive — these risks reduce the attractiveness of forestry to communities High R&D hurdles to replace native forest harvesting with plantations for high quality appearance grade timber. Significant appeal among community	√√
	14.	Socio-economic benefits from forestry compared to alternative land uses	Weak	Agriculture is significantly more socially acceptable than plantations. Higher employment multipliers only represent a case-by-case and politically determined ‘value’ in near-full employment economy	√√
	15.	Benefits from reducing negative perceptions: more conducive policy environment	Strong	Social perceptions are a barrier — generally forestry is not recognised as environmentally positive in cleared rural landscapes	√√

Source: CIE.

Integrating landholders and commercial investors

Whilst all investors require a more competitive return relative to the risk they take on in order to invest in long rotation plantations, there are unique factors which drive and constrain each investor. Table 2 characterises the drivers and constraints of the various types of investors. Importantly, processors require a relatively secure resource base, as well as satisfactory accessibility to the resource and quality parameters consistent with their processing capacity and business model. Therefore, if there is to be a viable commercial long rotation plantation industry in Australia we must give consideration to the investors and investment models which may supply the volume of resource necessary for the processing industry.

2 **Drivers and constraints to investment in plantations by stakeholder**

Investor	*Interests*	*Factors constraining investment in long rotation*
Forestry companies	▪ Profit (resource price, security of market)	▪ Economic barriers (entry costs, risk, return)
Processors	▪ Profit (resource security, resource price, resource quality)	▪ Economic barriers (entry cost, risk, return)
Private individuals	▪ Liquidity ▪ Comparable risk free rate of return or superannuation (lower taxation rate)	▪ Lack of liquidity particularly 0–15 years ▪ Poor record of forestry ▪ Constrained in capacity to assess risk ▪ Insufficient returns relative to other assets
Institutional investors	▪ Portfolio diversification ▪ Holding for medium term (<15 years) ▪ Large investments (not small parcels)	▪ Insufficient returns to risk for Greenfields ▪ Inability to sell asset in first 15 years ▪ Expertise required to identify, assess, acquire and manage commercial and farmland assets
Landholders / Cooperatives	▪ Multiple use benefits	▪ Economic barriers (opportunity cost of money and land, uncertainty, high entry costs, alternative use values of trees such as amenity values and expertise required to manage assets)
Government and taxpayer	▪ Social and economic imperatives, for example, regional employment ▪ Reduced deforestation ▪ Water use management ▪ Environmental objectives	▪ Conflicting objectives (commercial viability versus regional development) ▪ Social perceptions associated with MIS ▪ Competing land uses and predisposition of communities and policy toward agriculture

Source: House of Representatives Standing Committee on Agriculture, Resources, Fisheries and Forestry, 2011. CIE.

Landholders may form an important part of the resource base as they could be driven, under the right incentives, to establish long rotation trees. There are several important attributes of landholder investment in trees:

- They derive multiple use benefits from trees such that they may be less impacted by the long time frame to gestation than commercial investors.
  - Whilst economic barriers continue to hinder landholder investment, due to the multiple values derived from farm forestry it represents a very competitive mechanism for CMAs or state agencies to prompt investment through a small payment to achieve salinity, biodiversity and other objectives.
- Farm forestry also represents a highly acceptable form of plantations and source of environmental services for the taxpaying public.

There have been wide-ranging efforts to establish farm forestry, particularly over the last decade. However, consultation with industry suggested that farm forestry is not currently receiving any meaningful support which would be required to overcome landholder reluctance. Studies on farm forestry have concluded that landholder reluctance to plant is primarily associated with perceived or actual economic barriers associated with planting, maintaining and harvesting their trees. The CIE identified hidden taxation and superannuation issues which may disadvantage small holders and private individuals investing in forestry compared to agriculture or other assets. Achieving *equal* status with other investments, particularly agriculture, may partially alleviate economic barriers to planting trees.

Nonetheless, compensation for environmental values from CMAs or governments is likely to be required to provoke any serious commitment from landholders in farm forestry.

Private native forests are increasing in importance in some regions in which access to public forests for harvesting activity is diminishing. Best practice silvicultural management (for wood fibre) in private native forests is expected to derive public benefits which do not accrue to the individual landholder, including from the sustainability of the productive capacity of the forest and sustainability of forest ecosystems, health and vitality. These values derive longer term social and economic benefits not fully captured by the landholder, particularly in jurisdictions where the future rights to harvest are perceived to be insecure and there are greater incentives to exploit the resource earlier rather than endure significant costs and risks associated with good silvicultural management.

In line with other research, this report concludes that investment of scale by commercial institutions or private investors will be required if Australia is to have a viable and competitive processing sector for wood fibre.

- Farm forestry, on its own, is unlikely to provide the critical mass or resource security necessary for a competitive and viable processing sector. If landholders act according to their revealed preferences, researchers have suggested that they expect to see most planting by landholders done in initially small and perhaps irregularly shaped plots, creating a mosaic effect across the landscape (Harrison et al, 2002).
- Private native forests may assist in providing competition to markets, principally via a spot market rather than long term contracts. Variation in the quality of the resource and poor incentives for management are likely to reduce the capacity to extract high volumes of high quality sawlogs in the near term.

There are distinct challenges associated with getting commercial investors ‘over the line’, as this will depend on government involvement to recognise the values identified in table 1.

- The underpricing of wood fibre on world markets is expected to persist, imposing a cost on any trade-exposed forestry regions whose prices are driven by world prices.
  - In a small open economy such as Australia, reliance on imports to meet the demand for wood fibre for dwellings and construction does not constitute a significant risk to our economy to justify introducing subsidies.
- Opportunities for the establishment of viable softwood and hardwood plantations remain almost fully exploited as available and suitable blocks of land currently have higher use values.
- There is not sufficient evidence to suggest that commercial plantations derive socio-economic benefits which are greater than alternative land uses.
  - Whilst a net gain in employment is expected if forestry displaces agriculture, where a processing sector exists, the marginal value of employment in forestry in an economy close to full employment is relatively low. Forestry as a strategy to encourage regional economic diversification may apply in some circumstances, such as where labour is immobile, however there is no cohesive or strategic framework in Australia to support this case.
  - Research studies suggest that the expansion of plantations imposes very mixed impacts on the community and structural changes to regional economies and demographics.

This has generated benefits to some (such as through higher land prices and employment) whilst imposing costs on others, such that any dominant expansion in the area of plantations (as occurred through MIS) can cause regional scale transitional adjustment issues.

  - Regional surveys show that agricultural land uses are overwhelmingly viewed as very acceptable and favoured over plantations.

- Environmental externalities will remain at the core of the rationale for public investment in plantations. Payments for ecological services could offer a robust and transparent source of revenue. Establishing these markets remains dependent on the recognition of these values by government, and the communities and taxpayers that they represent.

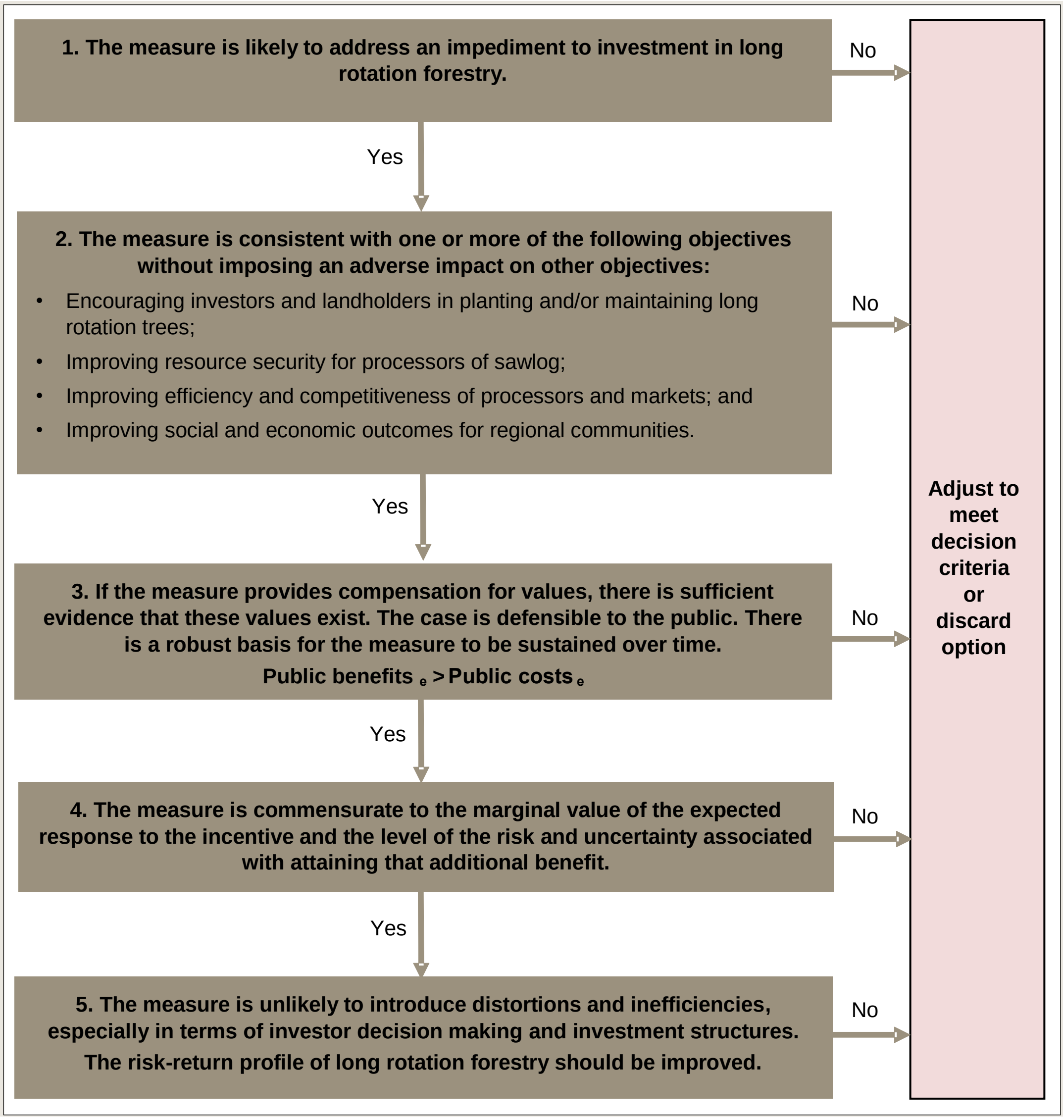
Proposed criteria for examining policy options

From the research conducted in Stage 1, there are grounds to support a 'case' for renewed investment in plantations as we have been able to identify constraints to the operation of 'efficient' markets which allocate resources in an optimal way. Through our analysis and consultation it became clear that attempts to foster investment in forestry such as through the MIS plantings can be well-intended but ineffective and distortive. As such, any incentives designed to target the constraints identified in this report must:

- be carefully designed to avoid harm to the reputation of the industry. The MIS scheme provided very modest taxation incentives in line with what is available to other industries, however, the scheme was associated with inefficient investment structures and decisions involving increased levels of risk; and
- ensure outcomes are sustainable and targeted toward alleviating the barriers to investment in *long rotation* forestry.

Based on our analysis of the constraints/barriers to investment in long rotation forestry, and the lessons from the use of MIS to drive investment, we have developed a criterion to assess the policy options and industry initiatives identified in the next phase of the analysis. Chart 3 provides a series of hurdles to assess the nominated measures. If the five criteria outlined could be *satisfactorily* achieved, the measure should improve the risk-return profile of long rotation forestry investment. The assessment hurdles are designed to provide the rigor of assessment required for the Treasury, whilst also seeking to ensure the measure is consistent with the above-stated objectives.

3 Proposed options assessment framework for Stage 2



Glossary

ABS	Australian Bureau of Statistics
BBi	Biodiversity Benefits Index
BIG	Biomass integrated gasification
CFI	Carbon Farming Initiative
CGT	Capital Gain Tax
CHP	Combined heat and power
CIE	Centre for International Economics
CMA	Catchment Management Authority
CO_2-e	Equivalent carbon dioxide
CRC	Cooperative Research Centre
DAFF	Department of Agriculture, Fisheries and Forestry
ESFM	Ecologically Sustainable Forest Management
EVC	Ecological Vegetation Classification
FMD	Farm Management Deposits
FWPA	Forest and Wood Products Australia
GVP	Gross Value Production
HOR SC	House of Representatives Standing Committee on Agriculture, Resources, Fisheries and Forestry
MAI	Mean Annual Increment
MIS	Management Information Scheme
NPV	Net Present Value
PNF	Private native forestry
PVP	Property Vegetation Plan
REIT	Real Estate Investment Trusts
RET	Renewable Energy Target
SCU	Southern Cross University
SMSF	Self managed funds
SMZ	Streamside management zones
TDS	Total dissolved solids
TIMO	Timberland Investment Management Organisations
TMA	Timber Merchants Association
US FS	United States Forest Service

VIFPC	Vertically Integrated Forest Product Companies
WADLC	Western Australian Department of Land and Conservation
WADW	Western Australian Department of Water

1. Overview

Whilst there has been considerable investment in short rotation plantations over the past decade, very little investment has occurred in new rotations of sawlog plantations since the early 1990s (de Fégely et al, 2011). Research indicates that without substantial payments for environmental services, or other uncaptured values of forestry, an expansion in the area of long rotation plantations is essentially unviable (Paul et al, 2011). Whilst the economics of investing in long rotation plantations is currently unviable, it could be improved if a case can be demonstrated that certain forestry values (environmental, economics and/or social) exist but are not being fully realised in the market.

The Centre for International Economics (CIE) and Rob de Fégely have been commissioned by Forest and Wood Products Australia (FWPA) to examine the case for renewed investment in plantations. The focus of this report is on the case for renewed investment in sawlog plantations (long rotation).

Background on key issues

In 2011, Rob de Fégely, Michael Stephens and Allan Hansard reviewed policies and investment models to support continued plantation investment in Australia. This study developed a model to examine key profit drivers underlying new plantation investment for long rotation softwood and hardwood sawlog plantations. It found that plantation viability in long rotation plantations was most affected and constrained by:

- the high initial costs of acquiring land;
- the high 'opportunity cost' associated with that investment due to the time to revenue generation; and
- the revenue stream being insufficient to counter this long time to harvest.

Institutional investors do invest in *established* plantations however they do not invest in Greenfields long rotation trees which are associated with a higher level of risk. The factors which contribute to higher risks associated with Greenfields investment include the uncertainty around the impact of site characteristics on tree performance including the expected tree growth rate and expected resource quality for a variety of candidate species. In August 2011, Jones stated to the House of Representatives Standing Committee on the Australian forestry industry:

> 'Institutions will not put their money in the ground to plant new trees, because there is too much risk, the risk of whether that particular site will grow a tree, how it will grow the tree, whether it will be a good tree or a bad tree, whether the soils will produce what you anticipate they will produce…'

Due to the perceived risks of forestry, relatively high discount rates of eight or more per cent are commonly applied to assess the rate of return. Although seen as a problem because the value of investment is eroded through discounting over a 30 to 35 year period for long rotation assets, there is no evidence that the choice of discount rate is being influenced by an inaccurate perception of risk.

Once the resource is more established at age 15 or so, whereby the resource has a proven track record in what the yield is likely to be in a particular location, there is substantially more interest from commercial entities in acquiring long rotation plantations in Australia (HOR SC, 2011). That is, the outcome of high upfront costs, high opportunity costs due to the long gestation period and insufficient revenue stream to compensate for risk is that there are no investors interested in establishing trees. For the same reasons private individuals and landholders are also rarely interested in investing in the establishment of long rotation trees.

Another significant barrier to investment in the industry, particularly for processors, is that forestry is an industry of scale which must compete head on with agriculture for land. In 2007, ITC reported that alternative land uses had higher rates of return in a number of catchments including northern NSW, the Murray western slopes, the Murrumbidgee, northern Victoria and the Hunter Valley in NSW.

These issues are not unique to Australian plantations. Typically, to establish long rotations in the past has required in most countries including Australia the involvement of governments either through the establishment of a state owned resource, or incentives to involve the private sector and landholders. Through the Softwood Forestry Agreements Act 1967, the area of softwood in Australia was able to expand from 170 000 hectares to around 900 000 hectares (Catton et al, 2004). The State Forestry Agreements Act enacted a series of five-year agreements whereby the States were initially advanced $20 million in long term loans to establish softwood plantations. The loans were interest free for the first ten years, with repayments commencing 15 after the advancement of the loan and paid over the subsequent 20 years (Catton et al, 2004). After the cessation of Commonwealth funding the state forest agencies were able to sustain only very modest rates of expansion.

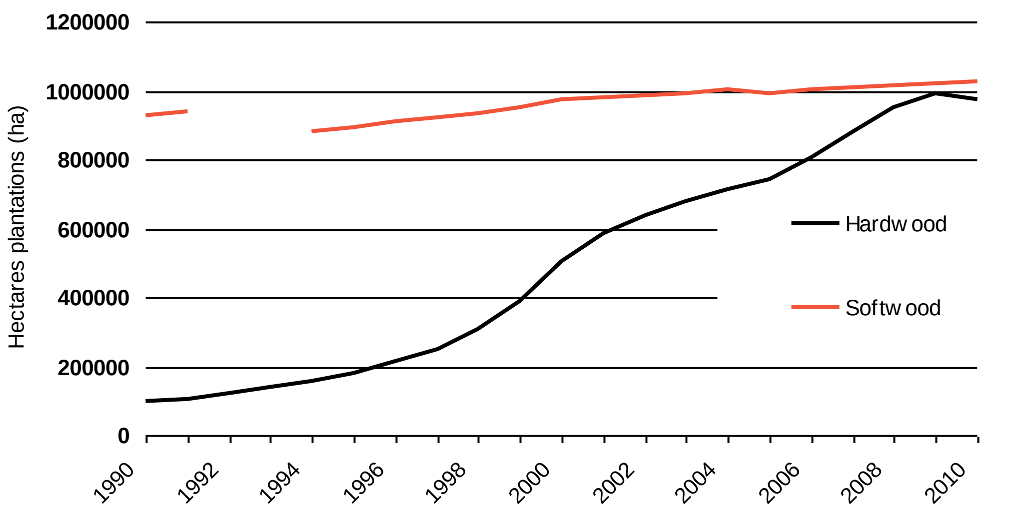
Through these agreements the Commonwealth leant approximately $504 million in 2011 dollar terms (adjusted from Catton et al, 2004). This is equivalent to approximately $690 per hectare of plantation established. In addition, the viability of the plantations was underpinned by the low financial cost of land which was predominantly sourced from the clearing of native vegetation (Catton et al, 2004). Although the state agencies have not been making an acceptable rate of return from a commercial perspective for reasons including underpricing and costs associated with mixed community and environmental objectives, the outcomes from the Commonwealth's investment have been sustained (as the CIE understands) without further financial commitment from the Federal government.

The Australian forest industry is a relatively small player in terms of international production and trade in forest products. This means that in regions in which there are export markets the industry is exposed to world prices (a price taker), albeit the distance from some international suppliers can provide a degree of price resistance as well as through legislation aimed to protect domestic producers from logs sourced illegally. Prices for products produced in long rotation plantations have historically been insufficient to cover the costs and risks associated with developing a sawlog plantation resource. This is associated with international factors including artificially low prices of huge volumes of native resource on global markets including from Siberia, Canada and Newfoundland (HOR SC, 2011). It has also been associated with domestic policies causing the underpricing of forestry assets to achieve social goals such as affordable housing, regional development and employment (Herbohn, 2001).

Business-as-usual scenario

Chart 1.1 shows the area of hardwood and softwood plantations on an annual basis since 1990. The area of softwood established by the states to grow sawlog prior to 1990 has been sustained over the past 20 years but with very little expansion in area. This contrasts to the rapid growth experienced by hardwoods grown for pulp and paper, and wood chip (through short rotation cycles). The hardwood resource is overwhelmingly comprised by short rotation trees.

1.1. **Area of plantations since 1990**



Note: Figures for 1995 to 1998 are approximate. Totals include fallow, mixed hardwood and softwoods and areas for which species was not reported. There is no data on the softwood estate for 1992 and 1993.

Data source: National Plantation Inventory.

The existing area of plantations is under threat of a significant withdrawal and contraction in the area planted, in particular, from the retraction of MIS plantations (short rotation Blue Gums) once they are harvested. However, most of the area established under the State Softwood Agreements is likely to be replanted due to contractual obligations. With a contraction in the area of short rotation plantations, and no increase in long rotations, the processing sector and regional employment may be at risk of stagnation or decline in some regions. There may also be adjustment costs associated with further restrictions in access to public native forests unless an alternative and more sustainable resource base can be identified.

The potential

Australia currently imports a significant volume of wood from overseas. This is commonly cited as an issue for the industry to address, however this may not necessarily represent an economic problem where there are more efficient producers of commodities overseas. However, where there is the potential to supply these markets competitively such as through the removal of existing market impediments, there is an opportunity to expand in to such markets. The very existence of these market opportunities provides an important indication of

the upper limit of a potential expansion of acreage to support domestic markets before significant market growth (such as in export markets) would be required to support prices.

Expansion in to existing market opportunities may be possible in relation to:

- the replacement of imports (see table 1.2), although markets are driven by world prices impacted by a fluctuating exchange rate. Australia is a net importer of sawnwood (mainly coniferous), as well as wood-based panels, driven by plywood imports, and paper and paper board products.
- niche market opportunities for high returns from long rotation hardwoods (see table 1.3).
- the potential to supplement the value lost from the decline in public native forest harvesting particularly in the demand for sawn timber. Hardwood demand accounts for around one quarter of national sawn timber production; this demand is mostly met through native forests with plantations supplying a small volume of low quality sawlog. Market barriers include technical hurdles whereby a better understanding of site suitability and silvicultural management is required to develop a high quality resource, and the considerable time required to develop this resource from a very low base.
- meeting a potential supply deficit in long rotation softwoods for the housing and construction market which could occur concurrently with a potential glut in hardwood wood chip exports. The extent of the deficit will depend on the rate of decline in per capita consumption, the rate of population growth and the impact of a price on carbon on the demand for wood as an alternative to emissions-intensive products.

1.2. **Net exports by category: import replacement areas**

	Unit	*2007-08*	*2008-09*	*2009-10*	*3-year average*
Roundwood	000 m^3	1 044.2	985	1 376.5	1 135
Sawnwood					
Coniferous roughsawn	000 m^3	-81.7	27.1	34	-7
Coniferous dressed	000 m^3	-297.9	-260.6	-354.9	-304
Broadleaved roughsawn	000 m^3	-21.6	-11.7	74.9	14
Broadleaved dressed	000 m^3	-44.5	-28.6	-28.5	-34
Wood-based panels					
Veneers	000 m^3	3.3	64.3	74.4	47
Plywood	000 m^3	-221.8	-146.5	-203.8	-191
Particleboard	000 m^3	-93.4	-52	-54.8	-67
Hardboard	000 m^3	-31.7	-21.7	-31.7	-28
Medium density fibreboard	000	134.8	92.7	48.1	92

	m^3				
Softboard and other fibreboard	000 m^3	-0.1	-3	-4.5	-3
Paper and paperboard	kt	-1 057.1	-886.7	-854.1	-933
Recovered paper	kt	1 275.7	1212.9	1 441.1	1 310
Pulp	kt	-367.5	-322.7	-247.5	-313
Woodchips	kt	6 165.5	5 254.1	4 816.9	5 412

Source: ABARES, 2011.

1.3 **Hardwood timber products — conservative estimates**

Product	***$ (2008) per cubic metre***
Round timbers	
Poles	$60–$220 [a]
Landscape uses	$130–$160
Piles	$130–$300
Girders	$170–$450 [a]
Sawn timbers	
Landscape	$500–$800
Decking	$900–$1 400
Structural timber	$900–$1 800
Appearance grade flooring	$1 000–$2 500
Product	***$ (2008) per cubic metre***
External cladding, screen boards, external architectural use	$1 200–$1 600
Exposed external beams	$900–$1 400
Rural and fencing timbers	$1 400–$2 000
Bridge and rail timbers	$1 800–$3 000
Wharf and marine timbers	$2 000–$3 000
Residue	***$ (2008) per tonne***
Biofuels, bioenergy, biomaterials	$20–$30
Charcoal	$400
Craftwood (MDF particleboard)	$400–$500
Stranded composite timber	$400–$600
Hardboard cladding and related products	$600–$800

[a] Industry experts suggest these estimates are highly conservative

Note: Sawn timbers of 40% but recovery of round timbers 85 up to almost 100%.

Source: Grealy, 2008.

1.4. **Indicative log prices in existing markets**

	Pulpwood (age of harvest)	*Sawlogs*	*Short rotation hardwoods*
	$ per cubic metre	***$ per cubic metre***	***$ per tonne***
First thinning	$12–$17 at 12–15 yrs	Rarely produced	n/a
Second thinning	$12–$25 at 19–22 yrs	$40–$45	n/a
Clearfall	$12–$25 at 30–35 yrs	$50–$75 at 30-35 yrs	>$40 at 10 years *Price depends on distance to port*
$ per cubic metre	$12–$25 per cubic metre	$40–$75 per cubic metre	>$30 per cubic metre [a]

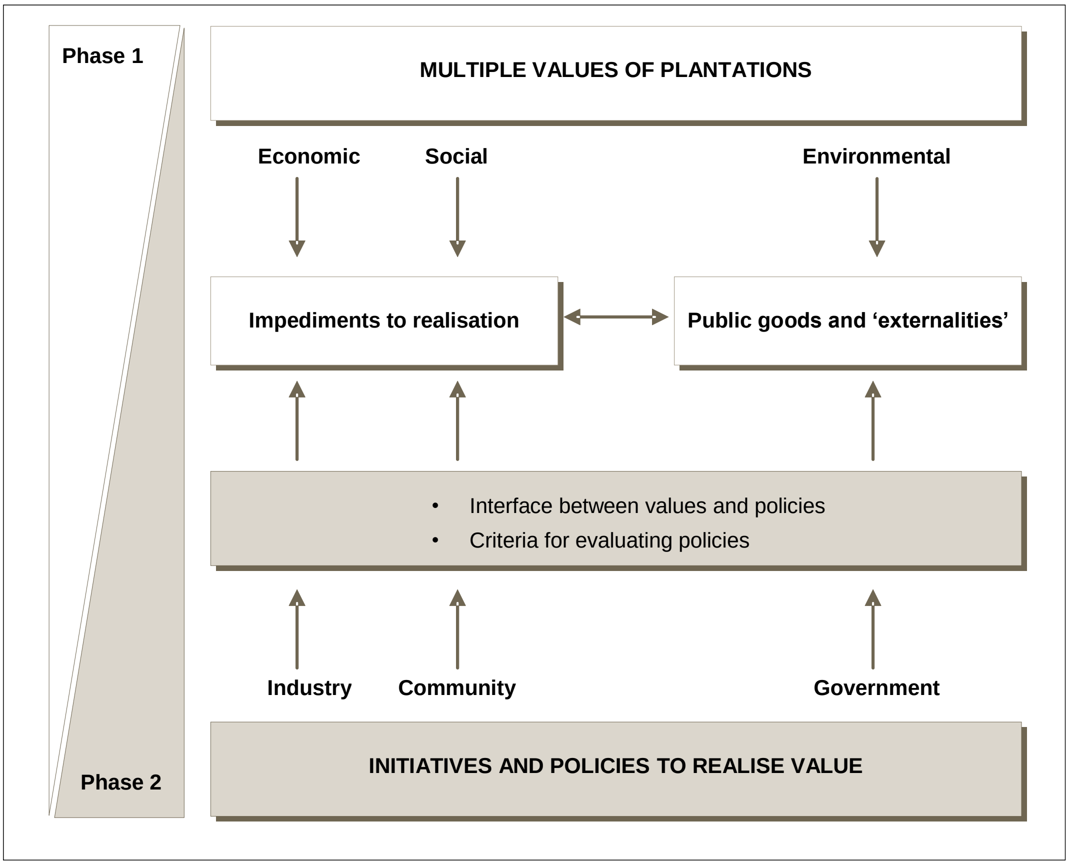
Source: de Fégely et al, 2011.

This report

To improve the viability of investment in long rotation trees and capture the market opportunities discussed above, industry needs to articulate the multiple *values* of forestry to investors including landholders, the government which are accountable to the community and taxpayers, and consumers. There are multiple values of plantations which are either partially or completely uncaptured in the market place.

This report identifies and analyses the economic, environmental and social values of plantations which are not yet being fully realised as a result of their public good attributes or ‘externalities’ and other impediments (see chart 1.5).

1.5. **Framing of the task**

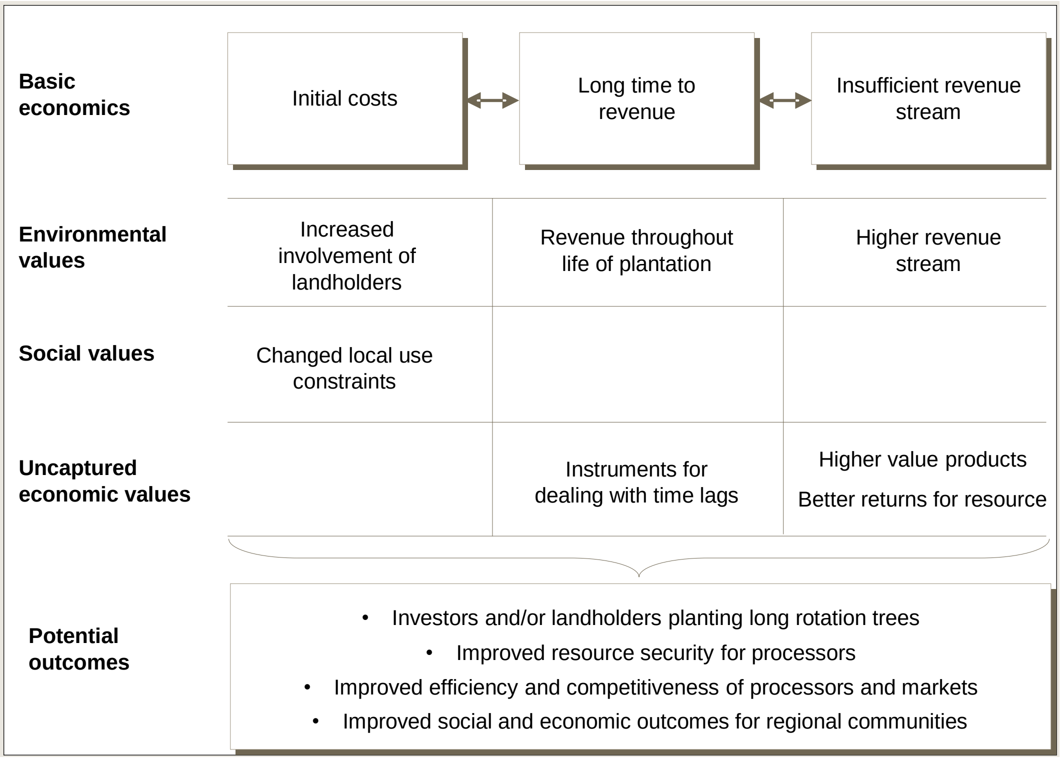


Source: CIE

Governments frequently implement policies to address market failures associated with externalities in cases where price mechanisms do not fully take into account the social costs and benefits from the production and consumption of goods and services. These often concern 'public goods' such as air, water and other ecological services whereby individual actions can positively or adversely affect all yet the positive or negative impacts are not priced in a free market. Potentially the most significant forestry values not being achieved are in relation to the multiple *environmental* services of forestry and wood products (Grealy, 2008). Due to the early stages of development these markets remain relatively fragmented, with some benefits possible through addressing regulatory uncertainties and improving the consistency of treatment towards comparable environmental benefits.

The realisation of such values may involve either or both the government and industry. Greater recognition of the wide range of non-market values has the potential to deliver wide-ranging benefits including increasing revenue and creating an earlier and more incremental revenue stream (see chart 1.6). Targeted measures to remove impediments should promote an improvement in net welfare and offer sustainable solutions which promote industry competitiveness and efficiency, particularly with respect to the processing sector.

1.6. **Linkages between potential values of forestry and impediments**



Source: CIE.

The analysis presented in this report is set out in four chapters:

- chapter 2 covers the environmental values of forestry, including carbon sequestration, salinity mitigation and water quality and biodiversity;
- chapter 3 provides analysis of the factors affecting the markets for environmental and wood values, including market structure and pricing issues, social perceptions, taxation and superannuation, and barriers for the development of new technologies;
- chapter 4 discusses the varying attributes, capacity and role of different forms of forestry in supplying sawlog, including farm forestry, private native forestry and commercial plantations; and
- chapter 5 draws conclusions and inferences from the analysis on the key identified constraints for investors and scope to improve the case for renewed investment in plantations by removing the identified barriers.

2. Uncaptured environmental values

There are a range of potential forestry values that are not being captured. Many of these values are associated with environmental services. They include:

- carbon sequestration in trees, wood products (including landfill) and soil;
- productivity improvements via salinity mitigation;
- water quality improvements;
- support for biodiversity and migration corridors;
- the use of biomass as a low emissions source of fuel and energy (see chapter 3); and
- productivity and environmental benefits from adding biochar to soil (see chapter 3).

There are wide-ranging challenges associated with establishing (and maintaining) markets or other mechanisms to capture these values. They include providing sound and rigorous scientific evidence to link planting or management (inputs) to expected outcomes, developing a methodology to measure/predict potential values associated with 'inputs' and linking the expected benefits to a monetary value. Furthermore, given the dependence of such values on the government, the political and social environment must be conducive to the long term recognition of these values.

Carbon sequestration

Carbon sequestration occurs through the establishment, harvest (particularly in longer life wood products) and replanting of plantation forests as well as through the sustainable management of native forests. These values are non-market values; the extent to which these are captured depends on the regulations and governance of markets for carbon offsets. The multiple objectives underpinning the policy framework around the carbon economy, including political and social imperatives as well as administrative simplicity and compliance to international frameworks, inherently make it difficult to apply a consistent framework to all sources of carbon sequestration and emissions. At present, political and social considerations represent the largest impediment to the recognition of carbon sequestration in trees.

New constraints and costs can be imposed on certain industries as a consequence of such exemptions and exclusions. Importantly, the carbon pricing framework exempts agricultural emissions. Where forestry competes with sheep and beef grazing and, to a lesser extent, cropping for access to land, the exemption of agriculture from the framework will reduce the capacity of forestry to exploit its low emissions intensity relative to agriculture.

As shown in table 2.1, carbon sequestration in trees is covered under the Kyoto Protocol, which forms the basis for Australia's carbon offsets market (through the Carbon Farming Initiative). There are no binding international agreements on carbon offsets for sequestration in wood products and soil. Although there is a framework for carbon sequestered in trees, there is very little current capacity for trees in commercial plantations to be recognised.

4 **Carbon sequestration values and coverage under regulation**

Carbon offsets	*Current regulation*
Sequestration in trees	Kyoto Protocol, Carbon Farming Initiative [a]
Sequestration in wood products	None
Sequestration in soil	None

[a] The Carbon Farming Initiative in its current form effectively does not capture sequestration in trees from commercial plantations.

Source: CIE.

Carbon Farming Initiative

Australia has taken initial steps to recognise emissions avoidance and sequestration in forestry and agriculture, via the Carbon Farming Initiative (CFI). At present the CFI is a stand-alone scheme, although the intent of the legislation was for the CFI to be complementary to a carbon pricing mechanism, which currently exempts emissions from agricultural activities.[1] The scheme covers land sector abatement meaning that any land management practice or activity that enhances biosequestration (sequestration) or reduces agricultural emissions or some waste emissions *could* be included.[2] The scheme splits Kyoto and non-Kyoto abatement projects to assist buyers, because under the Kyoto Protocol, not all land sector abatement is internationally recognised.[3] This is likely to result in some divergence in prices between markets for a given unit of carbon sequestration.[4]

Carbon values recognised under Kyoto but inaccessible under CFI

Despite the Kyoto Protocol recognising carbon sequestered in trees, effectively under the current CFI legislation, industry and investors are unable to value any opportunities of commercial scale due to high levels of uncertainty and prescriptiveness around which projects are likely to be eligible and ineligible.

Under the CFI, projects can be excluded by the 'Negative List' (DCC, 2012).

- The current negative list excludes 'specified tree planting in an area that, according to the CFI rainfall map, receives more than 600mm long term average annual rainfall, unless it is mentioned in the subregulations'.
  - Plantations may be included if established in areas where they make a significant contribution to dryland salinity (up to 800mm average annual rainfall).
  - To be eligible, a water access entitlement is required to offset water interception and provide high security for at least the volume of water likely to be intercepted or where National Water Commission commitments to manage water interception by plantation forests have been adequately implemented.

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1 Parliament of the Commonwealth of Australia, 2011, Carbon Credits (Carbon Farming Initiative) Bill 2011: Explanatory Memorandum, Circulated by the authority of the Minister for Climate Change and Energy Efficiency.

2 Ibid, 2011.

3 Ibid, 2011.

4 Ibid, 2011.

- Furthermore, projects can be excluded if the plantation is perceived to have the potential to be in conflict with other social and environmental objectives. Certain projects will not be able to quality as eligible offsets projects if there is a material risk they may have a materially adverse effect on (Anderson and Synder, 2011):
  - the availability of water;
  - the conservation of biodiversity;
  - employment and/or the local community; and/or
  - land access for agricultural production.
- In addition, based on the current terms outlined in the Positive and Negative Lists industry expects that any forestry projects would need to be native species.
- MIS plantations are also specifically excluded.

The exclusion of forestry projects in areas with greater than 600mm long term average rainfall (as per the first bullet point above) effectively excludes all land areas which may presently be suitable for commercial plantations. The potential to meet the requirements in regions with 600–800mm rainfall is highly uncertain for commercial plantation investors. It is unclear whether this is intended to ensure projects are ‘marginal’ and therefore, meets additionality requirements.[5] All investment in new acreage for long rotation plantations would be ‘additional’ as they are currently unviable.

Even if projects were able to meet the specifications around water and rainfall, there are no bounds to their capacity to be excluded on other grounds. The second bullet point listed above is possibly designed to prevent significant land use change which imposes other significant socio-economic costs on the community. However, in its current form the legislation exposes the industry to the threat of biased treatment which has resulted in industry uncertainty around the eligibility and, consequently, viability of long rotation plantations. There is an emerging risk that agriculture will be systematically favoured over other land uses, particularly commercial plantations. In particular, the availability of water, presumably for agriculture, may be placed ahead of other benefits related to forestry including salinity.

It should be understood that politics is at the heart of such provisions discussed above. Further articulation of the cost of previous land use change (deforestation) and the potential benefits of forestry may assist in more ‘neutral’ policy development (see chapter 3). Australia has a long standing history of deforestation in order to establish food production, around 13 per cent or 100 million hectares of the Australian landscape has been cleared, with much of this in the high rainfall area (Australian National Resource Atlas; cited Clarke, 2009).

Policy analysis and development in the lead up to the release of draft CFI legislation indicated expectations that the industry could be *partially* compensated for carbon sequestered in plantations as a result of tree growth. Values which were expected to be

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5 Under the current accounting framework which adheres to the principle of ‘additionality’, certain types of investments undertaken in Australia will be regarded as ‘additional’ whilst others will not. In addition, to be eligible, carbon sequestration projects are required to satisfy the ‘permanency’ principle which is usually set at a threshold of at least 100 years.

captured under the CFI included *additional* reforestation of long rotation commercial plantations. Burns et al (2011) estimate this could amount to between 190 000 additional hectares of commercial long rotation plantations under the medium global action scenario and 1.2 million hectares of commercial long rotation plantations under the ambitious global action scenario by 2049–50. Tree planting of long rotation hardwood plantations were projected to occur in southern Australia, particularly Tasmania and South Australia (Burns et al, 2011). This represents a significant revision from an earlier report released by Lawson et al in 2008. Lawson et al (2008: cited Burns et al, 2011) estimated a carbon price could stimulate the planting of an additional 3 million hectares of commercial long rotation plantations under the medium price (CPRS-5) scenario and around 4.5 million hectares of commercial long rotation plantations under the high carbon price (CPRS-15) scenario.

Considerations of the economic and social limitations to the expansion of plantations factored in to the Burns et al (2011) study and underpin the substantial downwards revision (from the Lawson et al 2008 study) to the expected additional area of plantation to occur within the carbon framework. The assumptions in the 2011 study included that a water interception charge would be required in timber and carbon plantings with rainfall over 600mm[6], the types of timber plantations eligible for carbon credits was restricted to *new areas* of long rotation plantations, and regional processing could expand to allow (only) a doubling of log harvest volumes from current levels by 2049–50.

Yet, it appears that downward revisions by Burns et al (2011) did not go far enough as investors are suggesting they cannot recognise any potential in the current version of the CFI legislation. The CIE consulted with an investor specialised in the area of environmental markets in Australasia which stated that there was currently no markets for environmental values from forestry and there was nothing in the current CFI for commercial plantations. In the past this investor had only one successful attempt to get a project across the line on the basis of environmental values: benefits from multiple environmental services were required, an intricate knowledge of CMA requirements and a client interested in environmental markets.

An important endowment of commercial plantations is their potential to provide a more cost effective form of carbon sequestration than alternatives such as unharvested environmental plantings. Richardson (2005) shows that a harvested plantation could be a significantly more cost effective form of carbon sequestration than an unharvested plantation even if carbon sequestration were discounted to favour earlier sequestration. Despite high(er) plantation establishment and management costs, the returns from harvesting wood products and residue could result in a significantly lower net cost per hectare (see table 2.2). The estimates reflect carbon storage capacity in wood, soils and landfill. Estimates are only indicative and would inherently vary across different scenarios.

6 No such requirement currently exists for forest owners, but the water interception charge used in Burns et al (2011) was designed to reflect the potential impact of water entitlement requirements for reforestation activities.

5 **Illustration of cost effectiveness of carbon sequestration**

	Unharvested	*Harvested*
	$A(2005)	$A(2005)
Tonnes CO_2 per hectare[a]	337	324
Net costs per hectare	6 526	1 723
Net costs per tonne CO_2	19.34	5.32

[a] Tonnage CO2 per hectare estimated using a Social Discount Rate of 6 per cent.

Note: Costs per hectare are based on a project life of 100 years, a real rate of finance of 5 per cent and a discount rate of 6 per cent.

Source: Richardson, 2005.

Exclusions due to international framework

Carbon sequestration values vary significantly between sites, across plantation (and supply chain) management and product handling. Some carbon sequestration values are broadly excluded from international carbon accounting frameworks due to debates across the forest sector and equity in the allocation of credits including across country borders (Paul et al, 2011b). Scientific studies suggest that there are significant values of carbon stored in wood products (including those in landfill) and there is the potential for increasing carbon sequestration in soils.

Business-as-usual sequestration

The current accounting framework is expected to exclude existing plantations. The current proposal for assessing which projects are eligible through meeting ‘additionality’ and ‘permanence’ requirements is *not* to assess each on a case-by-case basis. Anderson and Snyder (2011) assess ‘the Government’s position is that abatement practices and activities that are in wide use will not qualify as eligible offsets projects’. Currently a plantation established on land prior to 1990 is not eligible for a carbon credit for any sequestration value. Plantations on existing land established post-1990 could in theory be incorporated in the voluntary market, however, on the basis of CFI regulations they are effectively excluded. If included, however, they could represent around 10 per cent of the current area of plantations.[7]

Some industry representatives have indicated that there is a risk of short rotation hardwood plantations not being replanted in future years. It has been suggested that as much as 40 per cent of this market segment may decide not to replant. The reasons for this include the poor productivity of some plantings, the increasing cost of renting land, the difficulty in attracting investment as a result of poor investor confidence in MIS and investor perceptions of risk associated with the excess supply of hardwood chips. A reduction in overall replanting will reduce carbon sequestration and increase effective emissions, even though in an accounting sense it is not expected to amount to an explicit liability to the Australian government.

Short rotation plantations are not able to deal with permanence issues and as such, they are likely to continue to be excluded. Existing short rotation plantation products such as pulp

7 This reflects the share of the plantation estate established post-1990 on land already cleared (around 40 per cent) which is comprised by long rotation plantations (less than 25 per cent).

wood products and wood chips for export retain carbon for only a very short period of time and carbon sequestration values are expected to be highly modest.

Wood, soils and landfill sequestration

Under the current Kyoto Protocol framework a forest will sequester carbon until a steady state is achieved and carbon will be treated as ‘released’ once the trees are cut down. Yet research has shown that storage of carbon in wood products in service continues with subsequent minimal degradation and even beyond this in land fill over long periods (see for example, Ximenes, 2006).

Aside from limiting the capacity for plantation managers to be compensated, the exclusion of carbon stored in wood products and landfill has the potential to impact land use decisions. Whereby plantations are in competition with other land uses (agriculture) these exclusions could reduce their value relative to alternative uses (for instance, other sectors may have improved capacity to increase prices). In addition to lower investment levels in plantation forestry, such exclusions could cause a substitution of investment from commercial plantations to plantations for carbon only. As the carbon price increases, however, carbon plantations are likely to move further into semi arid regions (300mm–600mm) where the viability for commercial timber plantations is currently limited (Paul et al, 2011b).

Some studies have shown that long rotation hardwoods are capable of sequestering more carbon over 100 years than an unharvested (carbon) forest. However, Burns et al (2011) estimated based on the given policy environment that carbon forests were, on average, expected to be recognised as sequestering a higher quantity of carbon per hectare than a harvested forest. The values reflect expectations around average sequestration by plantation type under the CFI framework; as opposed to actual sequestration values which could be significantly higher for commercial plantations (see below). Under the medium price scenario in the Burns et al (2011) modelling:

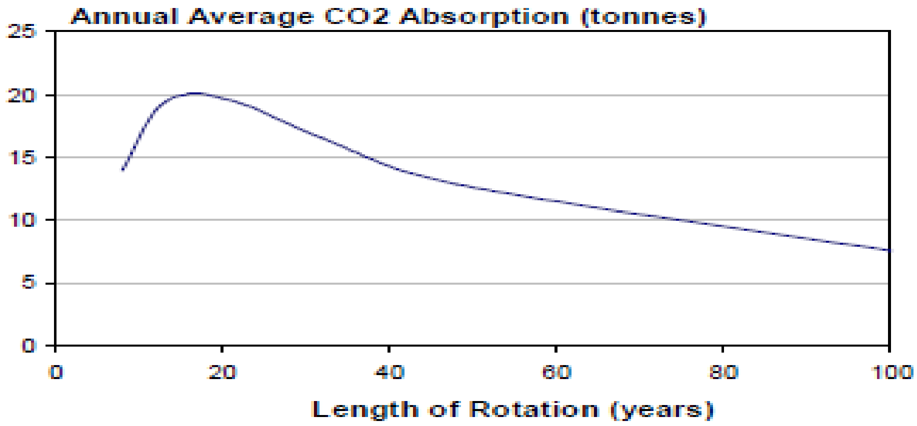
- Long rotation timber plantations are estimated to sequester a total of 35.7 million tonnes of CO_2 across 190 000 hectares from 2012–13 to 2049–50. This is equivalent to around 4.9 tonnes CO_2–e per hectare each year if averaged over the time period.
- Carbon plantations sequester approximately 36.7 million tonnes of carbon dioxide across 157 000 hectares from 2012–13 to 2049–50. This is equivalent to around 6.13 tonnes CO_2–e per hectare each year over the time period.

Carbon sequestration varies widely between sites depending on factors such as rainfall, soil fertility and plantation type which affect the rate of tree growth and carbon sequestration. Under the high rainfall and high Mean Annual Increment (MAI) scenarios the net average carbon dioxide sequestered over a 100 year period could be higher than 40 tonnes per hectare each year. Under low rainfall and poor soil fertility, it could be as low as five tonnes of CO_2 per hectare each year over 100 years (Paul et al, 2011b).

Notwithstanding the significant variation between sites, Richardson (2005) depicts the relationship between the levels of carbon dioxide sequestered and rotation length. Chart 2.3 shows the average annual rate of carbon dioxide sequestration is maximised by maintaining rotations at around 20 years in length in which around 20 tonnes of carbon dioxide is

sequestered each year compared to around 9 tonnes each year for an unharvested resource.

6 **Undiscounted annual average CO_2 absorption in tonnes**



Note: CO2 absorption estimates include carbon sequestered in wood products and landfill.

Source: Richardson 2005, figure 21.

Thus, in this study the ratio of carbon sequestered in commercial plantations compared to carbon forests without discounting may be around 2:1.

Once discounted to reflect a preference towards earlier sequestration, there is very little difference in carbon sequestration between harvested and unharvested (carbon) forests over the 100 years[8] (Richardson, 2005). But what is important is the actual amount of emissions reductions because the price (value) of future emissions reductions will in fact increase relative to the CPI under the carbon price trajectory.

Burns et al (2011) suggested that under the policy framework, carbon forests were likely to be compensated for a greater volume of sequestration than plantation forestry for a given hectare. However, the greater impediment to the industry is the effective exclusion of commercial scale projects from the carbon framework.

Wood sequestration values

Paul et al (2011b) examined a number of regional scenarios as opposed to estimating the whole-of-system or average potential. The study concluded that the additional sequestration values 'captured' from the recognition of carbon stored in wood products would be important, albeit relatively modest.

- It was estimated that the inclusion of wood products would capture an additional 0.75 to 1.32 tonnes CO_2–e per hectare each year, accounting for around 7 per cent of total sequestration.
- The increase in carbon sequestration from the recognition of carbon stored in wood products, even under these highly conservative assumptions, generates improvements in the net present value of a project by an average of 31 per cent at a 5 per cent discount rate

8 The discounted cumulative CO_2 absorption is estimated to be around 324 tonnes per hectare for a harvested rotation (with rotation length of around 20 years) and 337 tonnes per hectare for unharvested plantations (Richardson, 2005).

or 20 per cent at an 8 per cent discount rate. Gains could be significantly higher under a softwood sawlog enterprise (around $3000-$5000 per hectare at an 8 per cent discount rate).

Further refinement of carbon accounting assumptions and methodologies are expected to yield considerable gains. Paul et al (2011b) show significant increases from the recognition of carbon stored in wood under varied assumptions.

- Simply altering the product mix has a large impact. For instance, a separate currently unpublished report which focuses on farm forestry suggests longer rotation sawlogs could store between 0.35 to 4.14 tonnes CO_2–e per hectare each year (Paul et al, 2011a).
- Carbon sequestration in wood products could have increased by up to 17 per cent if the model employed the UNFCCC (2010) rate of decomposition for construction timber (sawlog products) as opposed to rates similar to the IPCC (2006).[9]
- In addition, if assumptions regarding wastage in mill residues were less conservative, maximum carbon sequestration in products could increase by up to 50 per cent and if decomposition rates were halved, maximum sequestration could increase by up to 34 per cent (Paul et al, 2011b).

Sequestration in soil carbon

Crediting carbon sequestered in soil also has an impact on the net present value, particularly where soil carbon content is low and rainfall is high. Up to 4.2 tonnes CO_2 per hectare each year may be sequestered in carbon under some planting arrangements where initial amounts of soil carbon are low.

- In a high rainfall scenario, the NPV of hardwood or softwood plantings may improve by an average of 39 per cent at a 5 per cent discount rate ($3000 to $5000 per hectare) and 26 per cent at an 8 per cent discount rate ($7000 to $10 000 per hectare).
- But under most other scenarios, the benefits were on average less than $2000 per hectare in net present values terms at a 5 per cent discount rate.

There are a number of impediments to the attainment of soil carbon values. There is an initial decrease in soil carbon after afforestation before a gradual increase (Paul et al, 2011b). Any liability to pay for soil carbon might add to up front project costs. In addition, a cost effective means to crediting soil carbon change would involve a modelling rather than sampling approach (Paul et al, 2011b). There is currently insufficient evidence to estimate the range of responses in soil carbon under different soil types, previous land uses, other site conditions and forest management options (Paul et al, 2011b). Paul et al (2011b) suggest that at the present time, given the current uncertainties, ‘modest’ impact of soil carbon and potential for short term liabilities, it may not be worthwhile to account for soil carbon prior to conducting further analysis.

9 Paul et al (2011) assume an average rate of decomposition of 33 per cent for very short products, 11 per cent for short, 4.2 per cent for medium and 2.9 per cent for long and 2.1 per cent for very long term product pools.

Native forest management — uncertainty and risk rather than opportunity

Some academics have argued that there may be significant potential to store carbon in Australia's native forests through incentives to change forest management. However, Australia has not adopted carbon storage through forest management mechanisms in the Kyoto Protocol[10], potentially due to the downside risks associated with the national carbon account whereby Australia would be accountable for all losses (such as from fire) as well as gains (Plantations 2020, undated). Forest management may be incorporated as a non-Kyoto reduction in emissions; the framework for this is still highly uncertain.

There are also areas of contention and uncertainty in relation to native forest management, including:

- the extent to which native forest regeneration (and halting native forest harvesting) could provide a significant source of carbon sequestration; and
- the pathway to increasing the stock of carbon stored in forests.

A modelling exercise conducted by Roxburgh in 2009 suggests that the cessation of native forest harvesting in 2010 across Australia could provide benefits in the order of around 18.7 Mt CO_2 per year, across 8.117 million hectares. This amounts to an offset of 2.3 CO_2–e per hectare per year (assuming a 'low' historical rate of harvesting) or 9.14 CO_2–e per hectare per year (under a 'high' historical rate of harvesting).

Roxburgh (2009) highlights a number of uncertainties associated with estimating the potential 'carbon carrying capacity' relative to current stores. One of these is that there are very few studies available that provide empirical data on the proportion of carbon losses from soil due to harvesting. Earlier studies such as Roxburgh et al 2006 may be relying on areas which were harvested more intensively than other forests, thereby overestimating the deficit in the soil carbon balance in other native forested areas. In addition, estimating the current 'deficit' requires assumptions regarding the rate of harvesting intensity over time, a parameter which is highly uncertain in terms of the temporal and spatial pattern. Furthermore, the spatial variability of forest growth in relation to environmental variables across the unharvested forest estate is also uncertain. But the forestry industry suggests that this deficit is a temporary accounting issue resulting from the non-recognition of carbon stored in wood products and lack of recognition of new regrowth which will eventually restore the forest to equilibrium.

The work undertaken by Roxburgh in 2009 is regarded as a more realistic estimate of landscape carbon storage than earlier assessments (FWPA, 2011a). However, a potential consequence of the research discussed above is that governments may perceive there to be significant carbon sequestration opportunities from the cessation of native forest harvesting. Importantly, commercially harvested plantations are not currently in a position to displace native forest harvesting.[11] The forestry industry has cautioned policy makers of the uncertainties associated with earlier work which suggests there is great scope to attain carbon

10 Currently there is an option to include 'forest management' within the Kyoto Protocol definition.

11 Generally, mature sawlogs in commercial plantations are not equivalent in terms of product quality and may not meet processor specifications in this market.

sequestration from native forest protection (through management or the cessation of native forest harvesting).

Carbon benefits awarded for carbon sequestration in native forest protection are unlikely to be sufficient to change the incentives for native forest harvesting to a profit maximising entity. However, it could play a role in private native forests where the value of resource management is often more marginal.

Summary carbon sequestration

Effectively, there are no carbon benefits in the CFI for commercial plantations despite there being a carbon framework in Australia. The existing arrangements to capture carbon in the economy favour agriculture over alternative land uses, an outcome which is likely to be consistent with policy intent and underpinned by political and social objectives/preferences. However, it should be recognised that such policy biases impose costs on other industries, in this case the commercial plantation industry.

A summary of the potential carbon sequestration values from plantations and private native forestry and their constraints to attainment is presented in table 2.4.[12]

Salinity mitigation

Zhang et al (2007) suggest the most significant role of afforestation in the Australian context could be its potential to reduce groundwater recharge to help manage dryland salinity (Zhang et al, 2007). Strategically located plantations can have positive hydrological impacts on dryland salinity through their capacity to reduce groundwater recharge in addition to providing other benefits of public good nature including support for biodiversity, erosion control and the protection of surface water quality (Zhang et al, 2007). The clearing of native vegetation is associated with the rising of the sub-surface water table as vegetation utilises less water, causing the salt stored in the soil profile to go into solution and be deposited on the land surface thereby causing the land to become unproductive (Lowell et al, 2007).

12 Although the CFI comes into effect on 1 July 2011, existing projects which were established after 1 July 2010 may also qualify (Anderson and Snyder, 2011).

The CIE is aware of two key examples of where plantations have been associated with

7 **Summary carbon values and constraints**

Value	*Application*	*Constraints*
Carbon sequestered in trees	New long rotation	High levels of uncertainty around eligibility requirements. High scope to exclude on the basis of perceived conflicts with other social or economic values.
		Due to negative list (rainfall and tree specifications, and excessive uncertainty for investors) investors cannot recognise the potential.
	Existing long rotation	Commercial plantations effectively excluded.
		Few long rotation plantations established post-1990 on cleared before 1990. These may not meet eligibility requirements such as those associated with water.
		Those established pre-1990 outside Kyoto compliant definition. Unlikely to be covered under non-Kyoto arm due to stringent eligibility criteria.
	Short rotation	MIS plantations specifically excluded.
	Carbon sequestered through native forest management	Uncertainty around extent of opportunity and means to achieve.
Carbon sequestered in wood and soil	Long rotation plantations	Exclusion of carbon in wood and soil.
Forestry as low emissions intensive sector in carbon economy		Emissions from primary competitor for land access (agriculture) are excluded.
Bottom line		**Currently there are no carbon opportunities recognised by potential investors**

Source: CIE.

salinity mitigation:

- the Wellington Reservoir in WA: inflow salinity decreased from a peak of 1275 mg per litre total dissolved solids (TDS) in 1979 to the current flow-weighted mean of 950 mg per litre (McTaggart et al, 2008). This was attributed to plantation establishment and diversions of the Collie River East (McTaggart et al, 2008); and
- the Demark River catchment: annual salinity in the Denmark River peaked at 1520 mg per litre TDS in 1987, but has decreased since 1991 by around 8 mg per litre per year due in part to the groundwater-lowering effects of plantations established after 1988 (Bari et al, 2004).

Salinity in Australia continues to be a widespread problem. Whilst the benefits of reducing salinity have often been expressed in terms of reduced damage to buildings and infrastructure, benefits also include improving the biological and productive capacity of land and improvements to drinking water quality. These benefits vary widely between regions, along with the ability for the commercial plantation industry to extract the ‘consumer surplus’ (or maximum price) for the salinity benefit from governments.

- **Markets for salinity benefits are highly fragmented and exist only in a disparate framework. An investor specialised in environmental service markets discussed with the CIE an isolated case where they approached a CMA to get a long rotation project 'across the line' on the basis of salinity and biodiversity services. This was only possible through an intricate knowledge of CMA objectives, a carbon market which existed in NSW at that time and a unique client. It was an extremely time consuming process which could not be replicated for other clients.**

Water quality objectives have underpinned government policies and incentives to promote tree planting. This has in part underpinned the support for farm forestry and commercial plantations such as in the Cotter Dam Catchment near Canberra and the role of plantations in meeting or maintaining the water quality objectives of CMAs. For example, the 'importance of buffering vegetation in stream-zones and catchments' has been recognised by the Mundaring Weir Catchment (WADW, 2007).

However, there is no market for water quality improvements associated with reduced salinity levels per se, or precedence for compensation of water quality improvements after-the-fact. In the past, benefits associated with water quality improvements have been packaged together with salinity and biodiversity, an approach which is expected to continue. This is a key environmental benefit which could be promoted as a package to the community and decision makers.

An auction-based approach to purchase environmental services from landowners in two catchments in Victoria showed vastly different costs associated with delivering a unit of salinity benefit (Lowell et al, 2007). In the Gippsland catchment, the total cost to establish forest plantations, whereby the grant to landholders was just one component, was $5430 per hectare whilst it was $1635 per hectare in the Corangamite catchment (Lowell et al, 2007). Costs are driven by the number and willingness of the landholders to participate in planting trees and the incentives required to augment participation, the scope for benefits associated with the scale and location of the plantings, and fixed costs per hectare including for model development and calibration (Lowell et al, 2007).

Table 2.5 shows a compilation of the compensation that has previously been granted to landholders, providing a proxy of the future value of salinity benefits from plantations in salinity-affected or at risk areas. Care should be taken in interpreting these values, those with higher values are usually associated with plantations which do not provide commercial wood and offer a multitude of benefits including carbon, salinity and biodiversity.

Salinity mitigation requires large scale plantations. Land prices and other land access

8 **Proxy values of trees planted to improve salinity — payments to landholders**

Initiative	***Year/s***	***Approximate value (2011 dollars) $ per hectare***
Heartlands Initiative	2007	$450 – $1 150
Sawlogs for Salinity – Round 1 Gippsland	2006–07	$1 350[a]
Sawlogs for Salinity – Round 2 Corangamite	2006–07	$1 000[a]
Wimmera River Catchment Tender – Round 1	2006	$900
Wimmera River Catchment Tender – Round 2	2006	$1 300
Murrumbidgee CMA Farm Forestry	2007	$1 100
Under the Replanting Victoria 2020 Initiative		
Port Phillip revegetation including farm forestry to establish carbon sink, address salinity, water runoff and biodiversity loss	1999–2002	$4 050
Corangamite establishment of carbon sink to address salinity, water runoff and biodiversity loss	1999–2002	$3 650
North Central: revegetation of uplands to address high salinity risk	1999-2002	$1 100

a Based on budgeted amounts for tree planting activities and area of trees planned to be planted. Does not incorporate the area of land expected to be improved or saved from dryland salinity.

Note: There are other potentially substantial costs associated with planning, model calibration and scheme administration as demonstrated by Sawlogs for Salinity in Gippsland and the Corangamite.

Source: ITC Limited, 2007; DPIV, 2011b; Coggan et al, 2009; Murrumbidgee CMA, 2007; MacKay et al, 2000.

constraints can affect the capacity for viable plantations in salinity-affected areas without substantial payments for environmental services. Dryland salinity also commonly occurs in low rainfall areas in which land is marginally productive, requiring incentive payments to meet financial hurdles. In higher rainfall catchments plantations have larger offsetting impacts on water yield and stream flow[13] (Zhang et al, 2007). For these reasons, plantation development to improve salinity will mostly be confined to regions with less than 800mm annual rainfall (Zhang et al, 2007). New markets in low rainfall areas would need to be fostered to develop this potential.

Community concerns about water yield impacts and amenity have the capacity to influence local planning decisions such as zoning and preferences for salinity mitigation measures within CMAs. Concerns may, however, be managed through integrated development and community consultation. In addition, improvements in catchment scale modelling have improved the capacity to estimate the volume of the reduction in flows and the net benefits associated with various afforestation schemes. This has the potential to provide significant benefits to the plantation industry through firstly, ensuring that the debate is informed regarding the expected benefits and costs associated with afforestation, including the cost of reduced water flows, and secondly, to provide a suite of options to the community regarding

13 High rainfall areas are associated with the highest reduction in runoff which reduces salt dilution. Trees should be positioned in low to medium rainfall catchments (up to 800mm rainfall each year) where salt stores are greatest but the runoff is less (Zhang et al, 2007).

landscape design and potential outcomes in terms of economic and environmental benefits. As stated by Parsons et al (2007), 'the position of plantations in the landscape and planting design can affect their water use'. Plantation water usage can be minimised at both the catchment scale or site level, however, there may be some trade off with salinity outcomes.

The cost of calibrating these models to various catchments is a significant upfront cost to local governments (Lowell et al, 2007). Investment in the development and calibration of models to assist in salinity mitigation through either commercial plantations or farm forestry could be highly beneficial to the industry, whilst also promoting social and economic objectives. Despite a sound general understanding of the salinity problem, data is often lacking at the local and regional scale to inform responses (ITC, 2007). Parsons et al (2007) suggest that there are a range of limitations to current data and analysis, including:

- data for a catchment is often available for one or few measurement stations that may not accurately reflect the variability across the catchment, particularly in larger catchments;
- models are based on studies of catchments with relatively stable vegetation cover such that 'they may not adequately reflect transitional effects', where afforestation is gradual or responding to previous events.
- most hydrological studies have been undertaken at a small scale, less than 100 hectares, such that it may not be appropriate to extrapolate results to larger catchments.
- hydrological data suggests there is a tendency of models to overestimate the reduction in water yield in some circumstances, particularly in lower rainfall areas.

Refinement of data and models has the potential to lead to improved decision making capability and greater adoption of replanting particularly in areas where economic and social concerns are strong. Areas of work suggested by Parsons et al (2007) include:

- long term monitoring of stream flows at catchment and regional scales;
- development of low cost methods of assessing different land cover types; and
- further comparative studies of water use and impact of run-off, groundwater/surface water connectivity and stream flow of different land uses and land cover.

In the Murray western slopes, Murrumbidgee and northern Victoria, the predicted reduction in stream flow outweighs the salinity benefits from integrated forestry, despite these regions having forestry development already (ITC, 2007). Further modelling is required to ensure the loss in stream flow does not outweigh the benefits of reduced salinity in these regions including research to establish local and regional impacts of large-scale tree planting on hydrology (ITC, 2007). In central west NSW, there are similar issues whereby if not well targeted there could be economic disadvantages associated with plantations for salinity (ITC, 2007). Better spatial and productivity data is required to assist in predicting the impact on water yield under different arrangements.

In the medium rainfall zone (600–800mm) certain regions are expected to have promising prospects to utilise plantations to address salinity: south west Victoria; south east SA; and south west WA (ITC, 2007). Yet there has been relatively limited demand for salinity plantations in medium rainfall regions.

There are significant constraints to the development of plantations in low rainfall areas (less than 600mm) at present due to thin markets. Typically, these areas are located far from existing processors (as is the case in south west WA) and commercial investors are reluctant to establish plantings on a commercial scale as rainfall is a key driver of tree growth rates (MAI) which is in turn a key driver of profitability. Industry experts have suggested commercial plantations would require a minimum growth rate of 10 cubic metres per hectare each year.[14] Whilst this could be met by better performing species according to some process-based modelling, Walsh et al (2008) suggest the most productive could also have the highest risk of mortality due to water stress. In these circumstances, the business model needs to incorporate agriculture whereby trees provide landholders multiple benefits so in theory they may be less inhibited by slower tree growth. Significant and targeted payments for public good attributes are likely to be required to encourage uptake and good silvicultural management.

Further R&D is required to reduce risks and uncertainties of plantation development in low rainfall areas as well as to identify and develop new markets. There is no substantive history of developing wood products on a commercial basis in low rainfall areas. Walsh et al (2008) explain that:

> 'large areas of land that are potentially available for farm forestry in Australia do not suit most of the hardwood and softwood species that traditionally have been grown in plantations; hence species likely to succeed on low-rainfall sites have had little or no commercial development'.

It is suggested that empirical site assessments developed to estimate site productivity for commercial species 'will have little direct utility for farm forestry' (Walsh et al, 2008). Estimates in low-to-medium rainfall areas generally use process-based models and expert knowledge and opinion to calibrate these models (Walsh et al, 2008).

Ongoing investment is R&D in this area would appear essential, given this is effectively a new arm of forestry with significant environmental externalities. This could encompass improved genetics, the development of silvicultural regimes for the production of sawlogs in low rainfall areas and species trials at prospective sites. With work continuing in these fields in some jurisdictions, the question is where are we likely to see benefits from augmenting investment in this research.

Infrastructure constraints affect the immediate potential of commercial plantations in northern NSW, central-west NSW and the Hunter NSW as well as low rainfall dryland salinity areas in WA (ITC, 2007). These represent significant challenges for the industry. Developing a resource without a significant processing sector is a higher risk strategy and there are cases in the past where a resource was developed without attracting a processor. Regional supply plans have been utilised although their effectiveness has been limited by crowding out by the States, whereby large volumes of state-owned softwood came on to the market at the same time.

[14] Discussion with Steering Committee, January 2012.

Biodiversity

Biodiversity losses from deforestation may be partly offset by the expansion of secondary forests and plantation forests. A large number of species can be found in areas of native regeneration and exotic tree plantations with an understorey of native shrubs (Barlow et al, 2007). The Forestry CRC in 2011 found that the net outcome of plantation forests may not always be positive for each establishment, but at a landscape scale, the net outcome of eucalypt plantation establishment on agricultural land was likely to be positive (Grimbacher, 2011).

There is a broad consensus that there are generally biodiversity benefits associated with the conversion of agricultural land to commercial plantations where forest is the natural land cover (see for example, Brockerhoff et al, 2008; Loyn et al, 2009). Researchers examining the conservation and environmental service benefits of farm forestry hardwood plantations (Hobbs et al, 2003) concluded:

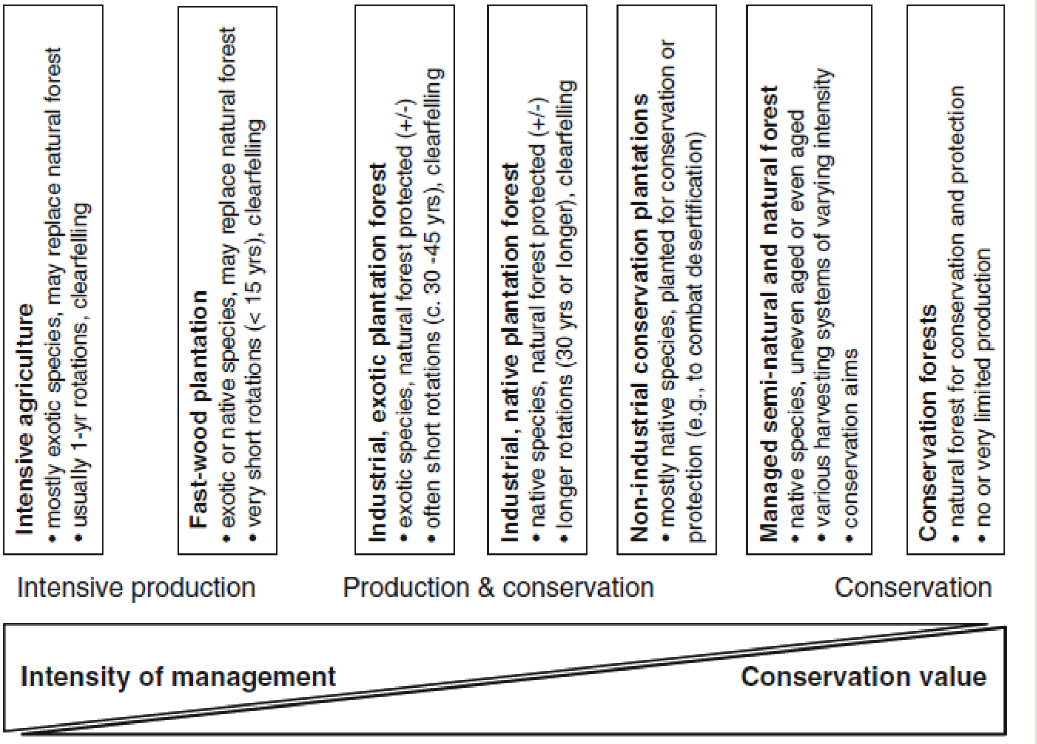
> 'plantations as they are currently managed deliver a biodiversity benefit which represents a 15–25 per cent improvement over agricultural land, based on habitat complexity scores (for vertebrates).'

It is expected that this conclusion may also apply to long rotation commercial plantations. It is less likely to apply to short rotation plantations, which may not provide sufficient habitat or time for old forest specialist species to adapt to and colonise the environment and reproduce (Brockerhoff et al, 2008). Additionally, the investment in long rotations for high quality sawlogs on land previously utilised for agriculture will continue to improve the domestic and global capacity to reduce the reliance on native forest harvesting.

- **The challenge is whether such values are broadly recognised, measurable, and valued by the community and governments.**

Chart 2.6 shows a continuum of forest management types and their associated conservation values as presented in Brokerhoff et al (2008). It suggests that we could think of biodiversity on a spectrum, with intensive agriculture at the one end and the conservation of native forests at the other. The authors note that many plantation forests cannot be clearly assigned to one of the main categories.

9 **Conservation values and the intensity of management**



Source: Brokerhoff et al, 2008.

Some forest practices inherently compete with biodiversity values.[15] Chart 2.6 suggests that production values can be traded off against conservation values, raising questions about the potential to compensate commercial plantations for practices supporting conversation values such as greater structural diversity and stand variation. In 2011 the CRC for Forestry concluded that ‘given the disproportionately positive contribution of remnant vegetation and biological legacies to landscape-level biodiversity values, management efforts that aim to maximise landscape-level biodiversity may be better focused towards conserving and rehabilitating remnant vegetation within plantation estates rather than maximising structural complexity within plantations’ (Grimbacher, 2011).

This approach appears to be adhered to within the current policy framework. For example, projects such as BushTender have offered incentives for landholders to improve management and security of high priority native vegetation and biodiversity sites on private land. Based on total landholder payments and the area under agreement, it appears that landholders have received between around $500 and $700 per hectare at the start of the contract, with further payments due periodically for maintenance activities (State of Victoria, 2012).

There are significant constraints to the extent to which commercial scale plantations may be adopted into biodiversity markets, which are highly orientated toward native forest conservation.

15 Such as the removal of windrows to control pest herbivores and the infrequent application of herbicides to reduce competing growth or fertiliser to promote tree growth (Lindenmayer et al, 2003). These are generally necessary in order to have a viable plantation but result in stand simplification which reduces the performance of the environment in maintaining key ecological functions (Lindenmayer et al, 2003).

- Firstly, the scientific literature on plantation forestry biodiversity is still not able to provide a simple answer to the question of whether or not plantation forestry is compatible with biodiversity conservation goals (Brockerhoff et al, 2008).
  - The current knowledge of the value of various habitats for biodiversity conservation is limited to a few taxa, with many studies said to have significant methodological shortcomings (Barlow et al, 2007).
  - Some species are more adaptable to plantations such as birds, insects with wings and large macropods, whilst studies have shown other species are poorly represented in plantations including mammals, reptiles, amphibians and native plants (Lindenmayer et al, 2003).
- Secondly, the relationships between habitat values and biodiversity outcomes are still not robust and prediction of conservation values remains difficult (Barlow et al, 2007).

State governments have previously acquired plantations due to the recognition of their significant contribution towards conservation of species of regional significance such as Koalas. Prior cases of this have demonstrated the willingness to pay for biodiversity values of plantations. However, such cases also exemplify the difficulties in *predicting* biodiversity values and therefore in obtaining an upfront payment. In essence, biodiversity values from plantations are determined well after their establishment.

Less contentious is the role of plantation forests in assisting conservation by 'providing complementary forest habitat, buffering edge effects and increasing connectivity' (Brockerhoff et al, 2008). The importance of retaining comprehensive vegetation networks as a part of a landscape management strategy is well recognised (Barlow et al, 2007). The landscape matrix performs a number of functions including (Brokerhoff et al, 2008):

- to supplement or complement species habitat or resources;
- landscape connectivity to facilitate the dispersal of species between isolated patches;
- to enhance the properties of native remnant vegetation; and
- dampening the effects of disturbance associated with the exposure of habitat in native remnant patches to open farmland (Loyn et al, 2009).

Structural complexity throughout the landscape may be enhanced by juxtaposition of different plantation types, sizes and shapes and appropriate spatial design across the landscape to perform connectivity and buffering functions (Brokerhoff et al, 2008). Varying the spatial and temporal patterns of plantation-dominated landscapes such as the timing of harvests and rotation length can promote biodiversity conservation in landscapes that are already dominated by plantations (Brokerhoff et al, 2008).

> *Loyn et al (2009) suggests that the highest priority for research is to address certain questions to assist in managing plantations in the broader landscape, including how plantations may affect patches of embedded remnant native forest and other areas around plantation design and management.*

Recent research has shown that plantations in regions of Australia are playing an important role in the provision of habitat for native bird populations as well as a few native mammals, particularly in pine plantation. Table 2.7 summarises the findings of a survey on bird populations conducted in the Green Triangle in 2006 and 2007 (Loyn et al, 2009). Native

birds were more abundant in native forests than all other habitats, somewhat more abundant in blue gum plantations than pine and substantially more abundant in forests than in cleared farmland (Loyn et al, 2009).

10 **Mean abundance of birds, observed per 10 counts**

	Farmland	*Pine*	*Blue Gum*	*Forest*
Native birds	32.34	36.64	57.18	167.57
Introduced birds	9.7	8.35	0.96	2.18
Introduced birds as a percentage of the total	23.08	18.57	1.65	1.28
Total birds per 10 counts	42.04	44.99	58.13	169.75
Bird species per count	1.48	3.31	3.46	9.08

Source: Loyn et al, 2009.

It is thought that plantations could assist in vital processes associated with the dispersal of native vegetation in cleared agricultural land through attracting such seed-dispersing fauna, creating a suitable microclimate for seed germination and growth and through shading out grasses and weeds (see Kanowski et al, 2006). Recent research has demonstrated the importance of on-site habitat variables in explaining the abundance of bird species (Loyn et al, 2007). This suggests there may be value in including plantations managed to promote or at least support biodiversity in landscape scale conservation strategies.[16]

Researchers are developing systems for quantifying potential biodiversity benefits associated with tree plantations, based upon intended management practices and the geographic location of the plantation. The Plantation Biodiversity Benefits Score, which is a rapid scoring system, generates a score on the basis of a range of attributes or ‘inputs’ expected to enhance the potential for biodiversity such as proximity to native vegetation, rotation length, plantation type, stand age variation, and strategies to manage pests and weeds (Cawsey and Freudenberger, 2005). Others developed for private native vegetation include the Habitat Hectares approach, Biometric, and the Biodiversity Benefits Index (BBi).

The subjectivity of biodiversity scores and indexes, including the weighting of different priorities, is an important limitation. However, the determination of biodiversity values will continue to reflect the interaction of subjective considerations including, on the demand side, the expectations of policy makers and the community about relative payoffs.

The principle demand for biodiversity conservation through commercial plantations will be contained to the government. Plantations do not form part of the Biodiversity Conservation Strategy of the Commonwealth Government, although landscape interconnectivity is recognised as an overarching objective. Biodiversity values associated with plantations will be reflective of regional and local conservation values and strategies. They will reflect the willingness to pay for biodiversity relative to other community objectives and the perceived benefits associated with competing forms of biodiversity conservation.

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16 Habitat requirements vary substantially between bird species. Insectivores, for example, forage canopy and tall shrub layers whilst nectarivores, carnivores and birds that forage among low shrubs are less common in plantations than in native forest.

There appears to be a significantly greater willingness to pay for the expected biodiversity benefits associated with farm forestry. This could be attributed to the perception that multiple government objectives are achieved through farm forestry. Importantly, due to other productive values associated with harvested plantations in some regions it may be cost effective for governments to incorporate forestry to achieve their landscape strategy.

Streamside management zones

Chiew et al (2002) showed that forested land is generally associated with lower total sediment, phosphorus and nitrogen concentrations than grazing land for catchments in south-east Queensland (Zhang et al, 2007) and research shows the quality of water draining from forests is generally much higher than from other land uses (Grimbacher, 2011). In addition, forestry can be associated with reduced erosion compared to agriculture (and therefore reduced turbidity) due to deeper roots and higher vegetation cover and surface litter (Zhang et al, 2007).

Forested streamside management zones (SMZs) provide a range of important ecological functions (Neary et al, 2011). These include water quality protection, streamflow maintenance, geomorphic stability and flora and fauna habitat (Neary et al, 2011). The exclusion of cattle using a fenced SMZ combined with forest plantations has been found to reduce the delivery of sediment, phosphorus and bacteria to a stream (Smethurst and Petrone, 2010). Smethurst and Petrone (2010) suggest that marked water benefits can be expected only where SMZs are established over a large proportion of headwater stream-length, but even narrow buffers can deliver substantive benefits.

According to Neary et al (2011), water quality functions by forested SMZs are provided through:

- the maintenance of low temperatures associated with shade;
- filtration and deposition of sediments;
- higher sediment trapping efficiency in forested SMZs compared to those primarily covered in grass;
- the detention of contaminants;
- plant uptake of nutrients, with periodic removal of vegetation potentially required to maintain or renew the uptake function provided by plants;
- transformation of nitrogen compounds; and
- the reduction of macrophyte growth.

Neary et al (2011) state that the major impediment to the introduction of SMZs on to properties is primarily cost related, including the opportunity cost associated with setting aside production land, the costs of isolating and fencing out of livestock and planting, managing and maintaining the SMZ. Fencing and providing watering points for livestock can be a significant expense. There is little capacity for these costs to be recuperated through wood production, due to current policies, legislation and codes of practice that ‘either prescribe how harvesting may occur within SMZs or may prevent SMZs being used for wood production purposes’ (Neary et al, 2011).

According to recent scientific reviews, selective harvesting of trees may be practiced in SMZs without causing a significant risk to water quality and is permitted in other countries (see, for example Neary et al, 2011). Sediment yields, a key factor affecting water quality, tend to vary significantly after forest harvesting. Although increases in sediment yields can occur after disturbance to the soil, the effects are expected to be transient and the largest increases in documented literature have been associated with post-harvest mechanical site preparation in the absence of SMZs, slope instability, road construction or highly erosive soils (Neary et al, 2011). Transportation corridors have been cited as the primary source of 90 per cent of the sediment generated by harvesting (Reid an Dunne, 1984, Swift 1988; cited, Neary et al, 2011).

Significant land and aquatic biodiversity and water quality benefits are associated with the establishment of trees in riparian areas; however there are economic barriers to planting trees. The hypothesis is that allowing selective harvesting in SMZs would provide an incentive for the establishment and maintenance of trees without compromising water quality. Generally, SMZs for biodiversity and wildlife habitat will be larger (and more expensive) than those established strictly for water quality improvement and payments for biodiversity services may be required to encourage biodiversity as a management priority (Neary et al, 2011).

3. Markets: barriers and new technologies

Markets for forest products are relatively distinct, having been highly influenced by state governments and fragmented by the distance between markets. Supply chain concentration from state forest agencies and processors has been affiliated with poor market transparency, low market entry/competition and inefficiencies in the processing sector. Governments and statutory bodies (such as CMAs) will, however, be inextricably linked to the future of long rotation forestry through being the principal (potential) customer and regulator for environmental service markets. Social perceptions will play a significant role in either supporting or inhibiting the development of a policy environment conducive to plantations, including commercial plantations, farm forestry and private native forestry. Industry has a role to play in shaping social perceptions, identifying strategies to overcome pricing distortions and adding value to the *whole* of the supply chain through new technologies and markets.

Market structure, pricing and log markets

It is widely acknowledged that the dominance of the states in the supply to regional processors has constrained the development of private investment in long rotation forestry including landholders. As shown in table 3.1, Australia is estimated one of the highest shares of publicly owned forest land including native forest (Haley and Nelson, 2007).

The issue associated with state ownership of forest resources is that competitive neutrality becomes fundamentally difficult when the states are not run to maximise profit. That is, state forestry agencies have both commercial viability and regional development at the core of their decision making. This creates significant transparency issues for existing investors and potential market entrants. This dual mandate is expected to have influenced the pricing of sawlogs, with the state forestry agencies interested in maintaining the processing sector that provides regional communities with significant employment. This is expected to have reduced log prices below what may have occurred in a strictly commercial market. Long term contracts utilised by state agencies have limited or infrequent opportunities for price renegotiation. There is limited opportunity for price arbitrage to reflect, for example, improved prices in international markets.

11 **Forest land ownership in selected developed countries**

Country	*Publicly owned forest land*
	%
Australia	72.0
Brazil	77.0
Canada	93.4
Chile	24.2
Finland	32.1
France	26.0
Germany	52.8

Japan	41.8
New Zealand	63.4
Portugal	7.3
Russia	100.0
Sweden	34.2
United Kingdom	34.2
United States	37.8

Source: Haley and Nelson, 2007.

These issues were reviewed by the Productivity Commission in 2001. The States and Territories agreed in the mid 1990s to apply competitive neutrality requirements to their commercial forestry activities, requiring forestry agencies to act more commercially such as through covering all expenses and earning an acceptable rate of return (Productivity Commission, 2001). Despite considerable reform to the operation of state forestry agencies to address past concerns about underpricing, recent analysis shows state agencies are still not achieving a risk-free benchmark return on assets (for example, the rate of return on Australian bonds of around 5.5 per cent) (Henry tax review, 2011). In 2006–07, the estimated return on assets ranged from 1 per cent to 4.7 per cent across the state agencies (Henry tax review, 2011). This could reflect both high cost structures and underpricing (Henry tax review, 2011).

Underpricing by state and territory forestry agencies is associated with a number of other issues:

- low levels of competition (and therefore market depth) including low involvement and planting by landholders and some crowding out in potential markets;
- lack of viability of plantation sawlogs due to low prices;
- a lack of transparency in market prices; and
- supply chain inefficiencies, in particular with some processors.

Reform in the management of state forestry agencies needs to continue. The Victorian government has been proactive in seeking to rectify these issues. It is promoting an open, transparent and market-based system to pricing and the allocation of logs from *public native forests*. The VicForests Price Allocation model which is an auction-based system has led to a number of improvements: log prices at 30 per cent above previously administered prices; greater price discrimination at different quality points; and expansion of a number of processors in response to access to additional timber supplies (DPIV, 2011a).

As shown from the Victoria example, alternative pricing arrangements appear to have assisted the industry to increase prices. Yet prices may be relatively fixed in the near term (<5 years) as contractual agreements are not due to be renegotiated for some time.

The impediments listed above are also affiliated with other factors. Market dominance, either by the resource owner or processor (state or private), can reduce transparency and competition (Quayle, 2004). Market dominance in this industry is to an extent a product of the large volume of resource required to service a processor and highly decentralised forestry

regions. Private sector market dominance is also due to commercial-in-confidence requirements and private benefits (low prices) associated with limited pricing information, although this may perpetuate landholder reluctance to participate in farm forestry (a long term cost). Private forest owners invited to partake in the Australian Pine Log Price Index which commenced in 1995 have not been prepared to provide their data (Leech et al, 2011).

Another crucial factor is the lack of secondary markets particularly for long rotation assets in the first fifteen years. Haile (2001) found that 'when bidders anticipate an opportunity for resale trade, the value of winning an auction is determined in part by the option values of buying and selling in the secondary market'. One implication of this is that the willingness to pay of bidders' increases with the expected level of competition in resale markets (Haile, 2001).

Potential solutions such as increasing privatisation may involve transitional costs and community concern around risks associated with changing the status quo. In SA, communities were reluctant to accept the proposal to sell three forward rotations of the ForestrySA resource due to concerns over the potential market volatility from the possibility of greater diversions of resource to export rather than processing markets. Other central concerns were with respect to fire management and possible productivity issues if incentives were to encourage management of the resource for the short term at the cost of a long term decline in productivity (Leech et al, 2011).

The shift towards privatisation in New Zealand was affiliated with greater market volatility due to a reliance on export markets. However, the proportion of the resource relative to the size of the population necessitates the reliance of NZ growers on export markets. Although some forestry regions interact with world markets, the Australian forestry industry is significantly less exposed and less reliant on world markets. Nonetheless, government attempts to introduce greater market competition should be sensitive to the potential adjustment costs to communities and industry.

A further issue is the lack of breadth in markets, particularly for residues from silvicultural activities. Markets for high value products and biomass (discussed in the proceeding sections) could significantly improve the opportunities for long rotation forestry.

High value markets

High quality hardwoods are expected to attract a premium price due to declining volumes available in both domestic and international markets, and consumer demand from ageing populations for appearance grade product. Higher value products will naturally contribute to the improved viability of long rotation plantations. They may also support smaller processors and a smaller resource base. A hardwood sawmill could be viable with only 50 000 cubic metres throughput and 3000 to 3500 hectares of plantation.

To obtain a premium the returns must be greater than short rotation pulpwood in which the returns from high quality paper are already significant and the markets established (Lott and

Gooding, 2008).[17] Consideration must also be given to market and operating risks could erode market premiums in an economic sense, which would reduce the policy imperative to invest in overcoming the barriers to capturing premiums from high quality hardwood products (see chapter 1, table 1.2). Factors which could erode the potential premium from high value markets include:

- higher uncertainty around the quantity and quality of the resource at end-of-rotation (compared to short rotations). Australia does not presently have a competitive advantage when growing hardwood plantations for sawn timber (Nolan et al, 2005: cited Lott and Gooding, 2008).
- Suppliers are also likely to require higher specifications.
  - The commercial success of long rotation plantations will be dependent on carefully selected sites, high growth rates, low processing costs and a good outturn of the highest value products as well as environmental services (Lott and Gooding, 2008).

Despite these potential risks, there could be a case from a public policy perspective to address the constraints to establishing such markets. The following key areas would need to be enhanced (RIRDC et al, 2008b):

- resource security through sufficient planted area managed for solid-wood products (there are a range of underlying impediments to planting long rotation trees referred to throughout this report);
- investment in processing technology and consolidation of hardwood processing plant;
- policy and investment structures that support their commercial viability;
- evidence to support conclusions and investor confidence such as through greater synthesis and dissemination to users of existing research findings;
- product innovation and increased product and market sophistication including environmental service markets;
- specifically, further research needs to include:
  - tree improvement through:
    - developing tree breeding objectives for sawlog-specific and multiple end-uses;
    - extending hybridisation and clonal breeding strategies;
    - improving existing species and site trials; and
    - establishing long term trials to gain more comprehensive data for key regional species.
  - wood quality research including:
    - determining the effects of silviculture on wood quality and processing;
    - exploring the potential of novel techniques and technologies to overcome processing and drying difficulties; and
    - proving and refining wood quality of fast-grown plantation species.

[17] However, we acknowledge that softwood prices have been declining in real terms over the past decade due to increased competitive pressure domestically and elsewhere, particularly New Zealand due to its favourable currency for exports.

- harvesting and transport efficiency and the effects of these operations on processing recovery.

Energy generation and biochar: interconnected issues

The carbon neutrality of biomass is a ‘longstanding and widely established principle’ (AFPA, 2009). When biomass is combusted for energy, carbon dioxide and small amounts of other greenhouse gases are combusted, but carbon is again sequestered during the regrowth of the restored vegetation through photosynthesis. In 2007-08, bioenergy represented around 4 per cent of Australia’s primary energy consumption but almost 80 per cent of renewable energy sources (BRS, 2009). The majority is sourced from bagasse and wood waste, representing around 92 per cent of bioenergy use for direct heat and electricity generation (BRS, 2009). Biogas represented a minority share of around 6 per cent whilst an even smaller share was comprised by biofuels for transport fuel (BRS, 2009). Some industry experts suggest that new markets for biomass represent one of the most substantial opportunities to improve the viability of commercial plantations.

Different processes are utilised to convert feedstock depending on the intended product, product mix and application. Biomass from wood waste, including wood chips, saw dust, black liquor and wet wastes, is already occurring at a small scale for electricity and heat generation (cogeneration). The growth of the bioenergy industry is expected to be influenced by the commercialisation of second generation technologies such as through increasing the range of bioenergy resource options and reducing competition between bioenergy feedstock sources. This was reiterated by the IEA in 2007 which suggested that biorefineries may open the door to combined, cost-effective production of bio-chemicals, electricity and biofuels. Where pyrolysis creates not only biochar but also synthetic gas (syngas) and pyrolysis liquor (bio-oil), the viability of biochar will also be dependent on simultaneously developing the markets for biofuels (Sparkes and Stoutjesdij, 2011).

In each case, the development of cost effective harvesting, transportation, processing and storage will be important to the viability and adoption of this potential. They will also be impacted by a carbon price which will impose costs on more emissions intensive technologies; this will be important in an environment where the price of electricity and natural gas remains relatively inexpensive compared with renewable technologies. There is significant potential for bioenergy production where it can occur at the source of the biomass, whereby transportation costs can be largely avoided, including paper mills and sawmills (BRS, 2009).

Such technologies and their markets are still developing. However, if investment became viable there could be a flow through effect across the industry. Benefits stemming from the creation of a market for biomass (through a carbon price or other mechanism) include higher returns associated with residues from thinning and pruning which in turn may support silvicultural operations on marginal blocks.

The high value of wood chip for export (around $170 per tonne) may constrain the investment viability for some businesses, depending on regional prices and the distance to export markets. There may also be some tradeoffs which could constrain the amount of

available resource, whereby some feedback in consultation suggested the removal of organic matter could compromise longer term site productivity.

Power generation and CHP from forest biomass

Forest biomass has the potential to offer a competitive source of bioenergy. Currently, its market value is covered under the Renewable Energy Target (RET) scheme introduced in 2009 to establish a market for renewable energy certificates to act as an extra incentive to trade and invest in renewable energy projects. The carbon price legislation will over time improve the viability of power generation from biomass by making renewable energy more competitive relative to alternative energy sources.

The technology to convert biomass into energy is well developed and is being utilised in many countries around the world. Various options for plant design are at different stages of commercial viability. These include (IEA, 2007):

- Co-firing — in modern coal plants, in which efficiencies of up to 45 per cent can be attained, is expected to remain the most cost-effective use of biomass for power generation in the short term.
- Dedicated plants for combined heat and power (CHP) — which may be viable for small scale, off-the-grid use. CHP plants require significant feedstock and are likely to be small due to feedstock availability issues associated with transportation costs.
- Biomass integrated gasification (BIG) in gas-turbine plants — integrated gasification using biomass in gas-turbine plants can produce biogas and other fuels and potentially biochar. It is not yet commercially viable, but BIG in gas turbine plants and bio-refineries is regarded by the IEA as having significant potential to expand in future.

Table 3.2 summarises the power generation efficiencies and costs in the United States.

12 **IEA estimates power generation costs from biomass (2007 dollars)**

Technologies	*Efficiency*	*Typical size*	*Capital costs*	*Electricity* [a]
	%	MWe	US$/kW	US$/kWh
Co-firing	35-40	10-50	1 100-1 300	0.05
Dedicated steam cycles	30-35	5-25	3 000-5 000	0.11
IGCC	30-40	10-30	2 500-5 500	0.11-0.13
Gasification and engine CHP	25-30	0.2-1	3 000-4 000	0.11
Stirling engine CHP	11-20	<0.1	5 000-7 000	0.13

a Assumes biomass cost of US$3/GJ

Source: IEA, 2007.

Investment in biomass for power generation has not occurred as quickly in Australia as it has in the United States or northern Europe, which has mostly adopted co-generation from wood residues (IEA, 2007). The investment in capital to utilise biomass for power generation is expected to be supported through the implementation of a carbon price, though uncertainty around the price of carbon may affect the willingness to invest: Australia has legislated a carbon price (at $23/tonne CO_2–e) in excess of twice that in Europe (around $8/tonne CO_2–e).

The BRS in 2011 suggested that there ‘are also potential risks associated with the expansion of biomass production into areas that provide valuable ecosystems to support high biodiversity’. This has been illustrated through the recent proposal for native timber wood waste used to generate power to be excluded from the RET.

The grounds for the proposed exclusion do not appear to be well founded. The timber merchants association rejects the rationale that the burning of native forest wood waste to generate electricity ‘could lead to unintended outcomes for biodiversity and the destruction of intact carbon stores, and (the rationale that) the carbon price provides sufficient incentive to encourage use of woody biomass as an energy source because it does not attract a liability’ (TMA, 2011). According to the industry, the exclusion of native biomass from the RET would not result in a change in the volume of waste or trees left in the forest (FWPA, 2011b). Above-ground woody biomass which is removed from the forest is done so to achieve a range of different objectives including management and access requirements for future harvesting, fire risk mitigation and biodiversity (FWPA, 2011b).

Costs would be imposed on the industry if the proposed amendment were adopted, including economic losses from diverting the tree biomass to a lesser value purpose. Whilst such a ban may only impose an interim cost because the carbon tax will come into effect and make bioenergy more cost competitive compared to coal and natural gas, if community concern is sufficient thereafter it is possible that governments could introduce corresponding legislation.

This issue concerns private and public native forests, as opposed to commercial plantations, however it also represents a risk for all forestry. The perception that the government may change the rules on the basis of political persuasions, without sufficient grounds, would be reflected in the market through higher risk premiums.

Aside from risks associated with political process, biomass potential for power generation will depend upon establishing a low conversion efficiency, feedstock availability and cost.

Second generation biofuel

Second generation biofuels utilise lignocellulous contained in non-edible fibrous or wood portions of plants to generate fuels through either a biochemical or thermo-chemical transformation process. (Sims et al, 2009).[18] There is considerable potential for non-food biomass as a low cost transport fuel if cost effective conversion processes become available (RIRDC et al, 2008a). Second generation technologies have the potential to be: co-fired in a coal fired power station to produce bioelectricity; converted into ethanol via enzymatic technologies; converted directly into syndiesel and syngasoline or biocrude using thermo-chemical processes; converted by pyrolysis into biochar and syngas and potentially produce a range of bioproducts as energy or fuel as a co-product (O’Connell et al, 2009).

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18 The biochemical processes is where ‘enzymes and other micro-organisms are used to convert cellulose and hemicellulose components of feedstocks to sugars prior to their fermentation to produce ethanol’ (Sims et al, 2009). The thermo-chemical process is where ’pyrolysis/gasification technologies produce a synthesis gas (CO_2 and H_2) from which a wide range of long carbon chain biofuels, such as synthetic diesel or aviation fuel can be refined’ (Sims et al, 2009).

Although the technology has been developed to convert crops into fuels (first generation biomass), second generation biofuels have additional technological hurdles to overcome in order to cost effectively produce fuels from non-food biomass. It still appears to be at least five or more years away until the technology may be commercially viable (see, for example, O'Laughlin, 2011).

Second generation biofuels have the potential to overcome many of the downsides of first generation biofuels.

- Some studies (although not all) have found that the production of biofuels from crop biomass requires more energy than is yielded and there are negative greenhouse gases effects (RIRDC et al, 2008a).
- Despite considerable subsidisation of the market for first generation biofuels in Australia, and considerable initial market interest, very few first generation biofuel plants remain viable.[19] Currently Australia produces only a small volume (around 171ML) of biofuels from coarse grains, wheat, molasses and sugar cane.
- Feedstock prices for first generation fuels (such as the grain price) closely follow oil prices. This provides no relative cost or price advantage in times of high oil prices.
- In some countries, first generation biofuels have been associated with increased rates of conversion of forests to crops and the diversion of food sources to energy sources.

For these reasons, first generation biofuel is regarded as a transition technology (Chemlink, 2011). Second generation fuels could overcome many of these downfalls, providing a longer term option. Feedstocks such as wood biomass are significantly cheaper and less energy is consumed through the lignocellulosic process than primary-fed process (URS, 2007). O'Connell et al (2009) suggest that, where viable, the conversion of plantations to bioenergy could yield greater benefits in terms of avoided emissions than environmental plantings in terms of the carbon sequestered.

O'Connell et al (2009) estimate the tonnage wattage that could be generated under the 'attainable' situation could include up to around 3.6 TWh each year from existing plantation resources and up to 12.2 TWh each year from bioenergy plantations by 2050. For a 10 year rotation, plantations would sequester carbon as it grows (at around 10 tonnes CO_2–e per year). At harvest, the benefit from conversion to bioenergy and avoidance of greenhouse gas emissions compared to conventional electricity generation could be more than 700 tonnes CO_2–e per hectare or 71 tonnes CO_2–e per year. Comparatively, a carbon plantation is expected to absorb approximately 155 tonnes CO_2–e over 100 years (principally over the first forty years).

19 The excise of A$0.38 per litre was waived for first generation biofuel, which is valued at around A$65 million per year (that is, production is around 171 ML) (Chemlink, 2010). Australia currently produces ethanol through the fermentation of molasses through CSR mill in Queensland (60 ML per year) and wheat by-product from Manildra in Nowra (around 90 ML per year).

O'Connell et al (2009) do not expect forestry to play a role in the generation of biofuels in Queensland due to technological constraints.[20] A small expansion of the plantation area for bioenergy plantations could be possible such as through farm forestry initiatives. These findings would be applicable to the rest of Australia. A commercial plant will require between 60 to 120kt biomass fuel (oven dry tonnes) each year to produce 25 to 50 ML each year using feedstock from a 20 kilometre radius. However, larger scale operations can expand over a wider area. The transition from first to second generation biofuels is expected to encompass the next one to two decades (Sims et al, 2009).

For the biochemical process, significant work remains in improving feedstock characteristics, reducing the costs by perfecting pre-treatment, improving the efficacy of enzymes, lowering production costs and improving overall process integration (Sims et al, 2009). Sims et al (2009) suggest this process has the potential to provide cheaper biofuels. Hemlinck et al (2005) suggests costs could come down by two thirds over the next 20 years (RIRDC et al, 2008a). For the thermo-chemical route, much of the technology is already proven but there are significant concerns about securing a large enough quantity of feedstock transported to the plant at a reasonable cost to generate the necessary economies of scale to ensure plant viability.

The market for second generation bioenergy is in its infancy and whilst demonstrated[21], it is not yet in commercial use either due to scale-up issues, technological hurdles or because conversion costs are currently too high (O'Connell et al, 2009). Information on biofuel production costs is currently uncertain and limited as it is treated with a high degree of commercial proprietary. Bioenergy production costs would be significantly higher than coal and wind (URS, 2007).

- In 2005, NAFI suggested the range of estimates could be significant: \$54– \$103 per MWh for biomass, \$66–\$107 per MWh for wind and \$24–\$43 per MWh for coal (in 2005 dollars) (URS, 2007).
- Most processes claim to be competitive with oil at around \$US40–\$US60 per barrel. But the IEA (Sims et al, 2009) suggested that commercialisation on a wide scale could see prices decline such that ethanol could be competitive at US\$70 per barrel and synthetic diesel and aviation fuel at US \$80 per barrel (2008 dollars).

Existing knowledge constraints are being addressed through a CSIRO project established to identify the true potential of second generation biofuels and capacity to generate biomass production systems to be grown at sufficient scale. The question is whether further investment could cause a step change in technological development.

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20 For Queensland, this was expected to be up to 3200 hectares by 2050 (assuming a yield of 56 tonnes per hectare biomass every 10 years). Estimates are for between 600 ML to 2900 ML of ethanol (using 2kt to 11kt feedstock) and annual synfuel and syndiesel of 700–2900 ML (3kt to 12 kt) by 2050.

21 Including co-firing wood in coal fired power station in CS Energy and Taragon in Queensland, Lidell in NSW and Verve Energy in WA (URS, 2007). Mallee eucalypts have been trialled to determine the cost effectiveness of establishing harvesting equipment and scale of resource close to a power plant in WA (URS, 2007).

Biochar

Another potential environmental service market is for biochar, a highly stable form of carbon. Biochar is a by-product resulting from bioenergy produced from the pyrolysis of organic matter (Krull, 2009). The feedstock incorporates a number of forest products and by-products: wood chips; saw dust; tree bark; and paper mill sludge. Around 50 per cent of production can be converted to biochar while the remainder is used for the pyrolysis process and bioenergy production (Krull, 2009). Products generated from pyrolysis include synthetic gas (syngas) and pyrolysis liquor (bio-oil) which can be used as a renewable energy source or as feedstock for producing other chemicals such as food additives and pharmaceuticals (Sparkes and Stoutjesdijk, 2011).

The potential benefits associated with biochar production include its capacities to (Krull, 2009):

- displace fossil fuel use (if used for energy), although emissions reductions from adding biochar to the soil are much greater than the fossil fuel offsets when using biochar as energy;
- sequester and potentially decrease N_2O and CH_4 emissions from soil;
- avoid CH_4 emissions produced from landfill waste;
- reduce energy requirements for soil tillage;
- increase carbon sequestration by plants through increasing soil strength and therefore crop vigour; and
- reduce emissions associated with the manufacture of fertiliser.

Krull (2009) indicates there is significant potential for a market for biochar products from farmers, with the incentives for soil amelioration high. This potential is widely endorsed as a mitigation technology in the post-2012 carbon framework and is an attractive option for countries. But, further quantification of these potential benefits to soil is required.

Potential values of biochar include (Krull, 2009):

- the renewable energy output as a reduction in GHG emissions from the energy sector;
- the increase in soil carbon stock through biochar application could be recognised as an eligible sequestration activity. There is a high level of confidence that over 90 per cent of the carbon in some biochars produced from wood at temperatures in excess of 500 degrees will be stable for 100 years. This benefit could be claimed under the Kyoto Protocol Articles 3.3, 6, and 12 or Article 3.4 if applied to agricultural land;
- the avoided emissions from a change in the management of biomass where conventional biomass leads to emissions of CH_4 or N_2O. Under Article 3.4 it is possible to claim the reduction in agricultural emissions in plants and soil from the application of biochar. There are already schemes that recognise the potential benefit of avoided CH_4 emissions where waste is diverted from landfill (such as the NSW Greenhouse Gas Reduction Scheme) or manure is improved through better management (for example, Regional Greenhouse Gas Initiative); and
- additional benefits (outside the carbon accounting framework) which could have both private and public good elements include soil amelioration to reduce soil acidity, improved

water-holding capacity and nutrient efficiency, improved uptake of pesticides and nutrients from waterways, and waste reduction.

There are a number of barriers to the achievement of these values. The recognition of sequestration in soil stock may be inhibited by high transaction costs associated with satisfying accounting principles of ‘permanence’ and ‘additionality’ (Krull, 2009). Compliance frameworks with acceptable transaction costs could be developed where there is sufficient scientific evidence about the relationships between soil carbon and other variables under spatial and temporal variation.

However, the most significant constraints may lie in the current data availability for the development of models for verification purposes. The current capacity for monitoring soil carbon accurately is limited. In particular, we do not currently know enough about (Krull, 2009):

- how biochars will influence different soil types and the interaction between biochar, clay and native organic matter;
- how biochar properties change over time and what the likely long term benefits may be, for instance, in terms of limiting potential, microbial effects and cation exchange capacity; and
- the types of biochars that can yield a reduction in N_2O and CH_4 soil emissions under different conditions and the quantity of reduction and impacts on plants growth and fertiliser requirements.

Despite there being sufficient confidence in the permanence of some biochars, Krull (2009) concludes there are too many unknowns at present to develop a reliable greenhouse gas accounting methodology.

The greatest returns in terms of efficiencies and greenhouse gas abatement potential through pollution control are from high-cost modern pyrolysis plants as opposed to kilns and pits (Sparkes and Stoutjesdijk, 2011). However, controlling operating conditions to improve process efficiency and optimise biochar production has not been extensively explored at this stage due to the competing priorities for bioenergy maximisation (Sparkes and Stoutjesdijk, 2011). In addition, operating conditions will impact the desired mix of products and the degree of flexibility with respect to the relative amount of products produced (Sparkes and Stoutjesdijk, 2011). The choice of operating conditions to create the desired product mix and product characteristics may also impact the lifecycle assessment of carbon intensity (Sparkes and Stoutjesdijk, 2011).

Sparkes and Stoutjesdijk (2011) explain that ‘developing a biochar pyrolysis system would be dependent on the price received for biochar and bioenergy products, and any value of avoided carbon dioxide equivalent emissions, the costs of feedstocks used and the cost of pyrolysis plant’. It would be dependent on proven benefits to ensure demand for specific biochar products. Importantly, it would also be dependent on having markets for other products: syngas and biofuels such as bio-oil (Sparkes and Stoutjesdijk, 2011). As such, it is a requirement that the constraints to using woody biomass as a feedstock for biofuel generation are addressed concurrently with constraints to the use of biochar.

Detailed analysis of the potential economic viability of different biochar production facilities has not yet been published (Sparkes and Stoutjesdijk, 2011). A study in the United States suggested that both fast and slow pyrolysis plants are unprofitable in there at present (MarCarl et al, 2009: cited Sparkes and Stoutjesdijk, 2011). It became viable when the value of biochar was increased from US$47 per tonne to more than US$246 per tonne, yet anecdotal reports indicate that a cost of $5000 per tonne would be required to purchase biochar from processing companies in Australia (Sparkes and Stoutjesdijk, 2011).

Social values — why perceptions are a barrier

Social values are derived from perceived or actual benefits or costs imposed by land use for forestry as opposed to other forms of use. Could there be an argument that the socio-economic benefits flowing from the *conversion or maintenance* of forestry as a land use are greater than alternative land uses? The subsequent question is to what extent is there a willingness of governments (and the communities that support them) to pay for such benefits? Claims of widespread and superior overall socio-economic benefits of forestry compared to alternative land uses are not well supported in the literature and unlikely to be supported by governments or communities, except perhaps where the opportunity cost of the alternate land use is low such as in the case of farm forestry.

If forestry displaces farming activity, a net gain in employment is expected to occur where a processing sector exists. A compilation of research on employment generation by industry is shown in table 3.3, including employment to the farm gate and beyond the farm gate. Where there is a processing sector, forestry has generated employment at levels comparable to dairy and more favourable to other competing agricultural land uses such as grazing and cropping.

13 **Employment generated by forestry**

Land use	*Jobs to the farm gate* [a]	*Jobs beyond the farm gate* [a]	*Total job creation*
	Employment/100 ha	*Employment/100 ha*	*Employtment/100 ha*
Beef	0.1-0.5	0.01-0.03	1.01-5.03
Blue gums (wood chipping and export)	0.15-0.25	0.30-0.45	0.45-0.7
Cropping	0.1-0.5	0.01-0.03	0.11-0.53
Dairy	0.9-1.7	0.2-0.3	1.1-2.0
Grapes	5.0-10.0	6.5-7.0	11.5-17.0
Sheep	0.2-0.6	0.01-0.03	0.21-0.63
Softwood plantations	**0.5**	**1.0-1.3**	**1.5-1.8**

[a] 2006-2008. *Note:* Data gathered by Schrimer via a survey of primary producers and plantation companies, the South West Victorian Farm Monitor project, the ABS and ABARE, reported in Schrimer (2009); Schrimer (2008); and Schrimer et al (2005).

Source: Schrimer, 2009.

In an economy with close to full employment, which has been close to full employment for the past decade, public policy should encourage the flow of workers to the most productive areas of the economy. That is, land, labour and capital presently have high alternative use

values except where land is not currently being utilised, is marginally productive or could be more productive if forestry were established.

According to consultation, opportunities for the establishment of viable softwood and hardwood plantations remain almost fully exploited as available and suitable blocks of land currently have higher use values. In this context, socio-economic values could be supported through identifying portions of properties in which there are lower opportunity costs such as through farm forestry.

Forestry also enables regional economic and employment diversification. This can be valuable in supporting higher levels of employment in regional economies and result in improved welfare and social cohesion across Australia, particularly where labour is relatively immobile. However, there is currently no coherent regional policy or framework underpinning a mandate (and value) on regional diversification at a strategic level. Values of such economic or employment diversification are effectively only realised through political avenues and therefore do not provide a sustainable platform for the industry's future.

In communities that shift from agriculture to forestry there are also significant social and economic adjustments that occur. Several research studies suggest the impact of the expansion of plantations on the community is very mixed and can involve changes in the structure of regional economies and demographics. This has generated benefits to some (such as through higher land prices and employment) whilst imposing costs on others, such that any dominant expansion in the area of plantations (as occurred through MIS) can cause regional scale transitional adjustment issues (see, for example, Schrimer, 2009). Several studies investigating community perceptions of plantations have suggested that commercial plantations are more likely to be associated with perceptions of negative rather than positive economic, social and physical impacts (Williams, 2008). One stakeholder consulted by the CIE highlighted the negative perceptions associated with plantations encroaching regional centres and indicated there could be a Pareto improvement in social values from land swap arrangements with the State government to relocate plantations.

Williams (2008) surveyed community perceptions in south west WA and Tasmania, finding that agricultural land uses are overwhelming viewed as very acceptable and are significantly favoured over plantations (see table 3.4). Williams (2008) suggests that the findings in the study are likely to provide a robust representation of the overall trends of opinion in these regions.

14 **Survey responses of overall acceptability of land uses (7=very acceptable, 1=not acceptable)**

Land use	*Mean*	*Standard deviation*	*Mean rank*
Dairying	6.37	1.00	7.07
Cropping	6.33	1.00	6.92
Horticulture	6.28	1.04	6.83
Grazing	6.14	1.19	6.51
Native vegetation	6.09	1.33	6.59

Commercial wind farms	5.91	1.52	6.34
Eucalypt plantations for timber	**4.97**	**1.78**	**4.58**
Pine plantations	**4.47**	**1.96**	**3.81**
Eucalypt plantations for pulp and paper	**4.19**	**2.10**	**3.49**
Rural residential development	3.77	1.86	2.87

Note: Around 1750 responses were received via postal survey.

Source: Williams, 2008.

Beliefs of the physical impact of plantations, including the impact on other land uses and the environment, were crucial in predicting the acceptability ratings. Plantations are more acceptable under circumstances where (Williams, 2008):

- they are planted in areas with high water availability;
- they are planted on land with poorer soil quality or on saline soils — this has been a factor attributed to the higher levels of acceptability associated with plantations in saline-affected regions of WA;
- they are grown for timber rather than pulp and paper;
- they are planted in areas where plantations have previously been grown, rather than on former agricultural land; and
- they are owned by an individual landholder rather than a plantation company.

The community attitudes displayed in table 3.4 are highly conducive to farm forestry. However, further community engagement is likely to promote greater acceptance of commercial plantations as a land use. Ford et al (2009) highlights the importance of constructive dialogue between the community and industry and role of trustworthy management of forests and/or independent sources of information on the costs and benefits of plantations in forming community perceptions.

Williams (2009) states that ‘while many people (including many forest managers and ecologists and some conservation lobby groups) would view plantations as environmentally positive in (cleared) rural landscapes, this is not reflected in resident perceptions overall’. Some community perceptions may be overly pessimistic and influenced by information asymmetries between the industry and the community, the dominance of opponents in debates, or the influence of MIS forestry on perceptions of forestry in general. Engagement with the concerns of the community including fertiliser use, fire risk management, water use, biodiversity conservation and on other environmental pluses of forestry may alleviate or reduce these concerns. The IFA (2011) suggests that there is a need for ‘a schematic approach to monitoring information on social values of forests and using this information as an input to major decisions affecting forest use’.

The CIE has not identified any evidence that existing social values from commercial plantations provide sufficient rationale for taxpayer funded investment. However, there may be some unique circumstances whereby social values from forestry could be more directly measured and captured by plantations. For instance, there are amenity values from tourism and recreation in plantation forests.

Hidden taxation and superannuation issues

There is evidence of varying levels of distortions within the Australian taxation and superannuation framework. This affects the capacity of forestry in Australia to compete with other assets for investors, and the capability to compete for land or landholder participation in tree planting. Taxation arrangements should not inhibit market liquidity or private investment *at any scale.* Taxation arrangements could be modified to improve their operation and fairness across asset classes and avoid any adverse consequences associated with investors from making their investment decisions on the basis of taxation treatment.

Box 3.5 provides a case study of the impact of favourable taxation treatment for savings vehicles such as superannuation or pension funds and real estate investment trusts arrangements on investment structure in US forestry.

15 **Impact of lower taxation rates to US forestry investment**

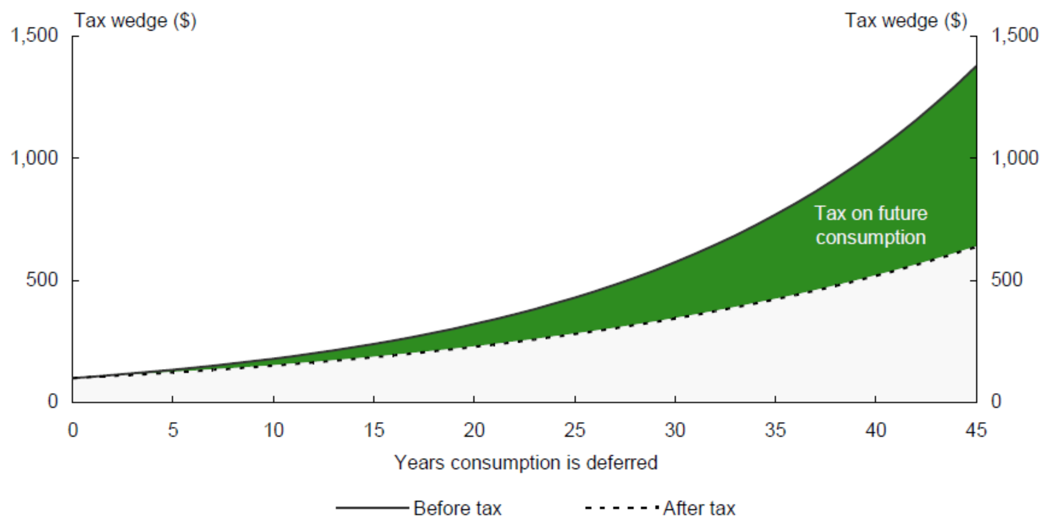
US timberland investments have been able to compete favourably with other investment options. Returns from timberland ownership averaged around 7.8 per cent from income generated and more than 12 per cent from the appreciation in asset values. When applied in a whole of portfolio, TIMOs and REITs have seen the investment in forestry assets as a risk diversification strategy (US FC, 2007). These rates of return have been attainable in part due to favourable taxation arrangements.

- Investors who own just forestland can normally pocket at least 85 cents out of every dollar of profit (US FS, 2007).
  - Real Estate Investment Trusts (REITs) which buy, manage and sell real estate assets on behalf of private investors were able to enhance their after-tax investment returns from forestry through the Real Estate Investment Trust Simplification Act of 1997 whereby only the shareholders of REITs pay income tax and this is normally computed at a rate of not more than 15 per cent as compared to the 35 per cent rate applicable to any income realised by regular Sub-chapter C Corporations.
  - TIMOs are typically engaged by pension funds and have benefited through access the favourable taxation arrangements associated with pension funds.
- For Vertically Integrated Forest Product Companies (VIFPCs) which are Sub-Chapter C Corporations 'any profits obtained from the sale of timber are taxed twice — once at the corporate level (35 per cent), and once at the stockholder level when the dividends are disbursed (15 per cent)' (US FS, 2007).
  - US Forestland Ownership by TIMOs/REITs soared relative to VIFPCs. The investment in TIMOs and REITs expanded from $1 billion in 1985 to more than $25 billion in 2005 whilst the acreage owned by VIFPC contracted from 58 million acres to 21 million acres (US FC, 2007).
- State and Federal cost-share incentives also encourage private landowners to invest in timberlands. For example, legislation passed in 1997 allowed open land converted to timber production to continue to be appraised as open land for the next fifteen years (URS, 2007).

Long gestation assets in the taxation system

The Henry tax review (2011, p12) argues that income taxes create a bias against saving by creating an increasing implicit tax on future consumption. It states that 'the essential reason for exempting lifetime savings or taxing them at a lower rate is that income taxation creates a bias against saving'. The review then states that the longer the person saves and reinvests, the higher the implicit tax on future consumption (see chart 3.6).

16 **Tax wedge on future consumption**



Note: Assumes pre-tax interest rate of 6 per cent each year and a tax rate of 30 per cent.

Data source: Treasury estimates (Henry tax review), 2011.

Investment in plantations is generally undertaken on a long term basis and represents a form of long term savings for consumption in retirement. Even if the asset is liquidated prior to retirement, as in a house being sold prior to retirement, these savings ultimately form the basis of retirement income. Long rotation forestry investments are virtually illiquid for the first fifteen years, taking more than 30–35 years to mature.

Other savings vehicles attract more favourable rates of taxation to compensate for the distortion caused by taxing savings for future consumption.

- Exemptions and lower rates of tax are applied to owner-occupied housing such as the absence of income tax on contributions to mortgages (a form of savings) and lower rates of capital gains tax on investment earnings at the time of sale.
- Superannuation also encourages savings through a discounted rate of taxation.
- Small business owners are able to access more favourable tax arrangements by retaining profits and redirecting income in to the company, greater ability to claim deductions for expenses and arrange income splitting, and access to capital gains tax (CGT) concessions (Henry tax review, 2011).

Table 3.7 provides a summary of the potential types of investors and the taxation stream they are likely to fall within.

17 **Rate of taxation among investors**

Investment vehicle	***Taxation stream***	***Rate of taxation***	***Deductibility of investment costs***
Equity based companies (forestry corporations, processors)	Company tax rate	30 per cent	Yes [c]
Publicly listed companies (forestry corporations, processors)	Mixed	30 per cent	Yes [c]

Retail investors e.g. MIS structures (private individuals)	Company tax rate	30 per cent	Yes
Shareholders (private individuals)	Company tax, followed by Capital gains tax	30 per cent on profit, 15 per cent taxation on capital gains (held >1 year)	Yes
Landholders	Marginal income tax [a]	Highest marginal tax rate	Uncertain
Cooperatives	Dividends, rebates and bonus treated as taxable income by recipient member Retained surpluses are subject to corporate tax	Variable	Yes [c]
Self managed superannuation funds through publicly listed companies, MIS or small-scale operations	Existing investments ineligible for transfer	15 per cent (new plantations only)	Yes
Superannuation (institutional investors, superannuation, landholders [b])	Superannuation rate	15 per cent	Yes

[a] Landholders may also be exposed to paying capital gains tax. Income averaging provisions are highly inaccessible to landowners with forestry (AFG, 2010) [b] Existing landholders limited in capacity to access provisions [c] Companies need to be of sufficient scale to enable costs to be offset against other business revenue.

Source: Compiled by CIE.

The effective rate of taxation varies considerably across industries, depending on their capacity to deduct expenses from their revenue stream (Greagg et al, 2010). The rate of taxation depends on the industry-specific tax provisions and available depreciation deductions. Potential investors in forestry may in many circumstances be unable to access the tax concessions provided for other savings vehicles and assets. Due to the long gestation of forestry investment, to deduct expenses as a usual business an investor in forestry requires another substantial source of income to deduct their expenses against. Larger companies are in a better position to deduct their costs than landholders and private individuals.

The CIE understands that MIS arrangements were established in order to enable small scale investors to pool their funds to access the same provisions as other larger investors. More efficient investment could be encouraged through a range of investment vehicles and investors with equitable ability to deduct expenses as per businesses in other industries. This could avoid the problems associated with establishing one new tax structure (such as MIS) in which all investment is diverted to receive relatively modest tax benefits. Previous analysis by the CIE showed the impact of up front tax deductibility was only very modest.

Landholders in cooperatives can access arrangements to deduct expenditures from other income in the business. However, this depends on the cooperative being an established entity with other revenue such as from processing existing resource. High administration costs in years where there is little or no income can be a significant barrier to their establishment. In reality, to get off the ground co-ops require external funding or significant personal contributions.

Impact of inflation on long gestation assets

Long gestation assets are inherently disadvantaged because of the impact of inflation to the real cost of investment over the investment period. The taxation system operates in nominal terms in which the non-capital business cost is deductible in the year in which it is incurred, whilst the income tax is paid on profit in the year it is earned. An investor making zero *real or nominal* returns may still be required to pay tax on the asset in the year in which it is earned unless the business can either carry forward their losses from previous years in real terms (through indexing) or where a loss is incurred in the year of harvest. Whilst most business can carry forward their losses into subsequent years, they cannot index these losses to reflect their *real* value. The investor also bears the risk that costs will appreciate at a rate in excess of the appreciation of the returns.

A private investor or landholder is impacted by their marginal rate of taxation at the time of investment and the time of revenue generation.

- Private investors paying income rather than company tax will benefit where their income is high in the early period of investment and they anticipate having a lower marginal tax rate on their future returns.
- In most cases, however, due to the significant returns accumulated at the time of harvest in one period it is likely that the marginal tax rate at the time of revenue generation is significantly higher than the marginal tax rate at the time of investment. Lumpy income generated by tax rate variation across different years results in higher levels of income tax paid in one year compared to if it were received in 30 or so equal amounts. The general business deduction enables landholders to *partially* offset this tax imbalance (AFG, 2005).
- This period inequity causes distortions in the attraction of investors to forestry. Private investors on high incomes with high marginal tax rates invested heavily in MIS whilst landholders (unless through MIS) or low income tax payers did not, as they were less able to equalise their tax treatment across these multi-period assets.

The bias that inflation imposes on long gestation assets is exacerbated by high rates of taxation. There are several ways in which these biases against savings and investment in long gestation assets could be 'corrected':

- improved access of forestry to lower rates of taxation associated with other savings vehicles. There is likely to be reluctance from policy makers to expanding the number of assets treated as such and specifically, forestry continues to haunt policy makes due to the perverse consequences associated with MIS forestry; and/or
- allowing for the indexation of costs or losses to the year in which the income is derived to enable neutral treatment of losses and reduce the impact of lumpy income on investment in forestry.
  - Removing period inequity through tax reform may discourage inefficient investment in the industry. Using the wrong structure of investment can erode potential returns from forestry.
  - We understand however that the capacity to deduct expenditures up front as a part of 'carrying on a business' remains important for attracting investment, particularly for landholders.

Potential disadvantages for forestry relative to alternative assets

Due to the long time frame to duration, many landholders are likely to utilise their harvest income as a form of superannuation. At present, landholders establishing or growing trees effectively do not have access to the provisions afforded to agricultural landholders or other asset types.

Firstly, landholders in agriculture have access to income averaging provisions which enable them to receive a lower average tax rate to promote their resilience in dealing with difficult years. The lumpy nature of forestry is more accentuated, with landholders incurring maintenance costs in all years but receiving revenue only during thinning (if markets can be identified) and harvest. As such, landholders are effectively confronted with paying the highest marginal tax rate rather than a concessional rate such as those applying to the money withdrawn from a superannuation fund (Qld Treasury, 2005).

According to Australian Forest Growers (2010), the accessibility of income averaging provisions to landholders could be improved by:

- enabling Farm Management Deposits (FMD) to be made on behalf of partnerships and family companies (only individuals currently eligible);
- redefining the *withdrawal threshold* in relation to death or retirement from primary production, with a specific provision for private forests or any primary production enterprise with long term or lumpy return characteristics of three or more years.[22]
- amending the current rules which restrict access to those with taxable off farm income of more than $65 000 which eliminates many private plantation growers and those that do not carry out other forms of primary production.
- increasing the maximum limit of funds held in deposits at any one time (currently $400 000) to $500 000 of annual farm turnover. Whilst agricultural enterprises can withdraw from their revenues over several years to remain under this threshold, the very lumpy returns of farm forestry are such that these thresholds may be exceeded in one year despite there being little or no income in other years. This restriction also favours smaller landholders over larger landholders whom suffer the same volatility.

There is also a bias against self managed funds (SMSF) seeking access to superannuation provisions for forestry investment. Currently, the CIE understands that the rules around SMSF only allow for the transfer of an established plantation into a grower's self-managed superannuation fund under very specific, qualifying circumstances. Most private plantations now approaching harvestable age have 'no chance of being made to fit SMSF conditions that would allow the growers to take advantage of the tax treatment of superannuation funds' (AFG, 2010). This is anticipated to affect the resale to potential funds. This represents another discrimination against long gestation assets.

Additional reform to CGT exemptions to improve suitability for farm foresters could also assist to lowering economic barriers to planting trees. AFG (2010) proposes improvements to the accessibility to CGT exemptions through:

22 'Eligibility is dependent on continuing primary production after final harvesting because any income placed with an FMD must be withdrawn within only 120 days of when primary production ceases' (Qld Treasury, 2005).

- amending the ‘active asset’ condition of the small business CGT concessions to either:
  - allow that a farm would still qualify as an active asset when leased[23]; or
  - delete the requirement for the retiring taxpayer to have an active asset at the time of sale or transfer of the property.
- removing or raising the *arbitrary asset value threshold* in relation to private forests to account for the appreciating nature of the asset. Engaging in private forestry can increase the likelihood of the landholder’s assets exceeding the asset value. A retiring landholder may receive a valuation for land (and trees which are treated as part of the land value) and other assets in excess of the maximum net asset value test to qualify for concessions including CGT for small business. The asset may be highly illiquid and yet the landholder may have a substantial CGT liability due to the appreciating value of trees on the land (AFG, 2005).
- resolving the lingering uncertainty around profit a prendre or landholder interest (AFG, 2010). Profit a prendre/forest rights are ‘not as tradable as they should be because the tax rules suffer from uncertainty and have an anomaly that could result in double taxation’ (Qld Treasury, 2005). This could be resolved through adhering to the Ralph recommendation (1998) by shifting profit a prendre into the income tax stream and out of the capital gains tax system.
- removing the need to hold trees for four years to enable an investor to claim a tax deduction on planted trees. This is according to Jones (HOR SC, 2011) ‘impeding the ability for people to transition from planting the tree to institutional ownership. It is an impediment which does not achieve anything’.

23 Certain CGT assets cannot be active assets even if used or held ready for use in the course of carrying on a business, for example, assets whose main use is to derive rent, unless where the asset was rented to an affiliate or connected entity for use in their business.

4. Security of the resource and land access

In concert with addressing market impediments, to promote an efficient and viable supply chain also requires there to be a relatively secure resource base. The accessibility of the resource and the quality of the resource are other important considerations for the processing sector. Farm forestry has many values which are well recognised, including social, environmental and economic attributes, which support its role in supplying regional fibre requirements. Private native forests are extensive in which environmental values could be enhanced creating the right incentives for silvicultural management. However, commercial plantations will continue to be a necessary component of the resource base if there is to be a sustainable and viable long rotation forestry industry.

Farm forestry: an attractive strategy for governments

The discussion on social values in the previous chapter highlighted that social attitudes are highly conducive to farm forestry. It is highly socially acceptable as it is seen as a mechanism to enhance regional economic, environmental and social values without displacing agriculture. Research has demonstrated that there are substantial areas on properties of essentially cleared land (NHT, 2003). Existing landholders already own the resource, such that land costs are already incurred. They can also be less interested in the growth rates and hence the time period to harvest because multiple benefits are being derived from the trees. Although there is great potential, models for integrating farming and forestry have not been widely adopted (FWPA, 2011a).

Due to the economic values derived from farm forestry, it also represents a very competitive mechanism for CMAs or state agencies to achieve salinity and other environmental objectives such as biodiversity conservation. Coggan et al in 2009 cited that revealing private timber values would have the potential to reduce costs associated with protecting infrastructure and natural assets, presumably through promoting planting.

Although the multiple benefits of farm forestry are well recognised, there is limited quantification of these benefits. To illustrate the potential public and private benefits of farm forestry most papers refer to a URS report from 2003 (see table 4.1). Benefits from public good aspects of farm forestry have been estimated to range from $6 to $115 per hectare each year (Paul et al, 2011a). In reality, benefits would vary substantially between sites, they are difficult to assess on establishment and there is great potential for benefits to be understated or overstated given the current lack of data (Hassall, 2008).

18 **Net Present Values for Environmental Benefits**

Type of benefit	*Net Present Value (2010 dollars)[a]*	*Estimated annual value (2010 dollars)*
	$/ha	$/ha
Public benefits		
Biodiversity	446	27
Riparian restoration and water quality	608	37
Salinity	304	18

Soil erosion	61	4
Aesthetics/scenic improvement	466	28
Private benefits		
Carbon sequestration	2 028[b]	122[b]
Crop and livestock shade and shelter	405	24
Fodder	142	9
Salinity	203	12
Soil erosion	142	9

[a] At a 6 per cent discount rate. [b] Derived in 2003, based on average carbon sequestration rate of 2.64 tonnes C/ha/year and a carbon price of $35 per tonne. Carbon sequestration payments become private values post-implementation of a carbon price.

Source: URS 2003. Values have been updated from 2003 to 2010.

Despite significant efforts to promote farm forestry over the previous decade, landholders still show some reluctance to establishing plantations. The number of plantations has increased substantially since the early 1990s; these have been principally in the high rainfall areas with the exception of WA inland areas affected by salinity (Cockfield, 2002). The area of plantations, excluding MIS plantations considered to be farm forestry, have increased by around 33 000 hectares since 2001, an increase of 50 per cent (URS Forestry, 2008). This increase represents a small component of the overall plantation area of approximately 1.7 million hectares. The largest increase has been in WA in which direct government involvement has been important (URS Forestry, 2008). Participants are typically smallholders and few commercial landholders have established plantations (Cockfield, 2002).

Chart 4.2 provides a summary of the approximate area of farm forestry as compared to the total plantation area (based on URS, 2007).

19 **Area established for farm forestry as share of total plantation area**

Data source: URS 2007 (cited Hassall, 2008)

The lack of an established industry in which economic benefits flow to farmers, and thereby the lack of stories of success, adversely affects participation (Herbohn, 2001). Correspondingly, it has been suggested there is a lack of farm forestry culture among forestry professionals.

Fristch and Hudson (2008) concluded from their study that ‘it was difficult to justify the promotion of investment in long timeframe sawlog regimes at the farm level’ without earlier income generation to offset costs or demonstrated integrated whole farm benefits. When considering the integrated benefits of farm forestry at the landscape scale for landholders, farm forestry produced a superior risk free net present value to livestock. For other enterprises, other less quantifiable private incentives (erosion control, aesthetics, extreme weather event protection and personal satisfaction) and markets for public benefits such as salinity control and salinity mitigation will remain important drivers.

Cockfield (2002) surveyed landholder attitudes in Queensland and NSW to the potential for establishing plantations on farm in a medium rainfall area (650-780mm). Tables 4.3 and 4.4 identify key barriers to and reasons for the establishment of plantations, respectively, from the survey responses.

The primary impediments to planting trees for commercial producers, especially grain farmers, were the high economic barriers (Cockfield, 2002). Stewart et al (2011) found that financial factors such as insufficient income to invest in a new land use and better returns available from off-property investments were more important than time and effort to acquire new knowledge and skills or bad experiences from farm forestry. A study by Herbohn et al (2004) of landholders in tropical eastern Australia also showed that financial barriers were inhibiting planting including uncertainty around rights to harvest, long wait for returns, lack of capital, contentment with existing land use, low profitability, limited flexibility with future land use and price uncertainty.

20 **Barriers to establishing plantations (ranking out of five)**

Barrier	***Mean***
Too much uncertainty about future returns from timber	3.78
It is more important to be able to quickly change enterprises	3.72
Future government regulation will restrict production opportunities	3.70
Requires too much capital upfront	3.68
Annual income is more important than long-term income	3.61
It is more profitable to graze or farm than to plant trees	3.58
Not enough knowledge about trees in the region	3.33
The risk of fire damage to trees is too high	3.16
The risk of pest damage to trees is too high	2.75
The risk of storm damage to trees is too high	2.65
It would be difficult to learn to manage plantations	2.49
There is not enough knowledge about suitable tree species in the region	2.33

Source: Cockfield, 2002

21 **Reasons for establishing plantations (ranking out of five)**

Statement of reason	***Mean***
Minimise land degradation by establishing ground cover	3.87
Establish shelter belts for stock or crops	3.79
Make better use of low-fertility country	3.75
Increase the value of the property	3.73
Make better use of unused parts of the property	3.59
Provide habitat for wildlife	3.49
Increase total farm income	3.45
Provide income for later in life	3.30
Diversify income	3.24
Make property look better	3.11
Less labour intensive and easier to manage	3.11
Provide timber for on-farm use	3.07
Reduce total tax paid	2.63

Source: Cockfield, 2002

Based on a survey of landholder perceptions, Cockfield (2002) concluded that there was unlikely to be a rapid increase in the area of farm forestry in the *broadacre* agricultural landscapes.

- Survey responses suggest using unused parts of their property was a low priority, suggesting the perceived opportunity cost of their time is high.
  - However, where some commercial producers (with the exception of graziers) are motivated to plant trees for soil protection, this is suggested by Cockfield (2002) as an opportunity to promote farm forestry.
- Establishing shelter belts ranks as one of the top reasons for livestock producers to establish plantations, and other commercial producers are also interested in their potential. Shelter belts deliver significant benefits from reduced wind erosion, stock shelter through reducing wind chill factor and reduced evaporation from dams (Sudmeyer et al, 2007).

To develop windbreaks for multiple products requires ‘special care in planning and management to maintain the primary function of wind protection while maximising secondary yields’ (Wilkinson and Elevitch, 2012). For instance, trees need to be spaced appropriately without significant gaps to enable the shelterbelt to function during selective harvest (Wilkinson and Elevitch, 2012). Selective harvesting of trees could be very expensive relative to the perceived effort and return. A major drawback of relying on shelterbelts for timber is that wind stress or damage may compromise the timber’s form or quality (Wilkinson and Elevitch, 2012). Windbreaks should only be pruned sparingly, or not at all, however the lack of pruning may reduce timber yields on some species.

Commercial producers and other part-time or recreational farmers are strongly motivated to plant trees to enhance the value of their property (Cockfield, 2002). This could partly account for some landholder disinterest in entering into long term joint venture arrangements or sharing property rights with industry, particularly without regular contract reviews (RIRDC,

1998). The benefits from the joint venture may not be sufficient to compensate for the loss of control over their land (Herbohn et al, 2004).

Landholders are interested in using their land with low alternative use values rather than using highly productive land for trees (see table 4.4). Whilst radiata pine is more forgiving, the most consistent and high quality product is sourced from high rainfall and high productivity sites. The view that trees are for the least productive parts of the farm can be challenged in some circumstances where trees may have higher returns than competing land uses. Several studies have shown that agroforestry can be more profitable than livestock grazing (see, for example Stewart et al, 2011), although such studies are usually referring to Blue Gum (short rotation) plantations.

Rigorous analysis and demonstrated opportunities for profit would be required for farm forestry to be accepted more widely (Fritsch and Hudson, 2008). At present, the primary motivations *for* planting trees are associated with environmental and agricultural benefits (Fristch and Hudson, 2008) whilst economic factors are the primary inhibitor.

There are several factors impeding the *financial* viability for sawlog farm forestry (Fritsch and Hudson, 2008):

- a lack of historical prices and measured growth rates for farm woodlots to generate expected returns based on measured species performance in different environments. There needs to be a better understanding by landholders and industry of the expected returns at different levels of risk;
- there are many risks including species selection not suiting the property, poor growth rates, silviculture influencing log quality, fire, feral animal control, disease, market uncertainty, market demand and stumpage price.
  - Fritsch and Hudson (2008) remark that the ‘capacity to offset some of these risks, such as leasing or share farm arrangements, was not prevalent or offered by the industry’;
  - Further research around site suitability would be required to better understand site quality issues and implications for the selection of varieties for planting within each region. Polglase et al (2008) suggest future research should cover growth data and prediction for dryland species, refinement of carbon accounting and prediction on a yearly basis to enable short term trading, and breeding and silvicultural techniques to maximise growth;
- the absence of liquid markets for prunings, thinnings, environmental stewardship and carbon trading to recuperate the cost of establishment:
  - There are significant distances to processors and markets. Portable sawmills have the potential to reach small-scale farm forestry resources that are isolated and uncompetitive to process at industrial-scale timber mills;
  - ‘Grower groups such as SMARTimbers are attempting to create these markets but need resources, industry assistance and further research to determine the capacity and potential influence these markets have’ (Fristch and Hudson, 2008);
- the need for expertise in extension to ensure localised experience on marketing, species selection, stand density and silviculture; and

- a lack of quantified data and impact on whole-farm value of integrated farm forestry such as from improved agricultural productive capacity.

For the multiple reasons outlined above, there are a range of complex factors to consider when establishing trees. For farm forestry to provide a high quality resource for sawlogs, growers are likely to require advice and well targeted incentives to manage the resource to meet this end.

Polglase et al (2008) suggests ‘a major impediment to agroforestry in the marginal regions of Australia, where the net environmental benefits are likely to be greatest, has been the inability to quantify and present the economic case’. URS (2008) recently suggested there was a strong potential for the production of hardwood timber supplies in many regions with existing access to infrastructure and potential markets[24]. The assessment was based on the market opportunities for ‘traditional’ forestry systems and products (Polglase et al, 2008). Polglase et al (2008) assessed the capacity for farm forestry in 57 NRM regions, mostly CMAs, based on expected profitability[25] and the level of support from community and government.[26]

Polglase et al (2008) conclude their work shows agroforestry can be competitive with some agriculture in some regions and for some forestry systems (see chart 4.5). However, farm forestry is *often* of marginal profitability although the full on farm and off farm benefits are difficult to measure and take in to account (Fristch and Hudson, 2008). The profitability of longer rotation sawlog systems would be significantly enhanced if impediments were removed, in particular if carbon were a saleable and accessible product (Polglase et al, 2008).

Private Native Forestry: part of the portfolio

Private native forests provide a significant resource, equivalent to around 22 times the area of plantations in 2007 (see table 4.6). There is a limited existing culture of management for the sustainable production of timber in private native forests. The status of private native forests is generally regarded as poor due to ‘a long history of indifferent management and/or high-grading… without due attention to silvicultural improvement treatment’ (Jay et al, 2009). Yet, private native forestry (PNF) is playing an increasing role in some regional economies and in supplying wood under diminishing access to public native forests. In some Australian timber producing regions, more than 50 per cent of the resource is being supplied by private native forests (AFG, 2010). Thompson and Connell (2009) state that ‘the current lack of incentives, combined with an emphasis on regulation provides little scope for improved management outcomes and results in a decline of the genetic and commercial potential of many of these forests’. Poor silvicultural management is a significant threat for processors which lack capacity in most regions for processing lower grade or smaller diameter products (AFG, 2010).

24 URS (2008) suggested there were substantial opportunities for hardwood production in Central and North Queensland, South East Queensland, North Coast NSW, South East NSW, Central Victoria, Gippsland, South West WA and Tasmania.

25 A combined factor of the ratings for market opportunity from URS (2008) and a determination of growing opportunity by Polglase et al (2008).

26 Regional support was gauged through a review of NRM plans (such as from CMAs) to gauge interest.

22 NRM regions with 'high' capacity for farm forestry[a]

Region	*Review of NRM plans: Regional support*	*Profitability*	*NRM, profit and biodiversity*
Burnett Mary	High	Medium	High
Corangamite	High	Medium	High
Fitzroy	High	High	High
Glenelg Hopkins	High	Medium	High
Goulburn Broken	High	Medium	High
South Coast Region	High	Medium	High
Border Rivers/ Gwydir	High	High	Medium
Burdekin	High	High	Medium
Central West	High	High	Medium
Hawkesbury/Nepean	High	Medium	Medium
Hunter/Central Rivers	High	Medium	Medium
North Central	High	Medium	Medium
North East (Vic)	High	Medium	Medium
Northern Rivers	High	High	Medium
South (Tas)	High	Medium	Medium

a Plantation regions refers to National Plantation Inventory regions.

Note: Report contains 57 NRM regions with a full assessment of potential.

Source: Polglase et al, 2008.

23 **Private native forest area in 2007**

	Area (million ha)
Queensland	10.2
New South Wales	8.5
Victoria	1.3
South Australia	0.8
Western Australia	1.6
Tasmania	0.9
Northern Territory	15.5
Total – Private native forestry	**38.1**
Total – Plantation resource	**1.7**

Source: URS, 2007 (cited Hassall, 2008).

There may be a case for regulatory reform of PNF and payments for ecological services. Incentives would be justified on the basis of the public benefits, in terms of biodiversity and forest sustainability, from good forest stewardship practices beyond those required by 'duty of care'.

Regulatory outcomes may not be consistent with intent

The regulation of PNF has been associated with higher costs for harvesting and processing, rendering sustainable management unviable for many private landholders (Thompson and Connell, 2009). Such regulations were borne out of public concerns with previous logging yields and practices such as clear felling and burning. Such practices were effective in promoting seedbed and understorey regeneration to sustain long term health and forest productivity (Thompson and Connell, 2009). Selective and partial harvesting methods became favoured to encourage the retention of a range of species mixes and age classes for biodiversity conservation (Thompson and Connell, 2009). However, researchers suggest that regulations in the pursuit of environmental objectives have not been effective in achieving long term forest productivity and, as logic would suggest therefore, also biodiversity outcomes.

Uncertainty arising from government policies and regulation is thought to be having perverse effects on landholder behaviour. A key aspect of PNF regulation is the Forestry Codes of Practice, implemented to deliver Ecologically Sustainable Forest Management (ESFM) outcomes in accordance with Regional Forest Agreements in the mid-1990s. Some of the key objectives of ESFM, in summary, include (Thompson et al, 2007):

- maintaining or increasing the full suite of forest values for present and future generations across the native forest estate including biodiversity, the productive capacity and sustainability of forest ecosystems, forest ecosystem health and vitality… long term social and economic benefits;
- ensuring legislation, policies, institutional framework, codes, standards and practices related to forest management require and provide incentives for ecologically sustainable management of the native forest estate;
- apply precautionary principles for the prevention of environmental degradation; and
- apply best available knowledge and adaptive management processes.

Researchers suggest that the outcomes are not meeting the intent of the regulation to maintain or increase the full suite of forest values including productive and biodiversity values. Under the current scenario, research suggests it is entirely rational for landholders in some jurisdictions (such as NSW) to seek to maximise short term profits without regard for long term sustainable management (Jay et al, 2009). Landholders cannot afford to invest heavily in their native forest in 'uncertain anticipation' of the long term benefits in which their future harvesting rights hang in the balance (Thompson and Connell, 2009). Long term uncertainty surrounding the rights to harvest can actually 'deter investment in good silvicultural treatment to return them to productivity' (Thompson et al, 2007).

Effectively, according to Thompson et al (2009), to comply with the proposed tree retention regulation (now implemented) in NSW or maintain high site value environmental scores landholders can either:

- obtain immediate cash flow from commercial high-grading without culling; or
- make a substantial net outlay.

Jay (2005; cited Thompson et al, 2009) shows that long term productivity and industry output will be reduced by the first option within the following one or two harvesting cycles. Yet, the

latter choice would only be financially viable if incentives are created and/or new markets identified. Poor practices may be able to continue under existing arrangements in NSW, including high-grading without culling of older degenerative trees[27], meeting tree and/or basal area retention limits through retaining poorer quality stems (Thompson et al, 2006).

Jay et al (2009) found when reviewing the proposed NSW PNF Code (now implemented) that there are areas of the code which impose a potentially significant burden on landholders without sufficient incentives to support their intended outcomes. The CIE understands this is the case in some of the other States and Territories. Jay et al (2009) suggest there is also the uncertainty that the Native Vegetative Act 2003 could be gazetted within the PNF Code, which refers to an extensive list of forest types that are grouped by CMA region in which any broadscale clearing would be prohibited if less than 30 per cent of the original extent remains (Jay et al, 2009). Jay et al (2009) state:

> *'considerable uncertainty surrounds the continued capacity to harvest logs from NSW private native forests, and landowners are, on anecdotal evidence at least, very reluctant to make any silvicultural investment in improving the productive capacity of their forests when future harvests may not be permitted or are highly restricted.'*

Victorian legislation on PNF also incorporates the Native Vegetation Management Framework which utilises conservation status ratings based on the Ecological Vegetation Classifications (EVCs) to determine conservation significance. EVCs are utilised to classify vegetation and can dictate which private native forests are available for timber harvesting, thereby providing the potential for vegetation to be upgraded to a higher class system (through enhancing silvicultural and biodiversity management) with more restrictive regulations.

The CIE understands that in many states, with the exception of Queensland and Tasmania, there is still significant uncertainty and restrictions imposed by planning arrangements.

- In Victoria, local government is the authority responsible for PNF and local councils are the planning authority that prepares and amends the planning scheme. Although the Victorian Department of Sustainability and Environment is consulted by local councils, there is still the potential for local councils to set and amend the rules (Thompson et al, 2007).
- In NSW, the harvesting of timber from PNF will require approval through the preparation of a Property Vegetation Plan (PVP) which aims to ensure environmental outcomes are improved or maintained. A PNF PVP is a legally binding agreement that stands for up to 15 years, with the intent to provide both resource and environmental security. It is unclear whether this has provided greater certainty for long term forest harvesting rights.
- In WA, PNF is treated as cleared and requires a range of approvals. The 'degraded' condition of private forests and 'need for silvicultural restoration' (Thompson et al, 2007) suggests legislation may in part be responsible for the short term nature of forestry practices.

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[27] High-grading without culling is detrimental for regrowth of new trees.

- In SA, PNF has also been treated as clearing whereby clearing activity is only permitted where clearing is ‘not seriously at variance with the Principles of Clearance’. These principles appear to have precluded any PNF activity from taking place (Thompson et al, 2007).
- In the NT, native forests are cleared for plantation development or agriculture with the timber being burnt and almost all timber production is based on plantations (Thompson et al, 2007). Landholders are required to pay a royalty for any timber sold from leasehold land (Thompson et al, 2007).

On the other hand, Queensland enables PNF to operate as an exemption on land subject to the Vegetation Management Act 1999 without a development approval provided operations comply with the Code. Under the Integrated Planning Act 1997 there are existing provisions which override local government strategic plans giving some certainty that existing land uses may prevail in future. There are also no forest-type exclusions based on conservation status, as there are in Victoria, although the Code does set out various management practices which apply to each (Thompson et al, 2007).

In Tasmania, where an area of land has been declared a Private Timber Reserve under the Forest Practice Act 1985, a forestry operation does not require local planning authority approval where landholders have a certified Forest Practices Plan. This provides greater certainty around the right of landholders to use their land for forestry in the long term (Thompson et al, 2007). Thompson et al (2007) suggests that the requirements under the Code are, however, the most extensive.

Metrics and ecological services

The states have a strong policy objective to avoid decline in the extent and quality of native vegetation and are increasingly looking for ways to monitor native vegetation habitat. Researchers are developing a number of metrics that could be utilised to encourage appropriate silvicultural management of forests for long term resource sustainability.

At present, Victoria is the only state in Australia with a habitat scoring method in place to regulate PNF (Thompson and Connell, 2009). Similar scoring systems are utilised in NSW to regulate land clearing, receive incentive payments, offset land use change (Biometric) or fund NRM investments (Biodiversity Benefits Index or BBi). These are not currently utilised to regulate or award good stewardship of private native forests in NSW.

Research by the Southern Cross University (SCU) found there were considerable limitations in using vegetation scoring systems such as habitat hectares, biometric and BBi to estimate the effect of PNF management on biodiversity. Preliminary results show the sustainability metrics are not significantly impacted by variations in silvicultural treatment (Thompson et al, year). The findings of this research include (Thompson and Connell, 2009):

- There is insufficient capacity to detect differences between silvicultural legacies and simply the recovery of vegetation from harvest.
- Harvesting by high-grading is expected to pass the general habitat scoring metrics, which could be associated with significant adverse effects on future wood production. For

example, high-grading can preserve a large number of large trees in the stand which may produce hollows and thereby meet habitat scoring measures.

- The metrics require modification for a forestry environment, including greater integration with landscape attributes and a silvicultural sustainability component.
- Metric scoring is still not able to deal with the intertemporal nature of sound silvicultural management in which there may be a short term reduction in biodiversity habitat for longer term gain.

Furthermore, the SCU project undertook limited fauna sampling which showed no clear relationship between fauna richness and forest structure including basal area, large or hollow bearing trees, management history or other metric scores. Conservation strategies to maximise a particular species will also vary from one that seeks to maximise habitat for all. Metric scoring is highly context specific and depends on realistic ecological classifications and benchmarks. That is, it must be informed through the current science or knowledge of the region.

Whilst the scientific rigour to align policy objectives with outcomes is still developing, there is the concern that certain segments of the community will push for more regulation (Thompson and Connell, 2009). The challenge is how to manage the uncertainties associated with silvicultural management and biodiversity outcomes with the imperative to change the current incentive framework which is reported to be leading to perverse outcomes for PNF and biodiversity. Despite the low precision between habitat and fauna, Jay et al (2009) suggest an objective scoring system could provide a filter approach to prioritise actions among or between sites.

Other important barriers

A range of other barriers would need to be overcome to support PNF in supplying regional fibre requirements.

- Currently, in many regions there are thin or no local markets for pulpwood, biomass or other residues from thinning such that retained trees are those that are suppressed or defective (Jay et al, 2009). Yet there will be a significant volume of low quality wood from thinning and harvesting operations in private native forests.
- There is a lack of knowledge of how to best manage private native forests for a range of values and the implications of alternative regimes (Thompson and Connell, 2009). Further research and monitoring is required to guide ecologically sustainable native forest management.
- In many cases the significance of the site and management options is not well understood by native forest managers or landholders.[28]. Landholders require extension to assist in the development and implementation of forest management plans to achieve regional objectives (Thompson and Connell, 2009).

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28 Some funding has been available to landholders and contractors to assist them in understanding and implementing the PNF Code and their understanding of forest management and best practice (NSW DCCW, 2009).

Scope for private native forestry to provide Australian hardwoods

Industry experts suggest that the sustainability of the private native resource is an important aspect of addressing the current challenges. However, the resource offers only a market to supplement or top up their log consumption through a spot market[29]. The private native resource is too disparate and transaction costs too high to enable the resource to provide security for processing mills.

Commercial plantations: part of the critical infrastructure

Commercial plantations are required to deliver the critical mass necessary to support a domestic-orientated processing sector for a hardwood sawlog resource. Nolan et al (2005) analysed the rate of hardwood plantation expansion and concluded that the rate of expansion would be insufficient to replace the withdrawal of log supplies from the public native forest estate, even if plantations managed for wood fiber production were converted over to sawlog production (Thompson et al, 2009). Without a substantial secure supply base, investment and innovation in processing will not occur due to excessive investment risk (AFG, 2005).

- Farm forestry, on its own, is unlikely to provide the critical mass necessary to provide the resource security for a competitive and viable processing sector.
- Private native forests may assist in providing competition to markets, principally via a spot market rather than long term contracts. Variation in the quality of the resource and poor incentives for management are likely to reduce the capacity to extract high volumes of high quality sawlogs in the near term.

If landholders act according to their revealed preferences, researchers have suggested that they expect to see most planting by landholders done in initially small and perhaps irregularly shaped plots, creating a mosaic effect across the landscape (Harrison et al, 2002). Farm forestry is a highly fragmented supply model and poses some potential difficulties in terms of consistency of supply flow and quality (Harrison et al, 2002).

Due to the poor silvicultural condition of regrowth dominated stands, Jay et al (2009) do not expect the private native resource will provide significant volumes of timber especially in terms of high quality large logs which are in short supply, and regulatory constraints are expected to prevent the harvest of old growth stands (Jay et al, 2009).

Yet there will be some distinct challenges for commercial providers in making their case. The political environment would not appear to be highly conducive to taxpayer ‘investment’, for reasons including the unintended perverse outcome associated with MIS schemes in which there was an unsustainable expansion of trees into unproductive and unsuitable areas. Negative perceptions and political persuasions may impede the capacity of the industry to capture environmental values whereby the government is the principle customer.

One argument put forward is that plantations represent ‘critical infrastructure’ for communities and a resource that needs to be established for future exploitation. The logic is that forestry requires human intervention to create the resource for future generations

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[29] Steering Committee views during consultation with CIE, 2012.

compared to our mineral resources which have been established over millions of years and are ready to be extracted. To make a case that plantations represent ‘critical infrastructure’ on socio-economic grounds requires critical analysis of the rationale (advantages) associated with having a long rotation plantation industry.

Global markets for forest products are not efficient in pricing sawlogs whereby the true cost of replacing the resource from native forests is not fully reflected in market prices. Analysis by de Fégely et al (2011) show the use of taxation arrangements and other forms of subsidies has been critical to the establishment of plantations to supplement the native forestry resource in other countries. The CIE is not aware of any country which has been able to establish a sizeable sawlog plantation resource without government investment. Industry experts expect prices for structural sawlog to remain flat, although prices for high quality appearance grade hardwoods are expected to increase to reflect declining availability from the native resource.

The distortions in the macroeconomic environment suggest that Australia may be able to import goods at lower prices from overseas for value-adding and consumption, but are less competitive than they might otherwise be in an efficient market. Such distortions provide cheaper access to products from overseas in which consumers can benefit and less expensive inputs to processors involved in value adding. Such distortions impose economic costs on some countries and their producers which may have had a comparative advantage in a free market. There may be a socio-economic cost associated with reliance on imports in a large economy such as the United States. However, the risks associated with importing raw materials in a small open economy such as Australia are expected to be minimal.

As discussed in chapter 3, it is likely to be very difficult to make a case that commercial plantations are associated with superior overall socio-economic benefits across regional Australia. There may be gains in employment levels generated from forestry where a processing sector exists compared to alternative land uses. However, due to high rates of employment sustained over at least the past decade this is a difficult case to put forward to the Treasury. If Australia were to adopt a more comprehensive policy of regional employment diversification, this case could be put forward however it would not provide a sustainable basis for the industry’s viability. A more robust economic argument is that forestry could promote superior socio-economic benefits when adopted on more marginal or underutilised land such as in the case of farm forestry.

The largest benefits derived from plantations appear to be those associated with the afforestation of previously forested, degraded agricultural land. To establish modern Australia, around 100 million hectares of land has been deforested. Taxpayers may also be willing to pay for plantations or other political reform on the basis that it could lead to less reliance on native forests. That is, there could be a socio-economic value placed on the avoidance of deforestation through plantations. There are currently mixed views around the near to medium term potential to replace native forest harvesting with commercial hardwood plantations.

In addition, as outlined in chapter 2, there is sufficient evidence to suggest that plantations are a highly competitive source of ecological benefits, particularly with regard to carbon and salinity. The scale required to capture these benefits is consistent with the large scale of commercial plantations. These externalities are at the core of the rationale for investment in

plantations and payments for ecological services may offer a robust and transparent source of revenue.

5. The case for renewed investment in long rotation plantations

Under the status quo, the investment in long rotation plantations is expected to remain unviable. The public good nature of environmental services and other barriers impede investment by landholders, companies and other financial institutions in planting long rotation trees to generate sawlog required for structural and high grade products. It is important to recognise that the capacity to change the current situation depends on how values are packaged to meet investor needs. Each type of investor is motivated and constrained by wide-ranging and varied factors which need to be addressed in a targeted and composite manner. There are several key stakeholders that should be considered:

- processors — investment in new capital is dependent on the security of a large portion of the resource needed to meet milling throughput targets;
- forest companies;
- Australian individuals/households — as with companies, individuals seek to earn a comparable risk free rate of return to other assets and are not usually interested in tying up assets for extended duration without the capacity to on sell. Although some individuals may be attracted to the environmental values of plantations, there are significant information barriers and dominant opponents of plantations which could impede their capacity to value these benefits;
- institutional investors such as superannuation companies — which tend to be interested in *established* plantations, whereby older plantations (>15 years) offer many positive attributes relative to comparable assets, and Australia has become one of the most attractive destinations for institutional investors due to a stable economic environment and the exposure to Asia (HOR SC, 2011).
- landholders — whom have the capacity to plant trees on the basis of multiple values, although in many cases the investment is still very marginal unless incentives are provided and it remains an opportunity which may not deliver resource security to processors; and
- Governments — that are driven by political (and socio-economic) considerations including the perceptions of plantations by the community at large and capacity of politicians from regional jurisdictions to exert their influence.

Below we have summarised the major constraints to investment for each investor. The barriers to investment are consistent across many stakeholders and meeting the objectives of one party must not be at the expense of others. For example, any compensation to landowners must provide sufficient volume and resource quality for the processing sector to enable landholders to sell their product and provide accountability/transparency for taxpayers. The integration and packaging of these benefits in a policy framework needs to be undertaken at least cost to the investor. Attention needs to be given to how policy reform and industry initiatives can minimise information barriers, distortions and transaction costs across each type of investor.

24**Drivers and constraints to investment in plantations by stakeholder**

Investor	*Interests*	*Factors constraining investment in long rotation*
Forestry companies	Profit	Economic barriers (entry costs, risk, price)
Processors	Profit (resource security, resource price, resource quality)	Economic barriers (entry, cost, risk, price)
Private individuals	Liquidity ▪ Comparable risk free rate of return or superannuation (lower taxation rate)	Lack of liquidity particularly 0–15 years ▪ Poor record of forestry ▪ Constrained in capacity to assess risk ▪ Insufficient returns relative to other assets
Institutional investors	Portfolio diversification ▪ Holding for medium term (<15 years) ▪ Large investments (not small parcels)	Insufficient returns to risk for Greenfields ▪ Inability to sell asset in first 15 years ▪ Expertise required to identify, assess, acquire and manage commercial and farmland assets
Landholders / Cooperatives	Multiple use benefits	Economic barriers (opportunity cost of money and land, uncertainty, high entry costs, alternative use values of trees such as amenity values and expertise required to manage assets)
Government and taxpayer	Social and economic imperatives e.g. regional employment ▪ Reduced deforestation ▪ Water use management ▪ Environmental objectives	Conflicting objectives ▪ Social perceptions associated with MIS ▪ Competing land uses and predisposition of communities and policy toward agriculture

Source: House of Representatives Standing Committee on Agriculture, Resources, Fisheries and Forestry, 2011. CIE.

Furthermore, any incentives to target the barriers identified in this report need to be designed with care to:

- avoid the harm to the reputation of the industry caused as a result of unintended consequences of the MIS scheme which provided in fact very modest taxation incentives in line with what is available to other industries; and
- ensure outcomes are sustainable and targeted toward alleviating the barriers to investment in *long rotation* forestry.

Market prospects and the removal of barriers

Table 5.2 summarises the environmental, economic and social values that are not captured, the key constraints to their attainment and the 'scope' in terms of the extent to which these values could, if attained, improve the outlook for investment in long rotation plantations. In the final column, using a qualitative scale we present our assessment of the degree to which capturing benefits may improve the outlook for investment in long rotation plantations (√√√ = significant, √√ = moderate,
√ = modest). In this assessment we have taken into account the nature of the constraints, including the extent to which it may be feasible to overcome these constraints. Time frame has not been taken into account, however, generally where there are significant research and development hurdles, as in the case of bioenergy, biofuels and biochar, or there is a need for

more rigorous scientific evidence, as in the case of biodiversity, there will be a longer time frame to the attainment of values.

25 **Summary of environmental, economic and social values, constraints and scope**

Value	***Constraints to attainment***	***Sco pe***
Carbon sequestered in trees	▪ Effectively no value on carbon under Carbon Farming Initiative for either short or long rotation cycles ▪ Significant uncertainty associated with power to exclude projects (‘Negative List’) ▪ Projects that may work under CFI are not at sufficient scale for commercial investors ▪ Constraints are generally of a political nature, rather than scientific	√√√
Carbon sequestered in wood and soil	▪ Excluded from domestic carbon framework due to current exclusion from international policy framework	√√
Forestry as low emissions intensive sector in carbon economy	▪ Exclusion of agriculture from carbon framework due to political considerations	√
Salinity mitigation including water quality improvements	▪ Markets for salinity are highly fragmented (non-existent) and difficult for commercial plantation investors to access ▪ Opportunities occur in low-medium rainfall areas which are less commercially viable than higher rainfall areas (which are also unviable for long rotation) ▪ In the medium rainfall zone — capacity to generate valuable resource but less demand from catchment authorities in this zone perhaps due to coordination difficulties. In some cases, reduced water flow from more productive sectors ▪ In the low rainfall zone — salinity often high priority but unlikely to attract commercial scale plantations unless substantial incentives. Limited infrastructure in some low rainfall regions — coordination required between industry, farm forestry and governments to make viable. Significant R&D required on tree species improvement, knowledge to inform species selection, silvicultural regimes etc.	√√

(Continued next page)

5.2 **Summary of environmental, economic and social values, constraints and scope** (Continued)

Value	*Constraints to attainment*	*Scope*
Biodiversity benefits from commercial plantations	▪ Lack of consensus around scientific literature of biodiversity benefits ▪ Although greater consensus that commercial plantations are better for biodiversity than agriculture, community preferences (limiting government/taxpayer and private markets) for expenditure on protection of mature, 'more natural' assets ▪ Good recognition of fringe benefits of biodiversity such as migration corridors and networks. Valuation techniques for different biodiversity management approaches difficult — valuation on case-by-case basis. Research required to understand role of plantations in broader landscape.	√
Farm forestry: integrated salinity and biodiversity benefits	▪ Adoption limited by actual or perceived economic barriers including uncertainty about future returns from timber, high upfront capital costs, marginal profitability from private goods, uncertainty around markets, alternative use values etc. ▪ Reasons cited to establish plantations include other non-wood values (shelter belt, property value) — landholders likely to require assistance and incentives to establish appropriate silvicultural management to develop saleable sawlogs ▪ Tendency to only consider setting aside low productivity land ▪ Taxation disincentives compared to agriculture	√√
Private Native Forests - silviculture to enhance habitat and resource security	▪ Regulation is burdensome in some cases and without incentives for good silvicultural practice. PNF are in poor condition and unlikely to provide significant volumes of high quality resource in near term. Processors not well established to adjust to lower quality and more variable resource ▪ Focus on regulation is not having intended policy objectives of maintenance of productive and sustainable ecosystems for sustainable PNF and biodiversity ▪ High perceived uncertainty around future rights to harvest in some jurisdictions ▪ R&D still required to develop suitable proxy for biodiversity values under varying silvicultural management regimes	√√
Environmental benefits in Streamside Management Zones (SMZ)	▪ Claim that regulations are overly prescriptive and prevent harvesting or impose excessive constraints on harvesting in SMZ. Cost imposed is the current rate of planting in SMZs is too low as economic barriers too high. Potentially significant water quality and biodiversity benefits not being achieved ▪ Regulation does not recognise scientific research showing selective harvesting can occur without significant adverse impacts to biodiversity and water quality	√
Bioenergy and biofuels	▪ R&D needed to improve the commercial viability of various power generation and biofuel processing options	√√√
Biofuels	▪ Established markets 'on a knife edge' in terms of viability ▪ Significant challenge to secure the necessary resource to ensure viability. Bioenergy markets cannot compete with woodchip for export markets	
Biochar	▪ R&D required to address significant uncertainties around impact of processing conditions on product attributes and the interaction of products and site conditions ▪ Limited data to develop models for verification purposes ▪ Too many unknowns to develop a greenhouse gas accounting methodology ▪ Pyrolysis plant used to produce biochar would only be viable if other products (and markets for these products) are developed e.g. syngas and biofuels	√√

(Continued next page)

5.2 **Summary of environmental, economic and social values, constraints and scope** (Continued)

Value	*Constraints to attainment*	*Scope*
Correction of distortions in domestic pricing structures	▪ State forestry agencies need further reform to improve price transparency and promote competitiveness ▪ Lack of secondary markets for long rotation assets in first 15 years of resource creation due to excessive risk and transparency issues ▪ Greater coordination among private sector required to promote price transparency	√√√
Capturing high value markets	▪ Currently no significant resource base and processing capability in time requires upgrading to manufacture high value products ▪ R&D required in tree improvement and wood quality and product innovation ▪ Need to balance objectives (creating the resource base) and undertaking required R&D.	√√
Removal taxation and superannuation barriers	▪ Taxation system displays bias against savings. Long gestation assets are disadvantaged due to impact of inflation on real value of initial investment. ▪ Limited capacity for small holders and private individuals to deduct their costs up front outside of MIS. Need for broader range of options to remove current incentives to structure business around the modest taxation incentive ▪ Effectively, landholders are limited in their capacity to access income averaging provisions through farm management deposits and capital gain tax exemptions	√√√
Improved acceptability of plantations (indirect benefits)	▪ Social acceptability levels significantly higher for agriculture. Plantations more favourable under circumstance where they are not competing with other land uses. ▪ Resident populations overall generally do not recognise plantations as environmentally positive in cleared rural landscapes despite experts/scientists being likely to agree they have greater environmental qualities to agriculture. This may have indirect costs in terms of access to payments for environmental services (policy making) and planning decisions such as zoning and land use requirements.	√√

[a] Polglase et al, 2011 (unpublished).

Source: CIE.

The case for renewed investment in plantations?

Private individuals, institutional investors, forestry companies, processors and even landholders, which derive multiple benefits from forestry, are inhibited by the insufficient risk free rate of return relative to alternatives. The question is whether there is a case for renewed investment in plantations on the basis of there being significant environmental, economic and/or social values which could be realised through addressing existing impediments? The CIE has been able to identify a range of areas where true forestry values are not being (fully) recognised, we have also established that to varying degrees there is the potential that if the corresponding barrier were alleviated the viability of long rotation plantations could be improved. However, almost all constraints cannot be alleviated without some level of involvement from governments (or CMAs), due to the unique position of government in intervening in markets where there are public goods or externalities.

Firstly, it is important to highlight that there are some unique issues associated with forestry contributing to the low profitability of sawlog regimes. The CIE understands that these issues are not however unique to the Australian plantation industry and do not stem from a lack of competitiveness. Prices for wood products continue to be affected by the release of native

timber products on to world markets at prices which do not reflect their cost of replacement and the subsidisation of commercial plantation industries across the world. Australia cannot easily influence international market distortions. However, despite being a net importer of many long rotation wood products, there is not strong grounds for any such intervention for resource security. World prices are expected to remain stagnant for structural woods although there is some forecast price increases for high quality hardwoods.

The underpricing of the state softwood estate and the native forest resource remains an issue. This is suspected to be causing a significant distortion in many markets in which prices are strongly influenced by domestic price drivers. The lingering effects of historical state dominance in log markets and log price determination need to be resolved, necessitating the involvement of the States and Territories.

There is a critical role for governments and subsidiaries such as CMAs as the largest customer of environmental services. Environmental services associated with carbon sequestration and salinity offer the best prospects for the industry in terms of the rigour of scientific evidence and capability to measure and predict tangible environmental outcomes.

- The market for carbon stored in commercial plantations is effectively non-existent. Investors are not able to recognise carbon values under the CFI due to broad exclusions and uncertainty surrounding their eligibility.
  - Without compensation for environmental values, particularly for carbon, it is unlikely that the viability of long rotation forestry investment will change.
  - Furthermore, the exclusion of the emissions generated from the agricultural sector represents a bias against forestry which is less emissions intensive than agriculture. This distortion will favour agriculture in the competition for land use, thereby imposing a cost on the industry.
- Despite significant potential for salinity mitigation (in composite with biodiversity) theses services are predominantly required in low or medium rainfall areas. In such areas trees impose a higher level of risk on landholders in terms of lower tree productivity, less established markets and lower access to the processing sector, and risks to processors in terms of the quality and quantity of supply.
  - Yet due to the potentially positive externalities associated with resources in low to medium rainfall areas, there may be a rationale for public support to overcome some of the constraints. Further R&D is required in low rainfall areas to reduce the risk to investors including through improving tree productivity on low rainfall sites.
  - A further significant barrier which could be addressed through better coordination between CMAs and the commercial plantation industry is the high degree of fragmentation in environmental markets, particularly salinity.
- Further R&D is required to overcome technical or knowledge barriers associated with other emerging markets for environmental services including biodiversity and biochar, biofuels and bioenergy.
- Investment in long rotation commercial forestry will improve the capacity of the industry in future to replace native forest harvesting.

Politics appears to be impeding the development of equitable and conducive policy frameworks for forestry. As outlined in this report, this may be influencing several spheres of policy development including taxation and superannuation, private native forestry regulation and the development of policy and markets for environmental externalities including for carbon. Improved engagement with the community and promotion of plantation values may support a more conducive policy and investment environment for forestry. In addition, farm forestry represents a form of forestry which is highly conducive with community preferences, as well as environmental and economic imperatives: further investment would be required to overcome barriers to uptake.

Industry policies such as to improve price transparency, market liquidity and broaden/deepen markets also have the potential to improve the viability of forestry. However, on their own, without the recognition of the values of forestry from government and their commitment to alleviating the barriers to their attainment, it is unlikely that there will be renewed investment in plantations.

6. Conclusion

In this report the CIE, with the assistance of Rob de Fégely, reviewed the case for renewed investment in plantations. There were a range of impediments to investment in long rotation plantations which were identified. The removal of these impediments may improve the risk-return profile of investment, such as through pricing the benefits associated with positive environmental externalities and reform to improve the fairness and conduciveness of policy to investment in forestry. Importantly, due to the unique position of the government as the principle (potential) customer of environmental services and role of the government in correcting market failures, the future of investment in long term plantations is inherently tied to government policy.

In reviewing the values of forestry, we found strong evidence for the existence of many environmental values. A literature review provided significant documentation of the 'values' which may be inhibited by market and pricing distortions, principally as a result of market concentration in the supply and demand for logs and the lingering effects of underpricing of public native forests and state-owned plantations. However, the scope to impact market pricing, market access and investment and the resulting impact on the viability of plantations is more difficult to assess. We were also able to identify evidence of subtle taxation and superannuation barriers affecting small holders and private investors and constraints on some types of investors accessing superannuation arrangements which are designed to correct general biases against long term savings. Negative social perceptions of forestry may impose constraints on forestry in terms of the development of policy and planning decisions conducive to plantation investment; however the CIE has not been able to identify a case for investment in long rotation plantations on the basis of socio-economic values.

The literature strongly supports the existence of values provided by carbon sequestration in trees, wood and soil, and salinity mitigation benefits from trees under certain conditions. In both cases, there is also good capacity to measure and predict environmental outcomes and estimate the value of these outcomes. The capacity to extract a higher *net* return from establishing plantations in salinity-affected areas is more difficult to assess, as services are predominantly required in low or medium rainfall areas where trees can experience lower productivity, markets are typically less well established, and there are risks in terms of the quality and quantity of supply. Further R&D is required to verify and improve the potential of tree species in low rainfall areas, as well as better coordination of investors and customers in environmental markets which are highly fragmented. Other emerging markets for environmental services, such as biodiversity and biochar, biofuels and bioenergy, face considerable hurdles in demonstrating their viability or value compared to alternatives. However, the development of markets for biomass and other products from trees grown in low rainfall areas will be important to encourage investment in low to medium rainfall areas to realise the environmental values of forestry.

Social perceptions and preferences associated with forestry as a land use may be impeding the development of equitable and conducive policy frameworks for forestry. As outlined in this report, this may be influencing several spheres of policy development including taxation and superannuation, private native forestry regulation and the development of policy and markets for environmental externalities including for carbon. However, R&D to reduce the

risks associated with long rotation forestry and improve the potential for plantations to reduce the reliance on the harvest of public native forests is expected to derive positive socio-economic values.

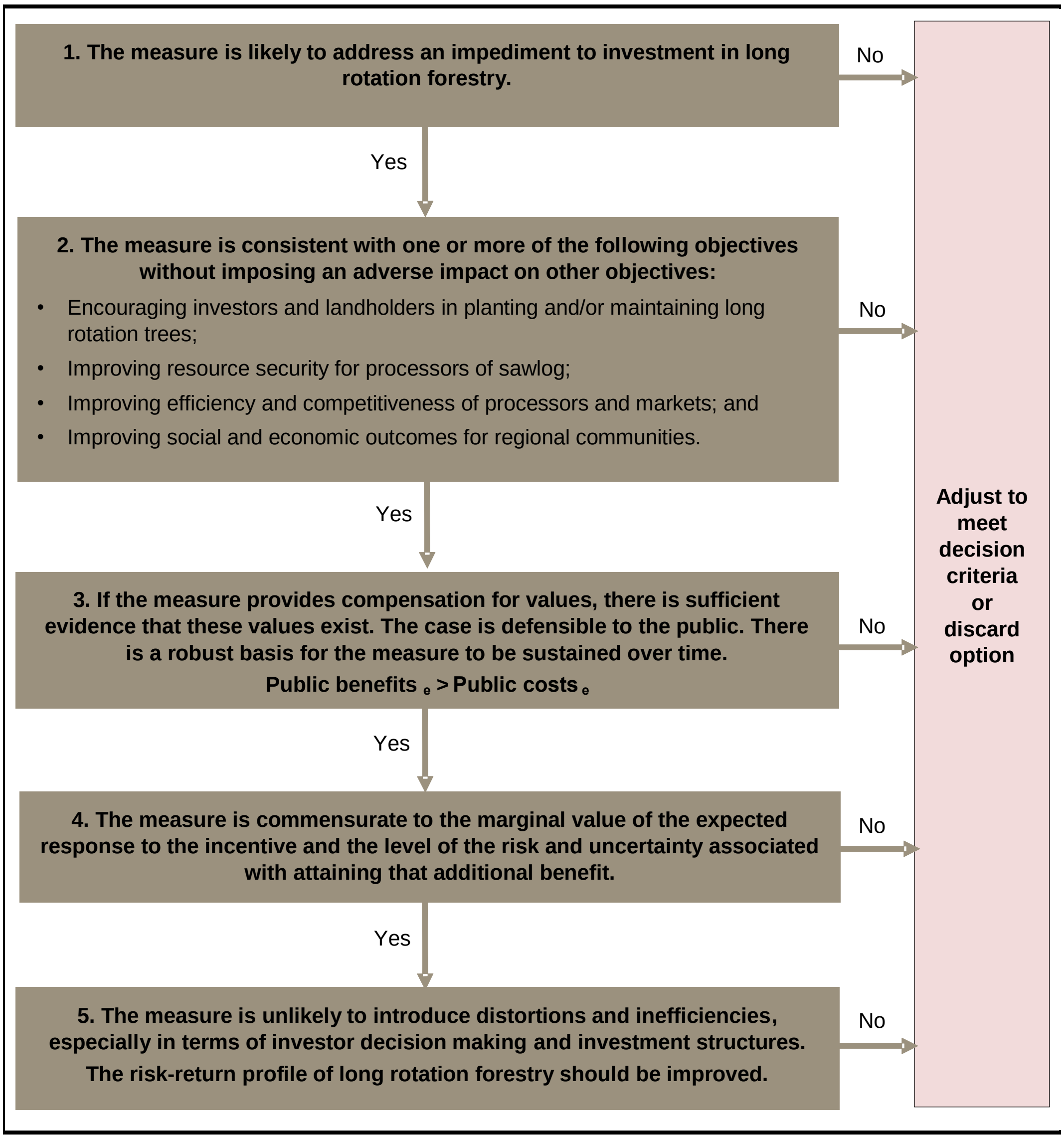
From the research conducted in Stage 1, values have been identified which underpin a 'case' for renewed investment in plantations. Yet this case is dependent on government recognition of the values of plantations and, still, the values identified represent only quite modest opportunities. The impediments to the attainment of these values require R&D and scientific advancement in some cases, as well as further policy and institutional development. This *should* already be occurring through the existing channels. However, particularly in terms of policy and institutional development, a case has been demonstrated for governments to revisit their approach to plantations to establish a more conducive framework for the removal of constraints to the realisation of plantation values.

Through our analysis and consultation it became clear that attempts to foster investment in forestry such as through the MIS plantings can be well-intended but ineffective and distortive. As such, any incentives designed to target the constraints identified must:

- be carefully designed so as to avoid harm to the reputation of the industry. The MIS scheme provided very modest taxation incentives in line with what is available to other industries, however, the scheme was associated with inefficient investment structures and decision making involving elevated levels of risk; and
- ensure outcomes are sustainable and targeted toward alleviating the barriers to investment in *long rotation* forestry.

Based on our analysis of the constraints/barriers to investment in long rotation forestry, and the lessons from the use of MIS to drive investment, we have developed a criterion to assess the options put forward in the next phase of the analysis in line with the objectives raised above. Chart 6.1 provides a series of hurdles to assess the nominated public policy options or industry initiatives. If the five criteria outlined could be *satisfactorily* achieved, the measure should improve the risk-return profile of long rotation forestry investment.

26 **Proposed options assessment framework for Stage 2**



Source: CIE.

References

ABARES, 2011, Agricultural commodity statistics 2011: Rural commodities forestry, http://www.daff.gov.au/abares/publications_remote_content/sewarch?sq_content_src=+dXJsPWh0dHAlM0ElMkYlMkYxNDMuMTg4LjE3LjIwJTJGYW5yZGwlMkZEQUZGU2VydmljZSUyRmRpc3BsYXkucGhwJTNGZmlkJTNEcGVfYWdjc3RkOWFiY2MwMDIyMDExMjFkLnhtbCZhbGw9MQ==.

AFG, 2010, *Australian Forest Growers Policy Statement*, 4th Edition, Canberra, http://www.afg.asn.au/AFG_Policy_Statements_4th_Edition.pdf.

American Forest Products Association (AFPA), 2009, 'Biomass Carbon Neutrality', http://www.afandpa.org/GTV/2010/CarbonNeutralitybrief_final_11-2-09.pdf.

Anderson, G. and Snyder, N. 2011, 'Focus: Carbon Farming Initiative Legislation Passed', Accessed December 2011, Allens Arthur Robinson, http://www.aar.com.au/pubs/cc/focc25aug11.htm.

Australian Forest Growers (AFG), 2005, 'AFG/TIMA submission to the Review of the Taxation of Plantation Forestry', 31 August 2005, AFG/TIMA submission to the Review of the Taxation of Plantation Forestry.

Bari, M.A., Mauger, G.W., Dixon, R.N.M., Boniecka, L.H., Ward, B., Sparks, T. and Waterhouse, A.M., 2004, *Salinity Situation Statement: Denmark River*, Department of Environment, Water Resource Technical Series No. WRT 30, http://www.water.wa.gov.au/PublicationStore/first/40468.pdf.

Barlow, J., Gardner, T., Araujo, A., Avila-Pires, T., Bonaldo, A., Costa, J., Esposito, M., Ferreira, L., Hawes, J., Hernandez, M., Hoogmoed, M., Leite, R., Lo-Man-Hung, N., Malcolm, J., Martins, M., Mestre, L., Miranda-Santos, R., Nunes-Gutjahr, A., Overal, W., Parry, L., Peters, S., Ribeiro-Junior, M., Silva, M., da Silva Motta, C. and Peres, C. 2007, 'Quantifying the biodiversity value of tropical primary, secondary and plantation forests', *Proceeding of the National Academy of Sciences*, vol. 104, no. 47, http://www.pnas.org/content/104/47/18555.short.

Brockerhoff, E., Jactel, H., Parrotta, J., Quine., C. and Sayer, J. 2008, 'Plantation forests and biodiversity: oxymoron or opportunity?' *Biodiversity and Conservation*, 2008, vol. 17, pp 925-951, http://fireintuition.efi.int/rep/officedocument/textdoc/pdf/brockerhoff_etal_200816856563115/brockerhoff_etal_2008.pdf.

BRS, 2009, 'Bioenergy', In *Australia's Energy Resource Assessment*, Ch. 12, http://adl.brs.gov.au/data/warehouse/pe_aera_d9aae_002/aeraCh_12.pdf.

Burns, K., Hug, B., Lawson, K., Ahammad, H. and Zhang, K. 2011, *Abatement potential from reforestation under selected carbon price scenarios*, ABARES Special Report, July 2011, http://www.treasury.gov.au/carbonpricemodelling/content/consultants_reports/ABARES_Abatement_potential_from_reforestation_under_selected_carbon_price_scenarios.pdf.

Catton, C., Gerrand, A., Jodline, A. and Miller, R. 2004, 'Impact of incentives on the development of forest plantation resources in the Asia-Pacific region: Australian case study', Ch. 4, In *What does it take? The role of incentives in forest plantation development in Asia and the Pacific*, Bangkok, http://www.fao.org/docrep/007/ae535e/ae535e00.htm.

Cawsey, M. and Freudenberger, D. 2005, *Biodiversity Benefits of Commercial Environmental Forestry: The Plantation Biodiversity Score*, CSIRO Sustainable Ecosystems, Canberra.

Chemlink, 2011, 'Biofuels: Ethanol (ethyl alcohol) and biodiesel', Accessed December 2011, http://www.chemlink.com.au/ethanol.htm.

Clarke, R. 2009, 'Biofuels and sustainable transport: Can biofuels be produced and used responsibly?' *International Journal of Socialist Renewal*, 19 June 2009, http://links.org.au/node/1106.

Cockfield, G. 2002, *Landholder Attitudes to Farm Plantations*.

Coggan, A., Whitten, S., Reeson, A. and Shelton, D., 2009, *Case Studies of Market Based Instruments for Ecosystem Services*, RIRDC, Barton, ACT.

de Fégely, R., Stephens, M. and Hansard, A., 2011, *Review of policies and investment models to support continued plantation investment in Australia*, Prepared for Forest and Wood Products Australia (FWPA), http://www.fwpa.com.au/sites/default/files/PRA189-1011_Research_Report_Policy_and_Investment_Model_Review.pdf.

Department of Climate Change (DCC), 2011, *Carbon Farming Initiative: Negative List guidelines: Management of adverse impacts*, October 2011, http://www.climatechange.gov.au/government/initiatives/carbon-farming-initiative/activities-eligible-excluded/excluded-activities-negative-list/~/media/government/initiatives/cfi/activities-eligible-excluded/CFI-Negative-List-guide-20111024-PDF.pdf.

——2012, 'Activities – Eligible and Excluded', Accessed February 2011, http://www.climatechange.gov.au/en/government/initiatives/carbon-farming-initiative/activities-eligible-excluded.aspx.

Department of Primary Industries Victoria, 2011a, 'Priority 1: A productive, competitive and sustainable timber industry', Accessed January 2011, http://www.dpi.vic.gov.au/forestry/about-forestry/projects-and-initiatives/timber-industry-action-plan/timber-industry-strategy/strategy-action-1.

——2011b, 'Sawlogs for Salinity', Accessed January 2011, http://www.dpi.vic.gov.au/forestry/about-forestry/projects-and-initiatives/sawlogs-for-salinity.

Ford, R., Smith, E., Williams, K., and Bishop, I. 2009, *Social Acceptability of Forest Management Options: Landscape Visualisation and Evaluation*, University of Melbourne, http://www.warra.com/documents/publications/Ford_etal_2009b.pdf.

Freeman, B, Dumsday, R, 2003, *Evaluation of Environmental Services Provided by Farm Forestry – A Discussion Paper*, Prepared for Private Forests Tasmania by URS Australia Pty Ltd, http://www.privateforests.tas.gov.au/files/active/0/URS%20final.pdf.

Fritsch, S, Hudson, B, 2008, *Whole Farm Financial and Environmental Returns Under Farm Forestry: Six Case Studies*, RIRDC, 2008.

FWPA, 2008, *Impact of carbon trading on wood products*, Prepared by Alison George, http://www.fwpa.com.au/sites/default/files/PR07_1059_carbontrading_web.pdf

——2011a, *The role of forest management in greenhouse gas mitigation: a contextual framework for Australia*, May 2011, Melbourne, Victoria, http://www.minela.gov.rw/IMG/pdf/PRC162-0910_Final_Report_Greenhouse_gas_mitigation.pdf. 4

——2011b, 'Submission on Exposure Draft Regulations to Amend the Renewable Energy Target (RET) Scheme', 11 November 2011, http://www.ausfpa.com.au/userfiles/file/AFPA_Sub_RET_Regs_Amend_Nov11.pdf.

Greagg, P., Parham, D. and Stojanovski, P. 2010, *Disparities in average rates of company tax across industries*, Business Tax Division of the Australian Treasury, http://www.treasury.gov.au/documents/1846/PDF/07_Disparities_in_average_tax_rates.pdf.

Grealy, M. 2008, 'Markets for Wood Products from Durable Hardwood Sawlog Plantations', In *Plantation Eucalypts for High-Value Timber: Enhancement through research and development*, Ed. A.Brown and C.Beadle, April 2008, http://www.dpi.vic.gov.au/__data/assets/pdf_file/0009/5679/woolybutt.pdf.

Grimbacher, P, 2011, *Biodiversity outcomes from eucalupt plantation expansion into agricultural landscapes of southern Australia: A review*, Technical Report 215, Sandy Bay, Tasmania, http://www.crcforestry.com.au/publications/downloads/TR215-Grimbacher.pdf.

Haile, P. 2001, 'Auctions with Resale Markets: An Application to US Forest Service Timber Sales', *The American Economic Review*, June 2001, http://www.econ.yale.edu/~pah29/usfsaer.pdf.

Haley, D. and Nelson, H. 2007, Has the time come to rethink Canada's Crown forest tenure systems? *The Forestry Chronicle*, Volume 83, 5.

Harrison, S., Herbohn, J., Jeffreys, I., Thompson, D. and Norman, P. 2002, *Decision-Support Systems in Farm Forestry: Implications of Research Findings and Future Directions*, http://espace.library.uq.edu.au/eserv.php?pid=UQ:8097&dsID=Ch_20_-_Summary_.pdf.

Hassall, A. 2008, *Quantifying the Value of Farm Forestry: A national level analysis*, RIRDC.

Henry tax review, 2011, 'The treatment of natural resource assets,' In *Architecture of Australia's tax and transfer system*, Ch. 8.5, Barton, ACT, http://taxreview.treasury.gov.au/content/Paper.aspx?doc=html/publications/papers/report/section_8-05.htm.

Herbohn, J., Emtage, N., Harrison, S., and Smorfitt, D., 2004, *Attitudes of landholders to farm forestry in tropical eastern Australia*, http://www.forestry.org.au/pdf/pdf-members/afj/AFJ%202005%20v68/AFJ%20March%2020045%2068-1/AFJ681%20p50%20Herbohn-f.pdf.

Hobbs, R., Floyd, R., Cunningham, S., Catling, P., Ive, J., 2003, *Hardwood Plantations: Quantifying conservation and environmental service benefits*, RIRDC, http://live.greeningaustralia.org.au/nativevegetation/pages/pdf/Authors%20H/13_Hobbs_Floyd_et_al.pdf.

House of Representatives Standing Committee (HOR SC) on Agriculture, Resources, Fisheries and Forestry: Australian forestry industry, 24 August 2011.

IEA, 2007, Biomass for Power Generation and CHP, January 2007, http://www.iea.org/techno/essentials3.pdf.

Institute of Foresters of Australia (IFA), 2011, *Social Values in Forest Management*, IFA Forestry Policy Statement No. 2.12, Yarralumla, ACT, http://www.forestry.org.au/pdf/pdf-public/policies/Statement-2.2.5-Social-values-in-forest-management.pdf.

ITC Limited, 2007, 'Regional prospects for integrated forestry', In *Integrated forestry on farmland: Prospects for integrated forestry as a management tool in salt-source catchments*, http://www.futurefarmcrc.com.au/documents/IntForestry40407_PartB.pdf.

Jay, A., Sharpe, D., Nichols, D. and Vanclay, J. 2009, *Sustainable Private Native Forestry: A review of timber production, biodiversity and soil and water indicators, and their applicability to northeast NSW*, RIRDC.

Kanowski, J., Catterall, C. and Wardell-Johnson, G. 2006, Biodiversity futures under alternative forest industry scenarios in north Queensland. In Harrison, S. and Herbohn, J. (eds), *Sustainable Forest Industry Development in Tropical North Queensland*, Rainforest CRC, Cairns, pp 103-122.

Krull, E. 2009, 'Stabilisation of organic carbon in soil through biochar production', In *An Analysis of Greenhouse Gas Mitigation and Carbon Biosequestration Opportunities from Rural Land Use*, St Lucia, QLD, http://www.csiro.au/files/files/prdz.pdf.

Leech, J., Parson, L., and Page, D. 2011, 'ACIL Tasman Report Discredited', http://www.dontprivatisesaforests.com.au/downloads/ACIL%20Tasman%20Discredited.pdf.

Lindenmayer, D., Hobbs, R. and Salt, D. 2003, *Plantation forests and biodiversity conservation*, Centre for Resource and Environmental Studies, The Australian National University, Canberra, School of Environmental Studies, Murdoch University, Murdoch, http://www.forestry.org.au/pdf/pdf-members/afj/AFJ%202003%20v66/AFJ%20March%202003%2066-1/12_Lindenmayer.pdf

Lott, R. and Gooding, G. 2008, 'Eucalypt Plantations for Solid-Wood Products in Southern Australia: A Review of Research Investment and Needs, In *Plantation Eucalypts for High-Value Timber: Enhancing investment through research and development*, Ed A. Brown and C. Beadle, April 2008, http://www.dpi.vic.gov.au/__data/assets/pdf_file/0009/5679/woolybutt.pdf.

Lowell, K., Drohan, J., Hajek, C., Beverly, C. and Lee, M. 2007, 'A science-driven market-based instrument for determining the cost of environmental services: A comparison of two catchments in Australia', *Ecological Economics*, 64, 207, 61-69, http://upi-yptk.ac.id/Ekonomi/Lowell_A-science.pdf

Loyn, R., McNabb, E., Macak, P., and Cheers, G. 2009, *Fauna in Eucalypt and Pine Plantations in the Green Triangle of south-eastern South Australia and south-western Victoria*, Arthur Rylah Institute for Environmental Research, Technical Report Series 186.

Mackey, J., Lockwood, M., and Curtis, A. 2000, *A Review of Policy Options to Enhance the Management of Dryland Salinity*, Albury, NSW.

McTaggart, A., Sparks, T., Bari, M., Dixon, R. and Williams, M, undated, Salinity reduction in strategic water resource catchments in the south-west of Western Australia, 2nd International Salinity Forum, http://www.internationalsalinityforum.org/Final%20Papers/mctaggart_C4.pdf.

Murrumbidgee CMA, 2007, 'Information Sheet: Farm Forestry', Wagga Wagga, http://www.murrumbidgee.cma.nsw.gov.au/downloads/info_sheets/Farm_Forestry.PDF.

National Heritage Trust, 2003, *Farm Forestry Strategy for NSW*, State of New South Wales, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0015/38031/farm-forestry-strategy-nsw.pdf.

Neary, D., Smethurst, P., Baillie, B. and Petrone, K, 2011, *Water Quality, Biodiversity and Codes of Practice in Relation to Harvesting Forest Plantations in Streamside Management Zones*, http://www.csiro.au/Organisation-Structure/Flagships/Sustainable-Agriculture-Flagship/~/media/CSIROau/Flagships/Sustainable%20Agriculture%20Flagship/SMZ-technical-report.pdf.

O'Connell, D., May, B., Farine, D., Raison, J., Herr, A., O'Connor, M., Campbell, P., Taylor, J., Dunlop, M., Poole, M. and Crawford, D. 2009, 'Substitution of fossil fuels with bioenergy from renewable biomass resources', In *An Analysis of Greenhouse Gas Mitigation and Carbon Biosequestration Opportunities from Rural Land Use*, CSIRO, St Lucia, QLD, http://www.csiro.au/files/files/prdz.pdf.

O'Laughlin, J. 2011, 'Forest Biomass Markets: Economics and Policy Primer', *Society of American Foresters*, Volume 56, no. 1, http://www.cnrhome.uidaho.edu/documents/JayO%27%27L_WesternForester_Jan-Feb2011.pdf?pid=120051&doc=1.

Parliament of the Commonwealth of Australia, 2011, Carbon Credits (Carbon Farming Initiative) Bill 2011: Explanatory Memorandum, Circulated by the authority of the Minister for Climate Change and Energy Efficiency.

Parsons, M., Frakes, I. and Gerrand, A. 2007, *Plantations and Water Use*, August 2007, Bureau of Rural Sciences, http://adl.brs.gov.au/brsShop/data/sfdm_plantations_and_water_use.pdf.

Paul, K., Reeson, A., Polglase, P., Crossman, N., Bruce, J., Freudenberger, D. and Hawking, C. 2011a, *Economic and employment implications of a carbon market for integrated farm forestry and biodiverse environmental plantings*, CSIRO, Sustainable Agriculture Flagship, Hobart, Greening Australia, Yarralumla, Australia, unpublished.

——and Reeson, A., Polglase, P. and Ritson, P. 2011b, *Economic and employment implications of a carbon market for industrial plantation forestry*, CSIRO, Sustainable Agriculture Flagship, Canberra, Forest Science and Industry Development, Department of Agriculture and Food Western Australia, unpublished.

Plantations 2020, undated, 'Plantations and Carbon Facts', http://www.plantations2020.com.au/assets/acrobat/Plantations%20and%20Carbon%20Facts.pdf.

Polglase, P., Paul, K., Hawkins, C., Siggins, A., Turner, J., Booth, T., Crawford, D., Jovanovic, T., Hobbs, T., Opie, K., Almeida, A. and Carter, J, 2008, *Regional Opportunities for Agroforestry Systems in Australia*, RIRDC.

Productivity Commission, 2001, *Competitive Neutrality in Forestry*, Commonwealth Competitive Neutrality Complaints Office, Belconnen, ACT, http://www.pc.gov.au/agcnco/publications/research/forestry.

Quayle, M., 2004, The Importance of Price in Re-Negotiating Long-Term Supply Contracts from Softwood Plantations – The Case of Queensland Australia, In *Proceedings International Symposium Human Dimensions of Family, Farm and Community Forestry*, Pullman, Washington, USA.

Queensland Treasury, 2005, *Review of taxation treatment of plantation forestry: Queensland Government submission*, Submission of the Queensland Government to the Review of Taxation Treatment of Plantation Forestry, http://www.treasury.gov.au/documents/1000/PDF/033_Queensland_Government.pdf.

Reid, R. 2008, *Direct Subsidies for Agroforestry Technologies: Is it a case of The Emperor's New Clothes?* School of Resource Management, The University of Melbourne, http://www.mtg.unimelb.edu.au/publications/Direct%20incentives.pdf.

Richardson, A.J. 2005, *The cost-effectiveness of carbon sequestration in harvested and unharvested eucalypt plantations*, The Urban Transport Institute, Alexandra, Victoria.

RIRDC, 1998, *Links between small-scale growers and industry: Principles and practices for commercial farm forestry*, RIRDC Short Report No 36.

——2008a, *Future Biofuels for Australia: Issues and opportunities for conversion of second generation lignocellulosics*, Barton, *ACT.*

——and Land and Water Australia, Forest and Wood Products RDC, Murray Darling Basin Commission, 2008b, *Plantation Eucalypts for High-Value Timber: Enhancing investment through research and development*, Ed. A. Brown and C. Beadle, April 2008, http://www.dpi.vic.gov.au/__data/assets/pdf_file/0009/5679/woolybutt.pdf.

Roxburgh, S, 2009, 'Carbon storage in post-1990 plantations', in Eady, S., Grundy, M., Battaglia, M. and Keating, B. (eds), *An Analysis of Greenhouse Gas Mitigation and Carbon Biosequestration Opportunities from Rural Land Use*, CSIRO, St Lucia, QLD, http://www.csiro.au/files/files/prdz.pdf.

Schrimer, J. 2009, *Socio-economic impacts of the plantation industry on rural communities in Western Australia*, Cooperative Research Centre for Forestry.

Sims, R., Taylor, M., Saddler, J. and Mabee, W. 2009, 'IEA's Report on 1st- to 2nd-Generation Biofuel Technologies', Accessed January 2011, http://www.renewableenergyworld.com/rea/news/article/2009/03/ieas-report-on-1st-to-2nd-generation-biofuel-technologies.

Smethurst, P, Petrone, K, 2010, *Streamside management zones for water quality protection*, Landscape Logic.

Sparkes, J, Soutjesdijk, P, 2011, *Biochar: implications for agricultural productivity*, Research by the ABARES, Technical Report 11.06, http://adl.brs.gov.au/data/warehouse/biochar9abcm001/biochar9abcm00101/TR.2011.06_Biochar_v1.0.0.pdf.

State of Victoria, 2012, 'BushTender: Past Projects', Accessed February 2012, http://www.dse.vic.gov.au/conservation-and-environment/biodiversity/rural-landscapes/bushtender/bushtender-past-projects.

Thompson, D., Jay, A., Connell, M., Norman, P. and Vanclay, J. 2006, Private Native Forestry: Silviculture, Sustainability and Incentives for Vegetation Management. In *Veg Futures '06*, Albury, NSW, 20-22 March, 2006, http://espace.library.uq.edu.au/eserv.php?pid=UQ:8041&dsID=U154_vegfutures.pdf .

Thompson, D., Macgregor-Skinner, J. and Vanclay, J. 2007, *Review of the Draft Code of Practice for Private Native Forestry in NSW*, Prepared for FWPA, http://www.fwpa.com.au/sites/default/files/PR07%204024.pdf.

——and Connell, M. 2009, *Issues in Assessing the Sustainability of Private Native Forestry*, RIRDC.

Timber Merchants Association (TMA), 2011, 'Draft Renewable Energy Target (RET) Regulations', Submission on the Exposure draft regulations to exclude native forest biomass as an eligible renewable energy source under the Renewable Energy Target (RET) scheme, 9 November 2011, http://www.climatechange.gov.au/government/submissions/closed-consultations/~/media/submissions/renewabletarget/ret-biomass/06timbermerchantsassociation.pdf.

United States Forest Service (US FC), 2007, *TIMOs and REITs*, http://www.fs.fed.us/spf/coop/library/timo_reit.pdf.

URS, 2007a, *Analysis of the Victorian forestry and forest products industry*, Prepared for the Department of Primary Industries Victoria, http://www.dpi.vic.gov.au/__data/assets/pdf_file/0007/8836/Analysis-of-the-Victorian-forestry-and-forest-products-industry-final-report.pdf.

——2007b, *Australia's forest industry in the year 2020*, Prepared for the Department of Agriculture, Fisheries and Forestry, 12 December 2007, Canberra, ACT, http://www.daff.gov.au/__data/assets/pdf_file/0009/643743/2020-report-final.pdf

URS, 2008, *Market Opportunities for Farm Forestry in Australia*, RIRDC publication.

Verbohn, J, 2001, 'Prospects for Small-Scale Forestry in Australia', in Niskanen, A., Vayrynen, J. (eds.) *Economic Sustainability of Small-Scale Forestry*, European Forest Institute, Finland, http://www.efi.int/files/attachments/publications/proc36_net.pdf.

Walsh, P., Barton, C. and Haywood, A. 2008, *Growth and carbon sequestration rates at age ten years of some eucalypt species in the low- to medium- rainfall areas of New South Wales, Australia*, http://www.forestry.org.au/pdf/pdf-members/afj/AFJ%202008%20v71/1/10Walsh.pdf.

Western Australian Department of Water (WADW), 2007, *Mundaring Weir Catchment Area: Drinking Water Source Protection Plan*, Water Resource Protection Series, Report 69, http://www.water.wa.gov.au/PublicationStore/first/72102.pdf

Wilkinson, K. and Elevitch, C. 2012, 'The Overstory: Multipurpose Windbreaks', Agroforestry Ejournal, Hawaii, Accessed February 2012, http://agroforestry.net/overstory/overstory32.html.

Williams, K. 2008, *Community attitudes to plantation forestry*, Technical report 194, CRC for Forestry, Hobart, Tasmania, http://www.crcforestry.com.au/publications/downloads/FINALTR.pdf.

Ximenes, F. 2006, 'Why wood products should be used more', Accessed February 2012, http://www.dpi.nsw.gov.au/research/updates/issues/june-2006/wood-products.

Zhang, L., Vertessy, R., Walker, G., Gilfedder, M., and Hairsine, P. 2007, *Afforestation in a catchment context: understanding the impacts on water yield and salinity*, CSIRO Land and Water Science Report Number 01/07, http://www.ewater.com.au/uploads/files/Afforestation_in_catchments.pdf.