Australia's Transition from Native Forests to Plantations: The Implications for Woodchips, Pulpmills, Tax Breaks and Climate Change

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Abstract

Deforestation and the degradation of native forests account for an estimated 20 per cent of Australia's annual net greenhouse-gas emissions. Most of the degradation occurs via chip exports, with the plantation sector having captured 80 per cent of wood processing in Australia. Being perfect substitutes for native forest chips, Australia's maturing hardwood plantations present a major opportunity for mitigating climate change. But this opportunity will not be realised with 'business as usual' forest-policy frames and policy information, which are steering Australia to perverse outcomes favouring investment in an inferior sequestration strategy (plantations) and handicapping the economically superior plantation-processing industry. A major review of the Australian forestry industry in the context of climate change is needed.

Introduction

This paper recommends a major review of the Australian forestry industry in the light of the needs of climate-change policy, and the burgeoning of plantation forestry.

The paper begins with a 'situation and outlook' review of Australia's forestry industry, before turning to the most salient contemporary forest-policy issues; the Federal Government's stance of disengagement; taxation-based plantation managed-investment schemes, and climate change. It identifies, within the Government's proposed emissions trading system, likely counter-productive market signals for climate-change mitigation and forestry-industry productivity.

The plantation wood surge

Today, Australia's 1.9 million hectare plantation estate (53 per cent softwood and 47 per cent hardwood (ABARE 2008: 18)) supplies two-thirds of the forestry

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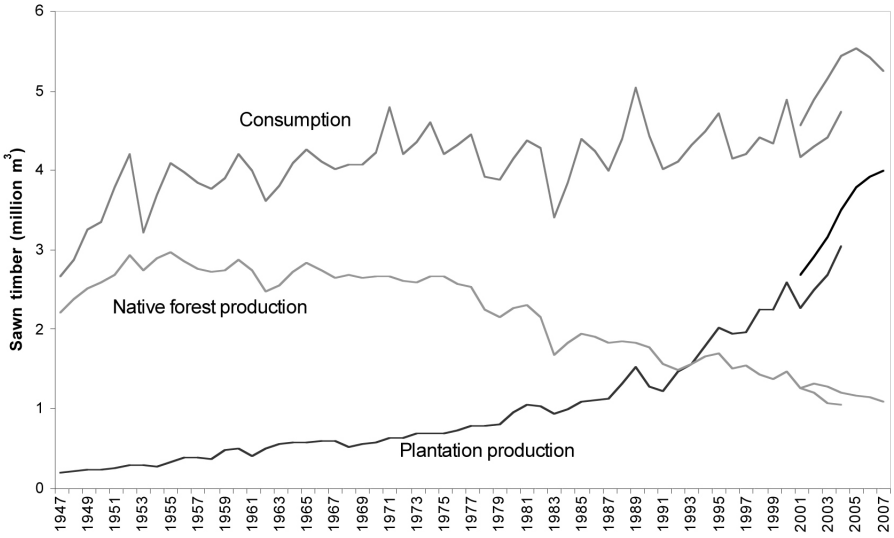
industry's wood: native forests now supply only one-third. Further, in the immediate term (over the next two years or so), the Bureau of Rural Sciences (Parsons *et al*. 2007) projects a 60 per cent increase in plantation supply from its current production; taking plantation supply to 3.4 times the volume of wood currently logged from native forests. With large areas of managed-investment-scheme hardwood plantations established since the mid 1990s coming on stream, Australia is on the cusp of a plantation-wood resource shock.

Australia's plantation-wood production continues to outpace its domestic wood consumption. Since 1990, plantation-wood supply has increased by an average 6.5 per cent per annum (coming off a solid base), whilst the amount of wood used to make all the domestic and imported wood products consumed in Australia grew by an average of only 0.8 per cent per annum (Figure 1).

Figure 1: Plantations supply most of Australia's wood needs



Source: ABARE Australian Commodity Statistics & Australian Forest and Wood Products Statistics; Parsons et al. 2007 (BRS plantation wood-supply projections)

Little wonder that the Bureau of Rural Sciences' projections indicate that Australia's plantation resources are currently being logged below capacity (Figure 1). According to the Bureau's projections and ABARE's plantation wood-production data, 2 million m^3 of mature plantation wood remained unlogged in 2007: equivalent to a quarter of the current annual native-forest log cut.

Under-logging in the softwood estate explains 60 per cent of today's unused supply (Table 1).[2]

Table 1: Estimated under-use of Australian plantation wood — 2006/07

	Actual production 2006/07 (million m^3 p.a.)	BRS projected annual supply 2005–09 (million m^3 p.a.)	Excess supply capacity (million m^3 p.a.)	% of projected annual supply not logged in 2006/07 (%)
Softwood sawlogs	9.2[a]	10.1	0.9	8.9
Softwood chiplogs & other	5.1	5.4	0.3	5.6
Total softwood	14.3	15.5	1.2	7.7
Hardwood sawlogs	0.158	0.224	0.07	31.3
Hardwood chiplogs	3.9	4.6	0.7	15.2
Total hardwood	4.0	4.8	0.8	16.7

a. An estimated 0.27 million m^3 of native cypress sawlog production was deducted from ABARE data.
Source: ABARE 2008: 20; Parsons *et al*. 2007: 8 (BRS plantation wood-supply projections).

With surging plantation resources and subdued markets — both domestically for wood and globally for hardwood chips (discussed later in this paper) — plantations have not 'complemented' or 'topped up' native forest-wood resources, as those in the native forest sector hoped. Rather, the new and highly efficient softwood plantation sawmillers have sent native forest sawn-timber production into permanent decline. The plantation-for-native-forest substitution process is about to be repeated in the hardwood-chip market.

Wood processing

The dominance of plantation forestry is also manifested in the wood processing sector.

Government statistics, by referring only to the generic 'forest products' or 'wood products', mask the plantation sector's substantial contribution to wood manufacturing investment, income and employment in Australia.[3] The gaps in government reporting can, however, be filled using industry data and assumptions (Ajani 2008). Today, 80 per cent of the wood processed in Australia to make sawn timber, wood-based panels, pulp and paper comes from plantations (Table 2).

[2] This static picture, however, masks the softwood sawmillers' desirable run down of the large softwood sawlog stockpile that had accumulated by the early 1990s (Ajani 2007: 64) and what appears to be the beginning of an undesirable stockpile in the hardwood estate.
[3] Whilst Federal Government statistics disaggregate almost all the wood Australia produces into distinct regimes — plantations (agriculture) and native forests (self-regenerating ecosystems) — processing industry data are not similarly disaggregated.

Table 2: Estimated Australian production of wood and wood products and unprocessed wood exports by wood source — 2006/07

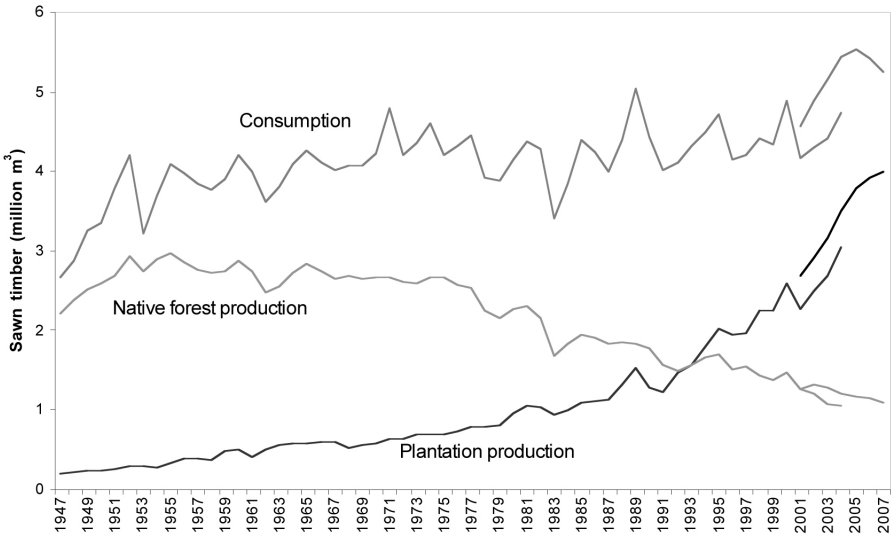
	Unit	Plantation	Native forest	% plantation
Wood production	million m^3 roundwood[a]	18.3	8.8	68
Sawn timber & wood-based panels	million m^3 finished product	5.6	1.3	81
Wood for domestic pulp production (2004/05)	million m^3 roundwood	2.4	0.7	77
Other wood products	million m^3 finished product	0.5	0.3	63
Unprocessed wood — chips & logs	million m^3 roundwood	7.2	5.7	56

a. Roundwood here means the volume of wood in (round) log form required to make the product and therefore includes processing residues.
Source: Ajani 2008

Sawn timber and wood-based panels

It is native-forest sawmillers that have suffered the most from competition from the softwood plantations. Cheap native-forest logs could not counter the plantation sector's advantages of scale economies and new product development.

Figure 2: Plantation sawmillers meet most of Australia's sawn timber consumption



Source: Ajani 2007 (Figures 4.2 & 5.3) and updated using ABARE *Forest and Wood Products Statistics*
Note: ABARE data since 2000, using a changed methodology, are presented separately. Plantation production since 2001 includes a small volume of native forest cypress.

Wood-based panels are rarely mentioned, despite being an Australian forestry-industry success story.[4] Most forestry-industry analysis separates sawn timber from wood-based panels and then shines the spotlight on sawn timber. The public forest debate ignores wood-based panels. Yet, these panels compete against native forest and plantation sawn timber in many markets and, together with non-wood substitutes such as concrete and bricks, have contributed to the flattening in sawn-timber consumption in developed countries and lacklustre sawn-timber consumption in developing countries.

In the Australian forest debate, the plantation processors' achievements remain a largely untold story. Whilst the native-forest sawmillers attributed their demise to conservation reserves and environmentalists focus on unsustainable logging, the softwood-plantation processors concentrated on building market share largely through displacing native-forest sawn timber in the Australian market. Their output of sawn timber and wood-based panels has increased by 145 per cent since 1990 (Table 3). They achieved this by displacing Australian native forest sawn timber and imports whilst boosting net industry output. Today, Australia produces 65 per cent more sawn timber and wood-based panels than in 1990. In the big picture, the decline in native-forest sawmilling has occurred less because of native-forest protection and more in the wake of the expansion of plantation processing: an industry outcome government unwittingly set in place many decades ago when it financed an Australia-wide escalation in softwood planting.

Table 3: Australian production of sawn timber and wood-based panels (million m^3)

	Year ending June 1990	Year ending June 2007	% change
Plantation			
Sawn timber	1.27	3.89	+206
Wood-based panels	1.03	1.75	+70
Total	2.30	5.64	+145
Native forest			
Sawn timber	1.75	1.17	-33
Wood-based panels	0.12	0.08	-33
Total	1.87	1.25	-33
Total	4.17	6.89	+65

Source: Ajani 2008; Ajani 2002 (following methodology as described in section 8)

[4] Wood-based panels, such as particleboard, medium-density fibreboard and plywood, are made by compressing and gluing particles or pieces of wood. They compete against sawn timber and non-wood products and, in Australia, are made primarily with plantation wood.

Pulp and paper

The dominance of plantation forestry is also manifested in the pulp and paper sectors.

To see this, we need to appreciate that the Australian pulp-and-paper sector falls into four segments — packaging and industrial paper; printing and writing paper; newsprint; and household and sanitary paper (Table 4).

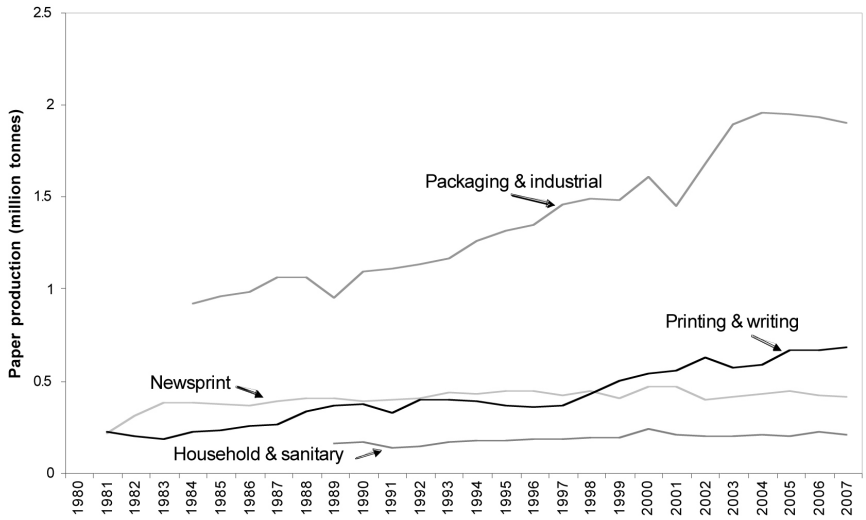
Table 4: Australian paper consumption and production — 2006/07

	Consumption (million tonnes)	Production (million tonnes)	Imports (million tonnes)	Exports (million tonnes)	Net self-sufficiency (%)
Packaging & industrial	1.5	1.9	0.3	0.6	127
Printing & writing	1.7	0.7	1.2	0.1	41
Newsprint	0.7	0.4	0.3	0.0	57
Household & sanitary	0.3	0.2	0.1	0.03	67
Total	4.2	3.2	1.8	0.8	76

Source: ABARE 2008. Figures unadjusted after rounding

Government attention to printing and writing papers is analogous to the attention still focused on native-forest sawmilling. In fact, packaging papers dominate Australian paper production (60 per cent in volume terms), as they do globally. Since 1980, growth in Australia's paper industry has concentrated entirely on packaging and industrial, and printing and writing papers, both growing at a strong average rate of 4 per cent per annum over this period (Figure 3). Whilst packaging and industrial-paper production has faltered since 2004, printing and writing-paper production continues on its long-term upward trend.

Figure 3: Paper production — Australia



Source: ABARE Australian Commodity Statistics.

Despite the dominance and export success of packaging papers, printing and writing papers very much shape the public perception of Australia's paper industry. Though this sector attracts most public attention, it is, in important ways, the odd man out in Australia's paper industry. Because Australia's monopoly producer of printing-and-writing paper (PaperlinX, formerly Amcor) uses little recycled fibre to make these papers (Table 5); wood is the main feedstock. For these papers, many producers prefer short-fibred hardwoods to long-fibred softwood (Higgens 1991). In Australia, native forests do supply plentiful and cheap short-fibred hardwood. But manufacturers of the other three paper-industry segments (packaging and industrial; newsprint; and household and sanitary) use mostly softwood (and so, in the Australian context, plantations) in their wood pulping to reap the strength benefits of longer fibres. Thus, as a whole, Australia's paper producers rely on native forests for only 9 per cent of their production (using a wood-to-paper conversion of 3:1) (Table 5).

Table 5: Australian paper production and its feedstock — 2004/05

Product	Production (000 tonnes)	Per cent made using recycled fibre (%)	Per cent made using new wood fibre & additives (%)	Softwood plantation wood input (000 green tonnes)	Hardwood plantation wood input (000 green tonnes)	Native forest wood input (000 green tonnes)
Packaging & industrial	1 885	70	30	na	na	na
Printing & writing	604	4	96	na	na	na
Newsprint	423	32	68	na	na	na
Household & sanitary	157	3	97	na	na	na
Total	3 069	48	52	2 156	303	788

Source: Australian Plantation Products and Paper Industry Council (AP3) 2005
Note: Statistics are compiled from information collected from Australia's six major paper producers and include imported pulp (20 per cent of pulp input) and imported recycled paper (4 per cent of recycled fibre input).

Increased paper recycling and increased softwood-pulping capacity have been the mainstays for Australia's growing paper production. Since 1980, three new softwood-plantation pulpmills have been constructed in Australia: at Albury (1981), Maryvale (1984) and Tumut (2001). All three mills were constructed primarily for the domestic paper market, with output absorbed largely by growth in domestic paper consumption and import replacement.

Gunns' proposed Tasmanian hardwood pulpmill breaks this pattern of domestic orientation. With PaperlinX having effectively stitched-up the domestic market through its monopoly production of printing-and-writing paper and controlling interests in imports of these paper grades, companies investing in new hardwood pulpmills are effectively forced into the roller-coaster global pulp market. In economic downturns, integrated pulp-and-paper producers scale back their paper production and offload their surplus pulp at cost price (Ajani 2007: 301–3). Survival for export-oriented pulpmills demands highly competitive projects from start-up. Gunns' proposed Tasmanian pulpmill may

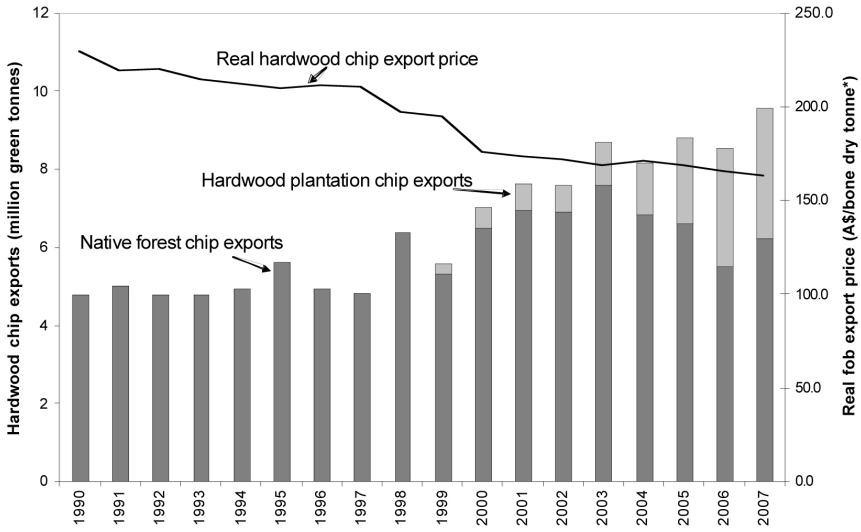
not make the grade, even with the commercial benefits of a low-priced public native-forest resource and government subsidies on capital costs (Edwards 2008). Whilst resource conflicts have dominated Australia's pulpmill debate over the past two decades, Australia's concentrated printing-and-writing-paper sector and the nature of the global pulp-and-paper market also work against Australia securing a new hardwood pulpmill.

Unprocessed wood exports

The dominance of plantation forestry will soon extend to wood chips.

Half of Australia's wood production is exported as unprocessed chips and logs (Table 2). This forestry-wide statistic masks important differences in the industry structures built around plantations and native forests. The native-forest sector exports a considerably higher proportion of its log-cut as unprocessed chips and logs compared to the plantation sector (Table 2). In Australia's major public native-forest logging regions of Tasmania, East Gippsland and south-east NSW, woodchip exports now account for between 80 to 90 per cent of the log-cut (Ajani 2007: 278).

Figure 4: Declining real prices for hardwood chip exports



* Prices deflated using Australian CPI 2006/07 = 100.
Calculated using ABARE forestry statistics and Australian Plantation Products and Paper Industry Council (AP3) 2005.

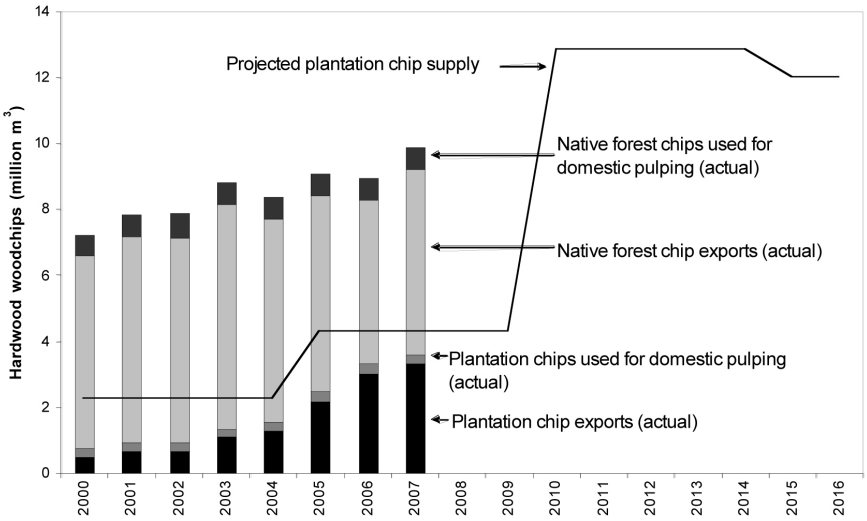
In the immediate post-Regional Forest Agreements (RFA) era of abolished Commonwealth woodchip-export controls, native-forest woodchip exports increased by 44 per cent, from 4.8 million green tonnes in 1997 to 6.9 million green tonnes in 2001. With Japan's stagnant market (Japan Paper Association; Japan Tariff Association), chip exporters (then mostly native-forest-based)

secured this 2 million tonne new trade by settling on an 18 per cent fall in real chip prices over the four years (Figure 4).

Woodchips from Australia's early managed-investment-scheme hardwood plantings are now coming on stream and substituting for native forest resources (Figure 4) in a continuing flat global market. Australia's hardwood plantation chiplog supply is poised to increase by 9 million green tonnes over the next two to three years (Figure 5). With little growth in global demand for hardwood chips, we can expect ongoing displacement of native-forest chips and, given the size of the additional plantation resources, continuing downward pressure on chip prices.

China may alleviate the market situation. Its industrial wood imports have increased by an average 19 per cent per annum over the 10 years ending 2006 and now account for a quarter of the global industrial wood trade (FAOSTAT 2008). Clearing Australia's hardwood-plantation chip resource through exports to China would require Australian exporters to lift their share of Chinese industrial wood imports from its current 2 per cent to 25 per cent within two to three years. This is a challenging task for trade negotiators, given China's buying-power capacity to drive prices down. Whilst China's wood imports surge, real import prices have declined by an average 6.8 per cent per annum over the decade ending 2006: in other words, halved (FAOSTAT unit import prices in US$ deflated by US CPI).

Figure 5: Australia's hardwood-chip glut



Source: Compiled using Parsons *et al*. 2007 (BRS plantation wood-supply projections); Ferguson *et al*. 2002; ABARE *Forest and Wood Products Statistics*; Australian Plantation Products and Paper Industry Council (A3P) 2005

Australia's current forest policy issues

To summarise: today, plantations supply 80 per cent of the Australian wood-processing industry's raw material (Table 2). With full uptake of Australia's plantation resources, processors can meet virtually all our wood needs without relying on native forests or imports. 'Virtually' is a key word used to cover at least 95 per cent of Australia's wood needs; namely, all paper grades, wood-based panels and most sawn timber. In these commodity markets, hardwood and softwood plantation products substitute readily for native-forest products (Ajani 2004). Substitution is less perfect for the relatively small amount of high-appearance-hardwood sawn timber produced in Australia. Supply options for these products are discussed below.

Whilst plantations underpin the Australian wood-products industry's enhanced productivity and have brought significant investment, income and employment to regional Australia, the ecological benefits arising from Australia's shift to plantation-wood products lie largely unrealised. This is because governments facilitated new markets for native-forest wood — namely, woodchip exports — rather than securing significantly more conservation of biodiversity, protection of water catchments and mitigation of climate change.

Australia is poised for a second plantation-resources boom (Figure 1) as large areas of private-sector hardwood plantations come on stream. Most of the logs are destined for the export woodchip market and, as perfect substitutes, will compete against native-forest chip exports, now the dominant outlet for native-forest logging. The issues facing government policymakers in these deliberations narrow to three groupings.

Federal Government disengagement

Despite the forestry industry's high and increasing plantation dependence that opens pragmatic conservation opportunities, the two major parties appear spooked by the public forest conflict. They judge that political safety lies in their mutual disengagement from native-forest conservation, while backing forestry and wood growing. Critical analysis is absent. The major parties maintain policy settings that drive ongoing plantation investment, but make no policy connection between Australia's burgeoning plantation resources and the potential for protecting native forests. Reading the parliamentary debates reveals a stronghold of forestry misperceptions (Ajani 2007: 218–42) justifying this behaviour.

As the decade-old claim that Australia's plantation resources are not able to meet the nation's wood needs becomes untenable, two other claims remain forcefully asserted. The first is that Australia must continue logging native forests at current rates to supply the sawlogs for high-appearance sawn timber that (softwood) plantations cannot. Woodchip exports are then presented as a

benign and sensible use of waste as a secondary business. So the decisive question is: how much of Australia's native forest log-cut is used to make high-appearance sawn timber, and how much of this product sells on its appearance (rather than its price); how much is sold as speciality native-forest hardwood products, rather than commodities with an array of substitutes?

ABARE's newly conducted national sawmill survey (ABARE 2008: 8–14) tagged only 36 per cent of hardwood sawn timber as appearance-grade (in volume terms, more softwood-plantation sawn timber is sold as appearance-grade). If, based on Neufeld (2000: 127) we allow for half of ABARE-reported appearance native-forest sawn timber being purchased on its appearance or aesthetic qualities, then perhaps around 2 per cent of Australia's native-forest log-cut currently finds its way into these appearance products (in roundwood equivalent terms, around 0.5 million m^3 of sawlogs per annum out of an annual native-forest log-cut of 8.8 million m^3). Whilst governments and major opposition parties grasp at the '2 per cent excuse' for rejecting forest conservation and overhauling an economically incoherent forestry-industry policy, Australia's plantation resources keep soaring (Figure 1).

Various interlinked and time-dependent options exist for sourcing 0.5 million m^3 of hardwood sawlogs per annum for high-appearance uses. Government resource projections indicate that hardwood plantations in the ground now will deliver increasing volumes of hardwood sawlogs, from 0.2 million m^3 per annum over 2005–09 to 0.4 million m^3 per annum over 2010–14 to 0.6 million m^3 per annum over 2015–19 and rising to 1.1 million m^3 per annum over 2020–24 (Parsons *et al*. 2007: 8). If these volumes or their quality are inadequate, the resource could be topped up temporarily using native forests (selectively logged, with forest ecologists setting the regulations) or improving recycling whilst more plantings for high-quality sawn timber are established. Given the small log volumes involved, finding the short-term, top-up logs in native forests at minimum ecological cost should not be an onerous or high-conflict task.

The high dependency of 'timber' workers on industry's access to native forests is the second claim that restricts new forest policy. There are no government statistics to prove, or disprove, this claim. However, we can establish a reasonable feel for the employment reality. Processing generates most forestry-industry jobs, and here plantations and paper recycling dominate: 80 per cent of Australia's sawn timber and wood panels are plantation-based and 90 per cent of our paper is made from recycled fibre, plantation pulp or other non-native-forest feedstock (Tables 2 & 5). Plantations also dominate wood supply. Plantation-wood growing, processing and exporting, together with paper recycling, probably generates between 75 to 80 per cent of the industry's employment, allowing for higher labour productivity in the plantation sector.

The Commonwealth was instrumental in creating Australia's plantation industry and employment reality. However, it has let misperceptions —notably around appearance sawn timber and jobs — silence its plantation legacy and be the excuse for not driving a fundamental overhaul of forest policy to address the interlinked imperatives of protecting biodiversity and water catchments and mitigating the effects of climate change.

Managed investment schemes, tax deductibility and future plantation wood supply

Who invests in trees is largely about who is prepared to take the risk of investing in a product that generates profits at the mid to lower end — like most other agricultural raw materials — and where income follows between one to three decades after the initial investment. Few wood processors or unprocessed-wood exporters have plantation assets and most that did have divested. In the past the public, through State and Commonwealth funding, bore most of the softwood-plantation risk. Today, managed investment schemes are the dominant vehicle for tree planting. But the risk-takers are still the public, whose purse has provided around $2 billion in tax deductions to thousands of tax-minimising, passive, plantation investors. In June 2008, the Australian Parliament enacted legislation to broaden the tax provisions for growers with a new tax deduction for tree planting for carbon sequestration (Tax Laws Amendment (2008 Measures No. 2) Act 2008) —without ruling out their future logging, which would add even more to the wood supply and remove most of the benefits of carbon sequestration.

While planting continues apace, prospectus expectations of market opportunities for woodchips have not yet materialised. Most of the now-maturing hardwood-plantation resource competes against low-priced native-forest chiplogs (Ajani 2007: 265) in the stagnant global hardwood-chip market. Domestic processing opportunities, namely pulp and paper mills and wood panel plants, lie dormant, hindered by high plantation stumpage prices. These prices, together with arguably high assumed wood yields, offset the high investment cost averaging $9300 per hectare in 2001 (Lonsec Agribusiness Research 2001), which generates a bigger tax deduction and bigger up-front profits to the prospectus company for each hectare planted. The all-up actual cost of buying a hectare of land, planting it with trees and managing them over the rotation is around $4500 a hectare (Ajani 2007: 255). From experience, we know that investment driven by the demand for tax minimisation, and not market realities, is associated with collapse.

The optimal allocation of water and agricultural land for food and fibre production requires final product demand to set the rate of new planting, not artificially driven plantation investment or incentives for inefficient 'carbon sink forests'. Evidence of market failure justifying these plantation assistance

measures is not compelling. There appears to be no evidence of capital-market failure resulting in plantation investors not being able to access finance. Higher interest rates may be attached to finance for planting, but this is normal for any long-term and therefore more risky investment. Similarly, evidence appears to be lacking of market failure justifying government intervention in plantation wood growing. Competition in the Australian plantation industry has increased, with increased private-sector investment breaking up state government dominance and it is difficult to claim information asymmetry between wood buyers and sellers. Other possible public goods associated with plantations, such as landcare and water-catchment benefits, should be investigated on a site-specific basis to justify government intervention. Plantation water use has emerged as a major disbenefit in many catchments.

Finally, as discussed in the next section, the carbon-sequestration public-good argument of plantations falls short when assessed against other land-use options.

Climate change

The Federal Government has elevated climate change to a high policy priority. Reducing emissions from the use of fossil fuels attracts much of the attention, and rightly so. However, emissions from forestry account for about 17.5 per cent of global emissions (Intergovernmental Panel on Climate Change 2007). Therefore, changes to land use and management in native forests hold opportunities for significant immediate and prospective reductions in CO_2 emissions, along with the potential for further sequestration over coming decades. Australia's plantation reality makes the realisation of these native-forest opportunities appealing, both economically and environmentally.

Once again, gaps in data frustrate policymaking. The Australian Greenhouse Office (AGO) generates valuable information and analysis in many areas but much greater attention is required on the native-forest front. Crucially, the AGO does not report the annual emissions from native-forest logging: emissions are reported net of native-forest sequestration. Using AGO data, Blakers (2008: 4) estimates that logging native forests generates an estimated 38 million tonnes of CO_2-e (carbon dioxide equivalent) annually, equivalent to 7 per cent of Australia's total net greenhouse-gas emissions. Combined with the estimated 11 to 13 per cent contribution of native-forest clearing to Australia's net emissions over 2005 and 2006 (Australian National Greenhouse Accounts), deforestation and native forest degradation from logging accounts for emissions equivalent to 20 per cent of Australia's annual net greenhouse-gas emissions.

Existing high-density carbon stores, especially mature native forests, cannot be substituted: there is not enough land or water to enable regrowing vegetation to recapture the emitted carbon in a policy-relevant timeframe. From a climate-mitigation perspective, significant emissions can be avoided by giving

priority to protecting the stores of carbon in existing native vegetation, especially mature and old forests with their large carbon-dense trees (Roxburgh *et al*. 2006), by removing them from wood production and allowing them to regrow. As demonstrated in the first sections of the paper, it is now possible for existing plantation resources to substitute for virtually all the forgone wood.

Scientific investigation into the carbon stocks and storage potential of Australia's native forests is now coming to fruition. Mackey *et al*. (2008) investigated the carbon-carrying capacity of 14.5 million hectares of south-east Australian eucalypt native forests (Southern Queensland, NSW, Victoria and Tasmania), about half of Australia's remaining eucalypt native forests. They estimated their average total carbon-carrying capacity to be 640 tonnes of carbon per hectare. Given this, they estimated that these forests in their natural condition have the potential to store some 33 billion tonnes of CO_2-e.[5] About 56 per cent of the study area has been logged and is therefore below carbon-carrying capacity. Given that previous studies have suggested that carbon stocks in logged forests can be around 40 per cent below their carbon-carrying capacity (Roxburgh *et al*. 2006), the carbon sequestration potential of these forests could be as much as 7.5 billion tonnes of CO_2-e. While further analyses are needed, this estimate is sufficient to highlight the order of magnitude impact on Australia's carbon accounts if logging was halted in these south-east Australian native forests, thereby enabling them to regrow their carbon stocks towards their natural carbon-carrying capacity.

Using the equivalence factor developed by Costa & Wilson (2000) to facilitate the assessment of sequestration-based land-use projects, the sequestration potential of halting logging in Australia's south-east native forests is estimated to be equivalent to avoiding emissions of 136 million tonnes of CO_2-e per year for the next 100 years (Mackey *et al*. 2008: 38): an annual rate of emissions equivalent to 24 per cent of Australia's net greenhouse-gas emissions from all sectors in 2006.

The Australian Government adopts the Kyoto Protocol carbon accounting framework in its Carbon Pollution Reduction Scheme Green Paper (2008). This framework ignores native-forest logging emissions and sequestration opportunities from shifting wood production from carbon-dense native forests to less carbon-dense plantations. The Government proposes not to include native forests in Australia's emissions trading scheme. Although not advanced in the Government's Green Paper, two arguments support this decision. First, because an emissions trading system works on flows, it is difficult to provide a continuing income stream for the permanent protection of the stocks of carbon in native forests. Secondly, because an emissions trading system treats carbon as a

[5] Australia emitted in the region of 576 million tonnes of CO_2-e in 2006. (www.climatechange.gov.au)

homogeneous commodity, it does not distinguish between carbon stored in a tree crop and carbon stored in a significantly more resilient bio-diverse native-forest ecosystem; nor does it recognise the longer residency time of carbon in the various pools of a native forest, the age of the forest, and therefore the time needed to recover CO_2 emitted from degradation of the carbon stores by logging.

However, given the significance of native forests in Australia's carbon story, excluding them from our climate-change challenge is untenable. Exclusion would increase the cost burden on other greenhouse-gas polluting companies forced to pull their weight. It would also advantage companies processing native-forest wood into sawn timber, pulp, paper and other wood products, including biofuels, since neither their associated biomass carbon emissions nor the lost native-forest sequestration opportunities would be costed.

Incorporating native forests in Australia's climate-change challenge is best done outside the emissions trading system and linked to a much-needed review of forestry-industry policy to capitalise on Australia's plantation resources. From a climate-change perspective, the task is to secure funding for the permanent protection of native forests (and other self-regenerating natural terrestrial ecosystems) for carbon storage, together with water and biodiversity conservation. A government body tasked with this job staffed by people knowledgeable in this field could set the priorities and build the strategies. Its funding could be multi-sourced (including redirection of government taxation support for 'carbon sink forests' and a proportion of government funding for land management), setting aside a fixed part of revenue from emissions-trading permit sales or trades and private/voluntary contributions.

In its Green Paper, the Government proposes that plantations established since 1990 on previously cleared land — and therefore in accordance with the Kyoto Protocol — be included in Australia's emissions trading scheme as an opportunity to generate offset credits within the forestry industry, on a voluntary basis (Australian Government 2008: 132). Relative to protecting native forests — from deforestation and degradation — and restoring native vegetation ecosystems, plantations are a high-cost and high-risk CO_2 mitigation option. For plantations to achieve the same sequestration benefit as halting logging in the native-forest study area investigated by Mackey *et al*. (2008: 38) requires a conservatively estimated additional 4 million hectares of plantations, at a cost of $18 billion ($35 billion if established through managed investment schemes).[6] Plantations, being production systems, lose most of their stored carbon on harvest or in short-lived products. Not being self-sustaining agricultural systems, they also embody higher management costs (which also generate emissions) and higher

[6] Author's calculation method and sources available on request.

risks associated with disease, drought, wind damage and fire (see, for example, Munishi & Chamshama 1994; Perera 1989). Relative to permanently protected, self-regenerating natural ecosystems, plantations are an inefficient carbon-sequestration system. However, because of this inefficiency, plantations are a significantly more climate-friendly way of meeting our wood needs than logging native forests. The CO_2 recapture time for plantation wood may be from one to a few decades, depending on the age of the plantation when logged, while the recapture time for native-forest wood is many decades longer, again depending on the age when logged.

By including plantations in its proposed emissions trading scheme — but not native forests — the Government will create counter-productive market signals for climate-change mitigation and forestry-industry productivity. Perhaps unwittingly, it proposes to reward investment in an inferior sequestration strategy (plantations) and handicap the economically superior plantation-processing industry relative to its native-forest-based competitors whose emissions will not be costed. The result may be perverse in two ways. First, emissions are likely to be higher overall, as logging is redirected into native forests where emissions liabilities do not apply. Secondly, wood supply for plantation processors may become too expensive as wood-growing competes with carbon-growing and the value of carbon rises (Wood & Ajani 2008).

This outcome could be avoided with a structural adjustment package to complete the forestry industry's plantation transition — particularly in the hardwood-chip sector — combined with directing the task of biomass sequestration to self-regenerating natural ecosystems managed under a new institution, as discussed earlier. In this policy frame, wood supply remains the objective of plantation investment. With fossil fuels covered in an emissions trading scheme and carbon sequestered in plantation biomass cancelling out emissions over a rotation, the plantation industry has grounds for arguing its raw material be excluded from emissions trading. If granted, the associated compliance costs evaporate.

Concluding comments

Being perfect substitutes for native-forest chips, Australia's maturing hardwood plantations present a major opportunity for mitigating climate change. This opportunity will not be realised with business-as-usual forest-policy frames and policy information, which are steering Australia to perverse outcomes favouring investment in an inferior carbon-sequestration strategy and handicapping the economically superior plantation-processing industry.

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