Forest and Wood Products Australia Limited

Submission to Productivity Commission Issues Paper on Rural Research and Development

8th July 2010

PREFACE

Forest & Wood Products Australia Limited (FWPA) is an industry services company providing a national, integrated strategy to increase demand for forest and wood products and reduce the impediments to their supply. FWPA is committed to helping the forest and wood products industry to be collaborative, innovative, sustainable and competitive.

VISION
To be the industry's leading source of knowledge, and the principal investor in innovation and promotion.

MISSION
To provide services to the industry, and to increase its sustainability and international competitiveness. These services include direct and collaborative investment in:

- Research and development to provide innovative solutions for the industry, and
- Promotion of the industry's products, services and values.

STRATEGIES
1. Promote the benefits and use of forests and wood products in accord with changing community attitudes, environmental awareness, and market trends.
2. Invest in and co-ordinate research and development to improve the industry's competitiveness, inform its climate change response, enhance investment, increase usage, and ensure the sustainability of forests, wood products and services.
3. Expand the industry's capacity and capability – including knowledge generation and adoption, and promotion – to facilitate growth.
4. Increase FWPA's capacity and scope to provide additional services for the industry's benefit.

Further information about FWPA and its operations can be founded on the website: www.fwpa.com.au including previous Annual Reports, Annual Operations Plans and its 5 year Strategic Plan.

FWPA has participated in the development of the submission provided by the Council of Rural Research and Development Corporations (CRRDC) and fully supports that submission. The following submission is based on FWPA's own circumstances as the Industry Owned Company of the Australian forest and wood products industry. It is intended to provide additional FWPA specific input against the matters identified in the Productivity Commission's issues paper released 31 March 2010 and should be read in conjunction with the CRRDC submission.

TABLE OF CONTENTS

Rationales for government funding support

Why should government provide funding support for rural R&D? Does the basic case for such support rest mainly on wider (spillover) benefits for the community, or are there other important rationales that the Commission should take into account?

FWPA supports the economic rationale provided in the CRRDC submission.

For the forest and wood products sector, one of the strengths of the RDC model is the effect of the government matching contributions in providing an incentive for industry to support and engage in pre-competitive research, development and extension. The RDC funding model allows for all business entities to contribute equitably to a funding pool that can engage with research providers at an appropriate level of scale to generate meaningful outcomes for use by the individual entities. The RDC model provides for equal access to priority setting, subsequent use and enhancements of R&D outputs by all levy payers through adoption into their individual business enterprises.

For forest growers, productivity improvement and risk management are most efficiently addressed from a whole-of-industry pre-competitive level. Recent examples have included genetics and tree improvement programs within the plantation industry, development of a whole of industry biosecurity response to incursions of *essigellae californica* into Australia and its subsequent impacts on plantation productivity, forecasting the impacts of projected IPCC climate change scenarios on productivity across Australia and the development of a national life cycle inventory database for timber building products.

For wood processors, the area of pre-competitive research has focussed on building the information bridge between the future resource and the processing technologies that may be required. Examples include development and validation of the relationships between measured standing tree and log properties and final commercial product yield and quality. Development of optimised processing schedules through in-mill segregation and batch processing of products with similar drying properties. Assessment of treated timber performance and durability under accelerated exposure regimes to assist with the introduction of alternate timber treatment agents.

Importers and domestic processors share a common interest in research that will grow the market for wood-based products in competition with other building materials. Examples include development of TimberLife – an interactive software package that can forecast timber building product in-service lifetime by species, application (exposed or weather protected, in ground or above ground etc), preservative treatment type and climatic region throughout Australia. Ongoing support for the refinement of timber building standards to incorporate current material engineering properties. Characterisation and reporting of the emission profiles of volatile organic compounds from standard grades of engineered wood products to demonstrate compliance with international import restrictions and maintain and expand industry access to export markets.

Is the case for government funding support for rural R&D stronger than in other parts of the economy and, if so, why? Do the various rationales apply with equal force to the RDC component of rural research as to the activities of, say, CSIRO and the universities? What specific evidence is there to indicate that projects funded by the RDCs have produced wider benefits for the community that are significant relative to those enjoyed by the industries concerned?

These questions are substantially dealt within the CRRDC submission.
In the forest and wood products sector, there is an ongoing challenge for individual entities to capture the benefits of R&D investments due to the long investment cycles for both growing and processing assets and the generic nature of the final products. A current review commissioned by FWPA (Burvill - unpublished)[1] of government and private R&D investments within the forest and wood products sector in international jurisdictions indicates that governments are dominant providers of funds.

What are the practical constraints on basing government funding support for rural R&D around notions of private/industry benefits versus wider benefits, and/or on the degree to which government funding is likely to induce additional R&D activity? Could a naïve application of such an approach have unintended consequences? Where does the appropriate 'sweet spot' between principles and practice lie? For example, can the notion of industry versus wider benefits usefully be employed to determine that at least some R&D should either clearly be inside or clearly outside the government funding net?

The distinction between private good versus public good is a theoretical argument as most research occurs in the space where private and public good is jointly produced. This is especially the case in forest growing and market access where it is often difficult for the benefits of R&D to be captured and capitalised by a single commercial entity. In the area of wood processing, there is more opportunity for companies to gain a direct commercial gain from company-specific R&D investments. FWPA ensures that its research investments are truly pre-competitive and thus produce private and public benefits.

What factors might mute the strength and/or timing of any increase in private funding in response to a withdrawal of public funding for industry-focused R&D? How important in this context are:

[1] Final report scheduled for delivery 1 September 2010.

- *divergences between the point in the supply chain where the research is funded and conducted, and the point where most of the benefits of that research are realised.*

At present FWPA is unique within the RDC funding model (ref CRRDC case study) in that it receives levies from all sectors of the supply chain, resource managers, processors and timber importers. This permits all FWPA members across the supply chain to have equal input and access to R&D priorities and project outcomes and thus no substantive distinction or access impediments operate between research activity and stakeholder adoption.

- *the long lags before many of the benefits may be realised?*

Again, due to its engagement with all sectors of the supply chain, FWPA's research priorities and active research portfolio covers a broad range of activities. Some areas of research have extremely long lead times to recognition of benefits such as tree breeding and silvicultural practices. Other priorities, such as improved QA/QC systems related to product performance and yield, can be adopted by timber processors very rapidly at the pre-competitive level.

Are differences in the benefits that individual producers receive from RDC-funded R&D likely to constrain their collective willingness to offset any reduction in government funding through increased levy payments? Are there other features of the levy system, or any regulatory issues, that discourage private investment in rural R&D?

Feedback from senior industry members has indicated that should government matching be withdrawn or substantially reduced there would be little appetite for industry to support the continuation of the R&D levy. FWPA has supported an ongoing analysis of sector R&D expenditure levels at 5 year intervals (see Annexure 1 Evaluation of research expenditure and capacity in forestry and forest products in Australia 2007-2008,Turner and Lambert 2009). Trend analysis has shown that nominal R&D expenditure has remained essentially static over the preceding 26 year period, but has declined substantially in real terms and as a proportion of volume and value of the sector.

Over this period, there has been a substantial shift in the government ownership of the sector with the privatisation of some state-owned plantations and processing plants and the corporatisation of other assets.

Until 2001-02, the increase in private ownership within the sector did not result in an increase in the proportion of private contributions to R&D investment. However, over the last six years, private contribution to forest growing research increased from 8% to 12% of total R&D expenditure.

Private expenditure on forest products research has remained static in nominal terms and has declined substantially in real terms and as a proportion of the total.

How important is it that government contributes to the cost of maintaining core rural research skills and infrastructure? Without that support, how specifically would the capacity to adapt overseas technologies to meet the particular requirements of Australia's rural sector be compromised? What role do RDCs play in maintaining core rural R&D capacities?

It is critical that governments contribute to the maintenance of rural research skills and infrastructure to provide a platform for innovation, risk mitigation and to help localise the findings from overseas R&D.

The private sector requires ongoing access to Australian based R&D providers familiar with local resource characteristics and processing systems to facilitate the development of new technologies or systems to meet market demands and challenges. However, the private sector is unlikely to invest in maintaining capacity on a "just-in-case" basis.

FWPA is an industry-owned company (IOC) that is owned by its levy payers and held accountable to its members for the delivery of R&D benefits and outcomes in line with the member-endorsed 5-year strategic plans. By its nature, an IOC must focus on project-based outcomes directly linked to member expectations. Thus the capacity to maintain rural R&D capacity is substantially constrained outside of individual fixed-term R&D projects. IOCs also provide substantial financial support to sector-based CRCs as a means of developing future R&D capacity through postgraduate training of researchers.

What importance should be placed on outcomes-based rationales for government funding support for rural R&D, such as enabling Australia's rural industries to meet increased global competition; facilitating adjustment to climate change; furthering food and bio-security objectives; and fostering regional development? Is there a risk that seeking to use government funding to drive specific outcomes such as these could distort the pattern of R&D investment and thereby reduce the overall returns to the community?

Establishing outcomes-based rationales, whether for government or private funding, will help ensure that research activities are focussed and adequately managed. Within any balanced national portfolio of R&D investments, there needs to be a mechanism for funding the expansion of knowledge for knowledge's sake (e.g. Australian Research Council). However, this is not the role of the RDCs.

Should the level of public funding have any regard to government support for rural industries in other countries?

As previously mentioned, there is evidence that substantial government support of R&D is the norm rather than the exception in countries that have major forest and wood products industries. Likewise, in Australia, federal and state governments have historically played a major role in the forest and wood products sector in terms of ownership, regulation and funding of R&D.

There is growing evidence that sustainably managed wood products can play an important role in responding to the challenges of climate change. If R&D funding within the sector continues to decline in Australia (but not in other countries), then Australia will be at a disadvantage compared to international competitors.

Is the RDC model fundamentally sound?
Some overarching system-wide issues

How effective is the current rural R&D and extension framework, and is the role of the RDCs within that framework appropriate and clearly defined?

The forest and wood products RD&E strategy (see Annexure 2) was endorsed by the Primary Industries Ministerial Council in April 2010. This strategy was developed during 2009 with active involvement by major providers, funders and users of R&D. Importantly, the strategy identified the substantial decline in RD&E capacity in the sector and the need to develop a collaborative mechanism to address this decline.

FWPA played a key role in the development of strategy and will no doubt play an active role in its implementation.

Does the significant number of entities, research programs and funding pools cause problems? For example, are there areas of major R&D overlap or gaps? Does any focus on 'leveraging' contributions across the various funding pools cause inefficiencies or perverse outcomes, or does it incentivise desirable behaviour?

The RD&E system within the forest and wood products sector is complex, which may result in inefficiencies in relation to coordination, communication and unnecessary overheads. There is also the potential for duplication of RD&E effort – however, this is not necessarily wasteful if it provides independent validation of R&D findings. Anecdotally, the amount of duplication is not considered an issue within the sector.

FWPA only accounts for approximately 7% of the total RD&E expenditure within the sector, although it is the largest single pool of contestable funds. In this instance, the ability to leverage funds allows FWPA to minimise duplication and ensure an outcomes focus.

- *Is there sufficient oversight of, and coordination and collaboration between, the different components of the framework? Are there any particular difficulties created for the RDCs by the current arrangements?*

Coordination and collaboration were identified as one of the key weaknesses of the current system and thus the RD&E strategy recommended the establishment of an R&D Forum.

- *Does the framework facilitate strategic assessment of R&D needs across the whole of the rural sector?*
  Does it encourage consideration of whether available funding is going into the right areas from Australia's point of view?
  Is there an appropriate mix between longer-term and broadly applicable R&D and shorter-term adaptive research, and where in this context should the RDCs be focussing their activities?

These are important issues that will hopefully be addressed by the R&D Forum once it has been established.

- *Is the framework sufficiently flexible to accommodate future changes in circumstances and requirements? What impacts have recent initiatives to improve the framework had on outcomes thus far? What are likely to be the particular implications of recent and prospective changes to the framework for the RDCs?*

In implementing the RD&E strategy, the proposed R&D Forum will need to consider the future needs of the sector and what institutional arrangements are appropriate to deliver cost-effective and outcome-oriented research.

- *Are there significant gaps in the data base which are impeding the effectiveness of the framework? For example, should there be greater effort devoted to assembling data on the total amount of public funding for rural R&D available through the variety of funding programs?*

There are significant information gaps for managing the sector's RD&E efforts. This was identified in the strategy and will need to be addressed by the R&D Forum.

- *Is there sufficient emphasis on the evaluation of outcomes and sharing the lessons learned? Are there any particular lessons for the RDC model from developments in other components of the framework?*

One of the surprising findings from the RD&E strategy process is that the sector does not have a clear narrative for explaining the past benefits or future needs from R&D. R&D in the sector is incremental by nature of the long-term assets and benefits can only be visualised by taking a long-run perspective.

Some specific strengths and weaknesses of the RDC model

Are there any reasons to argue that the RDC model is no longer fundamentally sound? Or can deficiencies in the model be addressed through more minor modifications to the current requirements?

This has been addressed within the broader CRRDC submission. However, from a FWPA perspective, the model is fundamentally sound and offers greater potential than has been realised to date by the forest and wood products sector.

If more fundamental changes might be warranted, what form could these take? How difficult would it be to replicate the strengths of the RDC model within such approaches? Is there scope for 'halfway' house approaches that would harness the respective strengths of the RDC model and alternatives to it? Are there any overseas approaches that are particularly instructive?
Are there other major changes required to the role of the RDCs? For example:

- *Do the current levy payment and governance arrangements for the RDCs lead to an excessive focus on R&D effort within the 'farm gate' and, if so, how might this be addressed? If there are prospective, high payoff, research opportunities further down the value chain, why are these not being taken up by processors and other downstream stakeholders?*

FWPA by the nature of its levy base, receives its industry levy income and industry input from all sectors of the value chain (see case study in CRRDC Submission). It operates well beyond the 'farm gate' to support R&D activities in areas of resource productivity and characterisation, materials processing and manufacturing as well as the use of forest products within the sustainable built environment.

- *Is overlap with the work of the CRCs largely complementary, or are changes warranted to either or both programs to reduce that overlap? Will the new guidelines for CRCs make it more difficult to get new rural CRCs approved and, if so, what are the implications for the future role and activities of the RDCs?*

In general FWPA's engagement with forest sector CRC's has been complementary to the CRCs research programs. In some cases, it has proven difficult for CRC proponents to obtain additional industry cash support beyond

FWPA contributions as levy payers feel that they are contributing indirectly to the CRC via the FWPA sponsorship. This has not been the case in all instances and it should be noted that several major enterprises have provided direct and substantial contributions to current and previous sector-based CRCs.

- *If State Governments continue to wind back their role in R&D and extension, should the RDCs be seeking to fill the gap, or are there private players that could effectively fill this role?*

The development of the Forest Sector RD&E strategy under the leadership of FWPA was facilitated by its role as a central R&D funding body within the industry. The majority of State forest agencies now operate as government business enterprises with a decreased focus on longer term strategic R&D. CSIRO has also recently announced the closure of its forest products research unit with a forecast reduction of 28 FTE researchers. The new Forest sector RD&E strategy calls for the establishment of an industry research forum to coordinate and resource collaborative R&D programs across all PISC agencies. FWPA has been identified as the coordinating entity under which the new forum can operate most effectively. At this time no additional resources have been committed by the members to support programs undertaken within the forum. It is unlikely that any private sector companies would enter this area until such time as additional financial support was committed by the forum's members.

Do RDCs manage Intellectual Property issues effectively? In particular, do their current approaches give rise to any difficulties for bringing new technologies to market? Can any shortcomings in this area be readily addressed within the current model?

FWPA's current Intellectual Property Management and Commercialisation Plan align with the general industry and research community views that R&D providers are best positioned to protect and exploit project IP. Under the terms of FWPA research agreements, all project IP is owned by the contracted research provider with equity (and proportional revenue returns from exploitation) held by all project contributors in line with their audited cash and in-kind commitments.

FWPA believes that this approach represents current best practice in that project IP is not unreasonably withheld from further enhancement by its creators on the basis that an equitable return of commercialisation revenue is provided to FWPA to be reinvested in further R&D. This approach also ensures that IP protection and maintenance costs are borne by the researcher and do not reduce future FWPA funding resources.

Funding level issues
Some particular considerations

What principles and benchmarks should the Commission bring to bear in assessing appropriate funding for the totality of rural R&D, and the right balance between public and private funding? Is there any new empirical work which specifically focuses on how changes to current overall funding would affect community well-being? Is it possible to determine the right balance between public and private funding across the totality of rural R&D using broad indicators and principles? Or must such assessment have regard to the characteristics of individual programs that provide public funding for rural R&D and, in particular, to the type of R&D that is sponsored through each of these programs?

As previously mentioned, FWPA is currently funding a review of programs for funding R&D within the forest and wood products sector in other countries. While the report has not yet been completed, the reviewer has identified several overseas models that may be applicable to Australia. Each of the proposed models have as a feature a core underpinning of central Government support for the funding model primarily based upon the creation and delivery of public goods through increased knowledge and accessible R&D capacity. The models allow and encourage the creation and exploitation of private industry benefits on the basis that the net outcome to the community is the ongoing viability of regionally-based innovation focussed enterprises with increased access to export markets.

Is there evidence to suggest that available funding prevents RDCs from investing in R&D which could provide a significant payoff to the wider community; or, alternatively, that RDCs are investing in some projects expected to generate only very modest returns? What does the fact that some RDCs have built up significant surpluses indicate about the availability of worthwhile projects to invest in?

FWPA is implementing a program of longer term investment plans to guide its RD&E investments. As a relative minor investor within the sector, it is important that FWPA identifies the areas of investment that can achieve the highest outcome for its stakeholders (government and levy payers). It is highly likely that the full suite of investment plans will identify greater investment opportunities than current funding will support. The plans may also identify some projects that are expected to generate modest returns but are a required stepping stone for implementation of the overall plan.

FWPA is currently running down its cash balance in accordance to a schedule agreed by the board of directors. This cash balance was due to a number of factors including a one-off transfer of funds from the Australian Government related to R&D expenditure linked to previously accrued importer levies.

If the focus of most of the RDCs is on industry-specific and adaptive R&D and related extension, does this suggest that the bulk of the benefits accrue to levy payers? If so, and given the recent evaluations suggesting that these benefits are large in overall terms, why is a significant public contribution justified?

FWPA was established under the provisions of the Forestry Marketing and Research and Development Services Bill 2007 as a not-for-profit forestry industry services company to provide marketing, research, development and other industry services to the forest industry.

In presenting the Bill to the House for the second reading, the Parliamentary Secretary to the Minister for Agriculture, Fisheries and Forestry commented:

> "The Forestry Marketing and Research and Development Services Bill 2007 and the accompanying transition bill are the result of a partnership approach to forestry matters between the government and the forest industry. It aims to provide the industry with greater ownership and control to enable them to be responsive to the markets and to have the capacity to respond more effectively and efficiently to current and emerging challenges. Ultimately this will mean increased access to domestic and international markets and improved sustainability and profitability of the industry."[2]

Industry-owned companies are intentionally established to be directly accountable to their members as a means of ensuring that company activities are aligned to the priorities of the industry. Reporting and accountability to members is primarily driven by the company's 5-year strategic plan and annual reporting against that plan. The company also reports its progress to the Australian Government under the requirements outlined within the Statutory Funding Agreement (SFA). The company's 5-year strategic plan as required under the SFA is developed in consultation with and endorsed by the company levy payers and members places explicit emphasis on the delivery of industry benefits and outcomes.

Are there particular features of the rural sector, or parts of it, which provide the basis for a significantly higher level of public funding support for R&D than in most other areas of the economy (see PC 2007, p. 435)? Are the wider community benefits from rural R&D commensurate with governments meeting an estimated three-quarters of the total cost of this R&D and, as part of this, the Australian Government meeting nearly half of the cost of the R&D sponsored by the RDCs? What other benchmarks should the Commission

[2] http://parlinfo.aph.gov.au/parlInfo/genpdf/chamber/hansardr/2007-05-28/0144/hansard_frag.pdf;fileType=application%2Fpdf

consider in assessing the appropriate level of public funding support for the RDC program?

The CRRDC submission provides a strong case for public funding of rural R&D in general. In relation to the forest and wood products sector, the justification for existing (or increased) funding of RD&E is based on the following:

1. Sustainable forest management and wood products are a cost-effective means of carbon sequestration when compared to alternative "technologies";
2. Native forests, and plantations to a lesser extent, provide other community public good values such as biodiversity, habitat, water catchment and landscape values. The protection and maintenance of these values in conjunction with the production of wood products requires ongoing commitment to R&D.
3. Forest growing and downstream wood processing can provide a diversity of economic activity and assist in community stability in some key regions;
4. Forest and wood products research in overseas countries is underpinned by long term government funding.

The allocation of public funding across RDCs

Is there any need to rebalance the Government's funding contribution across the individual RDCs? For example, do the general appropriations for the RIRDC and the Fisheries RDC give too much or too little weight to the somewhat different nature of the R&D projects that they fund?

Refer to the CRRDC submission.

Does the RDC model — and, in particular, the RIRDC industry umbrella arrangement appropriately cater for the research needs of emerging primary industries? If not, what should be changed? In allocating government funding to the industry RDCs, should any account be taken of differences in the longer term competitive prospects of those industries, or their potential for productivity improvements? Alternatively, does basing the government contribution on the value of industry output provide an appropriate means to calibrate contributions given the inherent risks in trying to pick winners or losers?

The RDC model should not be viewed in isolation of the other government mechanisms for funding RD&E activity. The current mechanism for basing government contribution on the value of industry output may be equitable, but it unfortunately limits this value calculation to "pre-farmgate." This approach runs contrary to taking a whole-of-supply chain approach to RD&E.

Improving the RDC model
Ways to enhance governance arrangements

Where do the main opportunities for enhancing the current governance regime lie? Does the fact that some RDCs seem to have more satisfied stakeholders than others provide any insights on how to improve governance arrangements, or are such differences mainly due to the nature of the industries concerned? What changes might be possible to reward (or punish) good or (bad) governance without risking perverse outcomes?

Effective corporate governance is a critical key success factor for any organisation and consists of institutional arrangements and human dynamics.

At the risk of stating the obvious, all rural industries have their own unique set of stakeholders with varying ownership structures, history and culture. Therefore, it is difficult to directly correlate the satisfaction of stakeholders with their respective RDC and its specific governance arrangements.

As one of the more recently formed IOCs, FWPA is in the process of building a stronger and direct relationship with its stakeholders to be able to monitor and improve satisfaction levels. Previously, as a statutory authority this relationship was arms-length via the industry representative organisations. In fact, the identity of levy payers was generally unknown except for the more prominent organisations.

Mechanisms to improve stakeholder relationships include the following:

- Opportunity to be a Company voting member
- Participation in industry advisory groups
- Regular communication about Company activities (including a copy of the annual report and invitation to the annual general meeting).
- Request for nominations to the director selection process.
- Provision of other services to stakeholders (e.g., generic promotion and coordination of building codes and standards).

More specifically:
….What practical impacts (positive and negative) have the national and rural research priorities had on the activities of the RDCs? Does the specification of these priorities strike an appropriate balance between signalling what the Government is seeking in return for its funding contribution, and providing the RDCs with flexibility to carry out their responsibilities efficiently and effectively? If not, what changes should be made?

The national and rural research priorities are aspirational, and as such, can be difficult to use as specific investment criteria at a project or program level. FWPA is developing longer-term R&D investment plans that will help provide greater direction to project approvals and provide a clear link to desired stakeholder outcomes.

- *Is there in fact significant synergy between the research needs of the sector and the Government's stated research priorities?*

The industry and the Government share a common desire for an innovative, profitable and internationally-competitive forest and wood products sector that is a major contributor to a sustainable Australian economy. There would also be a shared belief in the role that R&D can play in delivering this outcome. The challenge is to ensure that all players (including other government R&D investors and providers) are working in concert without being overly prescriptive.

- *Are there likely to be greater challenges in securing industry uptake of some of the outcomes of R&D directed at meeting the Government's priorities than for R&D which reflects the priorities of levy payers? If so, can this problem be cost-effectively addressed?*

Uptake of R&D outcomes is a challenge for all organisations involved in R&D as it requires a willing and receptive audience.

Importantly, measures of direct uptake and adoption of individual R&D outputs are difficult to assess at the individual enterprise level, as is attribution of any specific industry or market change to the outcomes of any single R&D program (see Annexure 3. FWPA R&D Program Evaluation, URS Forestry 2010) Also, individual firms may be reluctant to acknowledge their use of R&D at the risk of signalling information to their competitors.

Unfortunately, there is no magic bullet to direct the transfer and uptake of R&D findings as it requires constant communication by the provider and receiver of the information.

Does feedback from the Government on strategic and annual plans add significant value to the process and is that feedback communicated effectively? If not, what could be done to improve the arrangements?

Feedback from the Department of Agriculture, Fisheries and Forestry and the more recently formed Rural R&D Council provide an important check in the planning process to ensure that FWPA's planned activities are aligned with the interests of company's single largest funder.

What is the scope to improve the effectiveness of RDC boards?

As mentioned above, effective corporate governance is a result of institutional arrangements and human dynamics.

As an industry-owned not-for-profit company the FWPA board operates under the provisions of the Corporations Act 2001 and its own company constitution. At its second AGM (October 2009), FWPA members approved a suite of changes to the Constitution which were identified after working with the document over a two-year period. This highlights the difficulty of capturing and codifying institutional arrangements and the need for any organisation to constantly pursue best practice.

In a parallel process, the FWPA Board has recently implemented an external review to ensure that its processes are effective and reflect best practice.

As a consequence, FWPA believes that its processes and procedures are both suitable and appropriate mechanisms to gauge the effectiveness of the board in terms of stakeholder expectations.

- *Is there an appropriate balance on boards between industry expertise and more general skills? If not, is this a result of deficiencies in the processes for electing/appointing boards, or does it reflect other factors?*

As per the company constitution, the board of FWPA is a skills-based board with a requirement for a minimum of two independent sitting members at any particular time. Candidates for election by members are selected from all applicants by a selection committee comprising members of nominated peak industry bodies, an independent member selected by the current FWPA board and Chaired by a non-voting FWPA board member.

This process has now been undertaken over the last three years and FWPA has been pleased with both the quality and quantity of candidates that have applied to be a director of the company.

- *How has the Ministerial approval process for appointments to the boards of the statutory corporations affected outcomes?*

Not applicable to FWPA.

- *How might any negative impacts of the removal of government nominees from the boards of the statutory corporations be ameliorated? For example, has the attendance of a departmental representative at the board meetings of some of these corporations been helpful?*

Not applicable to FWPA.

- *What lessons can be learned from differences in the procedures for appointments to individual IOC boards?*

FWPA believes that its director selection process as described above is an effective and appropriate means of ensuring that a suitable balance of skills is represented on the board to assist in strategy setting and measurement of company effectiveness and value to its members.

- *Has board composition influenced whether individual RDCs have focussed on encouraging adoption of new technologies by more innovative 'top end' producers or, alternatively, on pulling 'bottom end' producers up? What other factors have played a role in the different strategies in this area and what lessons can be learned from the results?*

Within FWPA, the development of R&D strategies is guided by the inputs provided by its industry advisory groups. These groups, comprising the R&D and technology managers of its member companies, help to set the agreed R&D directions and impact measures for specific programs. Once endorsed by the FWPA board, these programs establish the mid to long term directions of FWPA with respect to its priority R&D programs.

While FWPA encourages participation in its advisory groups by all members (and levy payers), it is often the larger or more R&D focussed organisations that have the time and staff available to participate.

Therefore, by the nature of their membership, the industry advisory groups are predominantly 'top end' producers with an understanding and appreciation of the role of innovation in developing market opportunities for their products. 'Bottom end' producers within the sector are encouraged to adopt and implement best practice procedures through the development and dissemination of benchmarking studies across the industry as a part of a great number of FWPA R&D projects.

- *Are there any significant conflict of interest issues that need to be addressed in regard to the appointment and membership of boards, the relationships between RDCs and industry representative bodies etc?*

As discussed above, the FWPA director selection process is working well.

Are there aspects of the governance arrangements applying only to the statutory corporations, or only to the IOCs, that should apply across the board? For example, would it be possible and desirable to increase the input of the Minister into the strategic and annual plans of the IOCs? Would there be benefits in extending the periodic external review requirements for the IOCs to the statutory corporations?

FWPA believes that its own reporting and compliance requirements established through both the company constitution and SFA represent an appropriate balance of engagement with both industry and government stakeholders. The requirement for Ministerial engagement in the finalisation of strategic plans and notification of annual operational plans ensures that the company's activities remain in accordance with Government expectations.

To date all of FWPA's strategic and annual operational plans and reports have required no substantive changes following submission to DAFF or the Rural R&D Council.

As FWPA is presently within the terms of its first SFA it has yet to commission an external performance review but views the opportunity as a valuable input in the renewal of its SFA with the Government. The external assessment will also serve as an input to dialogue with company members and the broader industry when setting the strategic directions, member expectations and resources to be made available to FWPA for its subsequent period of operation.

How useful are the Statutory Funding Agreements, including as a means to ensure that the IOCs meet the core requirements in the PIERD Act? Would greater standardisation of these agreements across the IOCs be desirable?

FWPA views the SFA as a suitable and effective mechanism to ensure that the core requirements of the PIERD Act are met.

To what extent would governance be simplified if the Government's contribution was separately managed, leaving the RDCs to manage contributions from levy payers? Do the benefits for RDCs and levy payers that come with the government contribution outweigh the costs of the more complex governance regime and, in particular, the constraints on the way in which funds can be spent?

Anecdotal feedback from FWPA members is that the Government contribution is viewed as a valuable co-investment to leverage the investment of the R&D levy funds towards the creation of pre-competitive R&D outputs and knowledge. In the event that the government matching funds were withdrawn then it could be reasonably assumed that the interest from industry towards investment of levy funds in pre-competitive outcomes would diminish over time.

How effective are current industry consultation protocols? Are all of the key stakeholders routinely consulted, or at least provided with adequate opportunity to make their views known? Should the legislative requirement for some RDCs to consult with particular peak industry groups be scrapped and replaced by a more generic requirement simply requiring consultation with an appropriate range of stakeholders?

The stakeholder consultation requirements of the SFA are viewed as being suitable and appropriate. However under the provisions of the Corporations

Act 2001 and the company constitution, FWPA is legally accountable only to its members and thus a higher degree of emphasis is therefore applied towards consultation and endorsement of the company activities by its voting members through the FWPA Annual General Meeting and director election process.

What are the benefits and costs of the combination within the IOCs of R&D responsibilities and other industry services? To what extent have synergies between the two been a factor which has motivated the transformation of some statutory corporations into IOCs? What have been the other drivers and what have been the downsides experienced during and after such moves? What are the particular benefits and costs of combining R&D and industry representation responsibilities within a single entity?

FWPA believes that its establishment as an IOC with its inherent levy payer consultation and engagement function provides it with a unique position to consolidate a number of timber industry functions and roles within the one entity. As an example the development of the Forest sector RD&E strategy was streamlined under the ownership of FWPA as all state based forest sector PISC agencies are also FWPA members and have ongoing input and awareness of R&D strategies through participation in the industry advisory groups.

FWPA has also developed an industry leadership position in managing the development and revision of timber building product standards and codes. While a great deal of prior FWPA sponsored research had direct relevance and input into the ongoing development of Australian product and building standards, uptake of this research was constrained by the lack of an industry consultation mechanism that could feed into the Standards Australia process. As a new industry service, a member reference group had been established to resource and prioritise the renewal or discontinuance of the current suite of timber product standards.

As an IOC, FWPA also enjoys a unique position across the forest products industry value chain through its engagement with all sectors of the industry. This engagement with resource growers, forest contractors, processors and importer companies facilitates the collection and prioritisation of whole of industry research priorities as well as dissemination of research outputs to all relevant sectors of the supply chain. This expands the impact of FWPA beyond the traditional ‘farm’ gate and permits a rapid response and resourcing of R&D programs to address priority market issues.

Increasing administrative efficiency

What scope is there to reduce the costs of administering the RDC model without diminishing the outcomes it delivers?

Refer to the CRRDC submission.

Are there too many RDCs and, if so, how might this number be reduced? How big are the potential downsides of amalgamations, such as loss of focus and the increased challenges of dealing with a more diverse, and possibly hostile, range of industry stakeholders? Would wider application of the RIRDC approach be a means to reduce total administrative overheads, while still allowing individual industries to retain their 'research identity'?

FWPA believes that there is minimal overlap and redundancy of operations in the case of the forest and wood products industry.

The institution of a compulsory levy carries an obligation to provide accountability to the levy payer with respect to the outcomes of programs supported by their contributions. Anecdotal feedback from FWPA members has been that the current structure of industry ownership of the IOC is a preferred approach as it permits direct industry engagement and participation in the activities of the company particularly prioritisation of R&D programs and overall strategy setting for other industry service programs.

Are there examples where ineffective collaboration and coordination across the RDCs has lead to a significant wastage of administrative resources? Are there unrealised opportunities for greater sharing of skills amongst the RDCs? Are there other features of the RDC operating environment or governance regimes which lead to unjustified escalation in executive salaries, board fees, infrastructure costs, overheads and the like?

Refer CRRDC submission.

More robust ex post project evaluation

Do the program-wide benefit–cost ratios emerging from the two evaluations so far appear reasonable in the context of previous quantitative work and other more qualitative indicators of what the RDC model has delivered for farmers and other stakeholders? How do the numbers compare to those emerging from evaluations by individual RDCs (both before and after the event) and for comparable projects by other research entities such as the CRCs and the CSIRO? If there are significant differences, what are some of the possible reasons for them?

Refer CRRDC submission and Annexure 3.

As reported in Annexure 3 (note that this data was not included in the previous CRRDC report) – the external evaluators had great difficulties in attributing specific observed changes in forest product market volume, share or profitability to the identified outcomes from any specific R&D program or project.

> "Generally speaking, research results are but one factor influencing the market for timber products and the competitiveness and profitability of businesses operating in the forest and wood products industry. Movements in the exchange rate, the price of alternative products, and residential housing starts are all factors that have a significant influence on the timber products market. It is often difficult to distinguish the effects of research from these other influences." (Attachment x p. vii)

When weighted across three FWPA program groupings, resource development, processing systems and market access, the results of the 2010 Benefit Cost Assessments show that positive gains are returned from FWPA program investments with maximum benefits (14.8:1) attributable to projects within the resource development program.

Are there particular methodological issues that need to be addressed? For example:

Has the project sampling process been sufficiently random? Have evaluations given sufficient weight to failed projects, especially those terminated at a relatively early stage?

Has there been adequate recognition of the contribution of the core R&D and/or background knowledge on which adaptive research work sponsored by the RDCs is based?

- *Has proper account been taken of the implicit subsidies embedded in some of the research services provided to RDCs by State governments, universities and the CSIRO?*
- *Has there been sufficient rigor and consistency in the way in which 'counterfactuals' for individual projects have been constructed?*
- *Has adequate account been taken of the potential for projects with long payback periods to be rendered less valuable or obsolescent by the next wave of research effort? Should there be more focus on returns in the medium term?*
- *Have the assessments assumed levels of adoption which can be supported by previous experience?*
- *Has there been sufficient sensitivity analysis in regard to all of the key influences on reported project returns?*

Please refer CRRDC submission.

Should the next stage of the evaluation process provide for follow-up of initial project evaluations to see whether the expected outcomes have in fact been realised? Should there be more focus on the value added by RDC involvement in a project as distinct from the overall return to that project? What other evaluation initiatives might be helpful, including to facilitate more rigorous and consistent assessment of environmental and social benefits?

Please refer CRRDC submission.

Is sufficient data already collected to allow for these sorts of improvements and refinements to the evaluation process? If not, how might any gaps be addressed? For instance, when undertaking stakeholder surveys, should RDCs solicit more information on the farm-level impacts of specific R&D outputs to feed into the evaluation process?

Please refer CRRDC submission.

Are any changes required to the governance regime for RDCs to encourage improvements in evaluation protocols and methodologies? Should there be greater efforts to encourage consistency in the approaches adopted by the individual consultants employed by RDCs to undertake evaluations? What would be the most cost-effective way of providing for regular independent scrutiny of the evaluation process and its outcomes? Should evaluation outcomes be 'reality tested' with stakeholders?

FWPA BCA evaluations are commissioned on the basis of the endorsed CRRDC assessment protocol. During its most recent round of BCA evaluations the consultants reported difficulties in their attempts to attribute any specific market responses to the outcomes of individual FWPA R&D projects and programs yet noted.

More effective coordination and collaboration

Are there significant opportunities for additional collaborative research effort across the RDCs which would have significant payoffs? If so, where specifically do these unrealised opportunities lie and why do they still exist? For example, are some of the RDCs unnecessarily siloed and reluctant to work with others on value adding areas of common interest? Or is it simply that these collaborative projects are expected to provide a lesser return than other project options within each silo?

Where possible, FWPA seeks to actively invest in collaborative research initiatives with other RDCs and IOCs, however given the nature of its membership base there are only very limited opportunities to successfully do so and deliver member relevant R&D outcomes.

Previously, FWPA had been a strong supporter of the Joint Venture Agroforestry Program (JVAP) co-funded by FWPA, Land and Water Australia and RIRDC in addition to CCRSPI and the various communication initiatives developed under the CRRDC. FWPA is currently co-investing with RIRDC in an Industry and Innovation NSW project awarded under the DAFF forest industry climate research fund program as well as a joint project with HAL researching new procedures for the control of Eucalyptus Weevil incursions into commercial apple orchards.

Is there scope for RDCs to do more collaborative work with overseas entities? Are there any particular features of the current arrangements that discourage such collaboration?

The current operational arrangements for FWPA permit direct engagement with international research providers as required to address identified industry R&D needs.

At present, FWPA has substantial project investments with two New Zealand research consortia established under the Foundation for Research Science and Training (FRST). These consortia, the Solid Wood Initiative and the Structural Timber Innovation Company are industry-managed enterprises, somewhat similar to Australian Cooperative Research Centres, who pool industry and Government funding resources to purchase R&D services from the research community.

Participation in these programs provides Australian industry substantial leverage of FWPA funds to engage Australasian research providers on common industry issues aimed at delivering pre-competitive industry outcomes and opportunities.

The Solid Wood Initiative is refining softwood processing algorithms to maximise sawn product yields based upon measured physical properties of in-feed logs. This permits segregation of mill in-feed to eliminate costly inputs of processing and drying steps from those logs identified as producing inferior final products grades.

The Structural Timber Innovation Company is developing a system of prestressed manufactured timber beams to compete directly with precast concrete and fabricated structural steel components in commercial building systems.

As a mechanism for encouraging coordination and collaboration, what are the strengths and weaknesses of the CRRDCC? What specific initiatives might improve its effectiveness? Are there other mechanisms that might be employed instead of, or in addition to, the CRRDCC?

Please refer to the CRRDC submission.

To what extent will the National Primary Industries R&D and extension framework, once fully implemented, be likely to improve broader coordination and prioritisation of the research task and facilitate its execution in an efficient and effective manner? Will it provide flexibility to cater for future changes in the composition of the rural sector, or could it tend to lock in the current levels of funding support and infrastructure relevant to individual industries? How might the activities of the Rural R&D Council best add value to the overall effectiveness of the rural R&D effort?

The National RD&E strategy process has helped identify a number of shortcomings and opportunities for improved coordination of R&D within the sector. This should be considered the start, rather than the end, of the process.

Within the forest and wood products sector, there has recently been a significant erosion of R&D capacity. Further loss of capacity is expected over future years.

It is clear the institutional arrangements for the supply of R&D that have well served the sector over the last 30-40 years are unlikely to be there in the future. Therefore, the challenge is to redefine how R&D should be undertaken within the sector, which is a key task for the R&D Forum.

The Rural R&D Council can also play a key role in ensuring that opportunities and synergies between industry sectors are leveraged where ever possible.

Improving the levy arrangements

What are the relative merits of compulsory and voluntary levies for addressing free-rider problems? What lessons can be drawn from the voluntary levy arrangements that apply in the fisheries and cotton area? In practical terms, what are the differences between a voluntary levy and a compulsory levy where the levy rate is left to the levy payers to decide and can be set at zero?

FWPA and its members are supportive of the compulsory levy system and the ability to eliminate the issues of potential free riders from the outcomes of levy funded research. At present, the pulp and paper industry within FWPA has its levy set to zero (and has done so since the original establishment of the FWPRDC).

Are the arrangements for collecting the levy and channelling these collections to the RDCs administratively efficient? Does the (variable) levy collection charge closely reflect the costs incurred by the Department of Agriculture, Fisheries and Forestry in collecting and distributing levy funds?

FWPA is working closely with the Levies Revenue Collection Branch to ensure that the arrangements are as cost-effective as possible.

Are the processes for amending levy rates unduly cumbersome? Are there options for streamlining these processes that would maintain appropriate protections against unduly frequent and potentially disruptive or costly attempts to change levy rates?

Refer CRRDC submission.

Could the basis for the matching government contribution be modified so as to give better effect to the underlying rationales for public funding support?

Refer CRRDC submission.

For instance, would it be desirable to pay a higher contribution on classes of R&D with a demonstrable focus on wider community benefits, offset by a lower rate on R&D with an industry-specific focus? Is there any case for differentiating the rate of the matching contribution between start up or high growth rural industries and more mature industries?

Refer CRRDC submission.

Should there continue to be scope for RDCs whose levy receipts are below the ceiling on the matching government contribution to accept funds from ‘donor companies’ for specific research projects and use this funding to secure an additional taxpayer contribution?

At present the terms of the FWPA SFA do not permit this process. There are a number of existing collective industry R&D programs and initiatives currently in operation that seek to deliver pre-competitive or collective industry outcomes that are threatened with the ongoing decline of available R&D capacity and voluntary funding that could benefit from this mechanism.

The broader industry has expressed ongoing reluctance to increase general levy rates. However, there has been an overall high degree of interest amongst a number of parties to commit voluntary program specific funds as permitted under other RDC and IOC arrangements that support longer term collective industry initiatives under the IOC banner. To the extent that these funds would not exceed the current matching fund ceiling limits FWPA members would support this concept.

Should processors generally pay a levy for R&D? If they were required to do so, what is the likelihood that they would simply pass the cost back down the line to the primary producer? Does this happen in those industries where processors currently pay a levy?

Since its establishment, the Forest and Wood Products Research and Development Corporation (predecessor to FWPA) received the majority of its levy income from log processors. As the majority of the major timber growers at the time were State-owned enterprises, under S.114 of the Australian Constitution, the Commonwealth was prohibited from applying a levy (tax) against State-owned property. The FWPRDC levy was consequently collected at the point of primary conversion (i.e. the sawmill).

While it was argued at the time that this levy was essentially being collected on behalf of the grower enterprises, the companies that actually remitted the levy took a very strong level of interest and engagement with the FWPRDC and provided direct and clear input into the R&D priority setting process of the RDC.

As a result, growers argued for the imposition of a direct grower levy with the establishment of the IOC with all state-based entities agreeing to commit to five-year voluntary agreements to contribute the equivalent amount of funding to FWPA on the basis of reported harvest volumes.

Is there any evidence of a significant mismatch between the regional distribution of levy payments and the regional distribution of the benefits from the ensuing R&D, for particular RDCs or across the program as a whole? Would an explicit effort to more closely align the two materially reduce the overall return to the community from the RDC program?

Due to the structure of FWPA and the use of its industry advisory groups, R&D program priorities are developed on the basis of levy payer input and feedback. As a consequence the current R&D investment priorities are an accurate reflection of consensus industry needs and consequently also reflect general levy income distributions.

Forest&Wood Products Australia
Knowledge for a sustainable Australia

CAPABILITY, ADOPTION & PROMOTION

PROJECT NUMBER: PRD111-0809

MAY 2009

Evaluation of research expenditure and capacity in forestry and forest products in Australia 2007-2008

This report can also be viewed on the FWPA website
www.fwpa.com.au
FWPA Level 4, 10-16 Queen Street,
Melbourne VIC 3000, Australia
T +61 (0)3 9927 3200 F +61 (0)3 9927 3288
E info@fwpa.com.au W www.fwpa.com.au

Evaluation of research expenditure and capacity in forestry and forest products in Australia 2007-2008 and development of research

Prepared for

Forest & Wood Products Australia

by

J. Turner and M. Lambert

Publication: Evaluation of research expenditure and capacity in forestry and forest products in Australia 2007-2008 and development of research

Project No: PRD111-0809

ISBN: 978-1-920883-76-8

Researcher:
J. Turner and M. Lambert
Forsci Pty Ltd
Suite 4.05, Delhi Corporate, 32 Delhi Road
North Ryde NSW 2113

Final report received by FWPA in May, 2009

Forest & Wood Products Australia Limited
Level 4, 10-16 Queen St, Melbourne, Victoria, 3000
T +61 3 9614 7544 F +61 3 9614 6822
E info@fwpa.com.au
W www.fwpa.com.au

Table of Contents

- ***Summary***

Total expenditure on Australian forestry research and forest products research was $87.8 million for 2007/08. This comprised $61.0 million on forestry research and $26.8 million on forest products research and was estimated using methodology similar to that in the several previous assessments. The total expenditure represents an annual average increase of about 4.8% but a generally slow decline in real terms (0.7% per annum) since 1982. The total expenditure increased to approximately $106 million when some peripheral expenditure such as support, administration and surveys was included.

The expenditure was estimated according to broad sectors undertaking research, that is, Commonwealth, State, University and Private and also according to broad research areas. Research undertaken on native forests and exotic species plantations has generally declined whereas that on native forest plantations has increased sharply from 2001/02 to 2007/08. Similarly, research capacity has declined in areas such as pests and diseases and fire behaviour, and increased in areas such as carbon and bio-energy.

Across the four sectors, approximately 50 organisations reported undertaking forestry or forest products research and additional to this, various other organisations provided funding for research (FWPA, ACIAR, RIRDC, etc). Approximately 600 full time effective researchers and technicians were involved in research, and additionally, there were support and management staff. The research organisations ranged in size from individuals to more than 50 staff.

In 2007/08, approximately 52% of the research funds were provided directly or indirectly by the Commonwealth Government, 28% by State Governments, and 20% by private companies.

Total forestry and forest products research expenditure averaged $5.78 per hectare of managed forest. The forestry research according to forest type comprised $14.80 per hectare on exotic species plantations, $36.90 per hectare on native species plantations, and $0.99 per hectare on native forests (including environmental research). Additionally, there was expenditure of about $0.45 per hectare on surveys, and they were mainly carried out in native forests.

Total forestry and forest products research expenditure also equated to an average of $3.90 per cubic metre of harvested timber. In terms of forestry research, this comprised research expenditure of $1.02 per cubic metre of harvested timber from exotic species plantations, $7.38 per cubic metre from native species plantations, and $1.90 per cubic metre from native forests.

➢ *Introduction*

Expenditure on research in commercial forestry and forest products is an investment into the future of the industry. The forestry and forest products industries are scientifically and technically based and research is essential for continuous improvement and innovations in forest management and utilisation. The outcomes and benefits of research depend on the level of investment, the strategies for the research, the structure of the research sector itself and its relationship with the industry it supports. The present report is an analysis of expenditure on forestry and forest products research within Australia in 2007/08. The methods used were basically the same as previous assessments to allow for reasonably direct comparisons to be made.

➢ *Methods*

The two broad areas of interest are research expenditure on commercial forestry and on forest products. The definitions and methods were those used in previous analyses (Quick and Booth 1987, Lambert and Turner 1992, Turner and Lambert 1997, 2005). Some additional specifically identified areas, mainly related to forest bio-energy and carbon, were also included. Forestry research was divided into that on exotic species plantations and native species plantations, native forest and environment which, based on the initial detailed analysis (Quick and Booth 1987), was primarily soils and hydrology research spanning more than one forest management type. Forestry research mainly included research in relation to the management and protection of commercial forests, including environmental and ecological considerations. It did not include research on areas managed specifically for conservation (for example, forest areas in National Parks). Costs of monitoring such as for growth, health, nutrition or biodiversity were not included within research costs, but they were tracked separately where available to ensure there was no overlap with research as in past reviews. Costs of research management were also identified separately where available.

Research on forest products involved that on value adding to timber in its broadest sense, however, it did not include work on final product development (for example, furniture production), production runs in mills, environmental monitoring or quality control assessment.

The primary data include annual expenditure (for 2007/08) on research activities by organisations undertaking research. That is, the focus of this review was on research undertaken as opposed to the provision of funds for research. The information was obtained from direct contact with the organisations and was supported with documentation, such as annual reports, where available. Data were tracked separately from sources where multiple organisations were involved to avoid double counting, this being a potential major source of error. Data were pooled according to sector and individual private organisations were not identified.

The data were compiled within Excel spreadsheets and combined with information from previous surveys. Analyses included changes with time, expenditure according to sector, comparisons of values adjusted for CPI, and expenditure in terms of the forest estate or quantity of timber harvested.

➢ *Forestry Research*

- ***Expenditure***

Estimated expenditure on forestry research in 2007/08 was $60.99 million. This represented an annual increase of about 3.1% since the last assessment in 2001/02 (Table 1). There have been significant changes in expenditure by individual sectors as a result of a number of factors, primarily restructuring within the industry. Expenditure by the University sector has increased markedly and this is partly a result of changes in State Government staff in Victoria relocating to Melbourne University and the actual larger number of Universities reporting on some level of forestry-related research. Some activity in this sector may have been missed in previous surveys.

The first estimate of expenditure on forestry research was provided by the Standing Committee in 1982 followed by assessments at five-year intervals. In unadjusted terms, expenditure on research has increased at an annual rate of about 5.8%, although in the most recent period the annual increase was 3.1%. In adjusted terms (to 1982 dollars) over the 26 years of assessments, there has been a decrease of about 0.38% per annum (Figure 1).

Table 1. *Summary of expenditure ($m) on commercial forestry research in Australia from 1981/82 to 2007/08. The annual change is a simple arithmetic estimate.*

Sector	*1981/82 * ($m)*		*1985/86 * ($m)*		*1989/90 * ($m)*		*1994/95 * ($m)*		*2001/02 * ($m)*		*2007/08 ($m)*
Commonwealth	*10.00*		*12.11*		*14.91*		*19.52*		*22.84*		*19.40*
State Organisations	*11.33*		*14.35*		*17.62*		*20.25*		*21.65*		*19.96 **
Universities	*1.07*		*1.94*		*2.22*		*2.65*		*3.37*		*14.24*
Private	*2.02*		*2.71*		*4.51*		*3.82*		*3.50*		*7.39*
Total	***24.42***		***31.11***		***39.26***		***46.24***		***51.36***		***60.99***
Annual change (%)		*6.9*		*6.6*		*3.6*		*1.6*		*3.1*	

* *Previous data for 1981/82 (Standing Committee estimate); 1985/86 (Quick and Booth 1987); 1989/90 (Lambert and Turner 1992); 1994/95 (Turner and Lambert 1997); 2001/02 (Turner and Lambert 2005).*

** *Lower expenditure by this sector due to the relocation of Centre of Forest Tree Technology (CFTT) staff in Victoria to the University of Melbourne.*

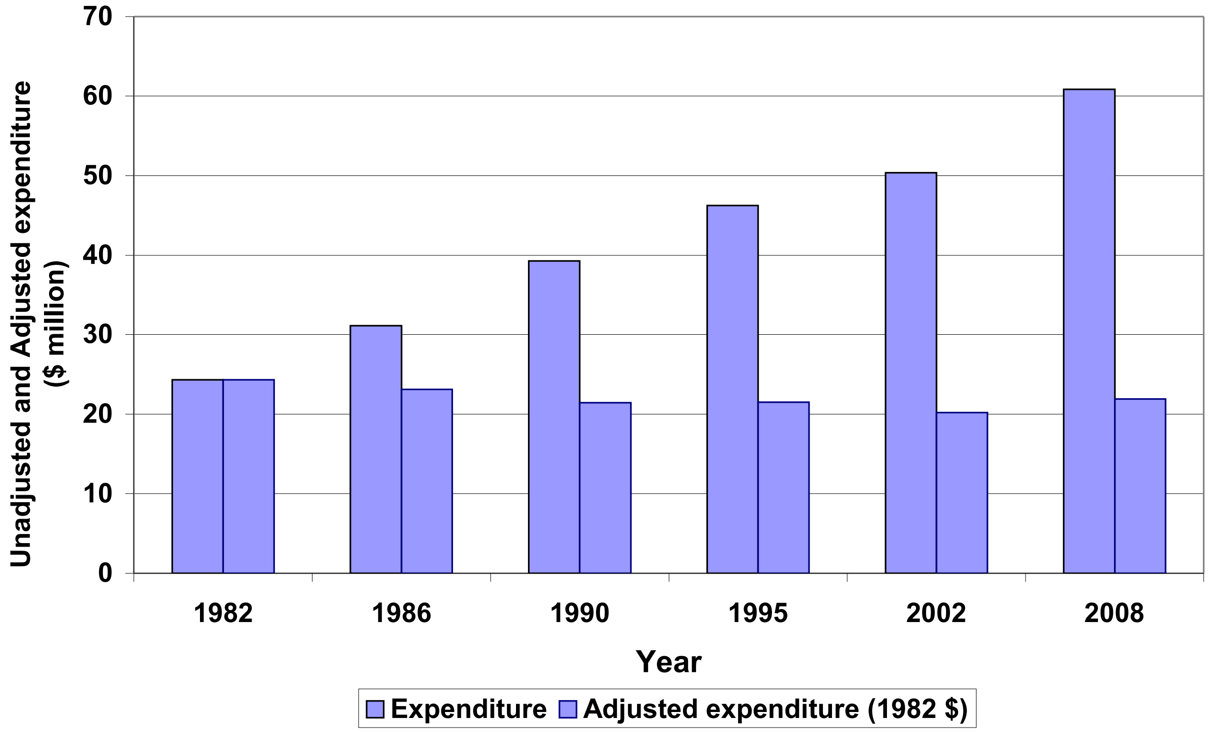


***Figure 1**. Forestry research expenditure from 1981/82 to 2007/08 in both actual dollars and adjusted to 1982 dollars.*

The main sources of funding for forestry research were estimated (Figure 2). The Commonwealth Government provides direct funding for research through CSIRO and Universities. They also provide funding (as grants, matching funds, etc) through a variety of funds and organisations (FWPA, ACIAR, RIRDC, CRCs, etc) and the funds are passed on to research providers through various processes. It was estimated that the Commonwealth provided a total of about $30.02 million for forestry research in 2007/08 and spent about $33.60 million on forestry research through its organisations and Universities.

State Organisations provided funds of about $21.40 million and spent about $19.96 million. One reason for the difference between these two amounts is due to State employees in Victoria, now embedded in Melbourne University and their funding is sourced from the State but spent through the University, that is, there is a significant decrease in State expenditure and a considerable increase in University expenditure. Private companies provided about $10.16 million and spent $7.38 million. Universities appear to be the main recipients of the additional funding derived from funding bodies. Overall, we can account for about $1 million more in funds than in expenditure. Administration costs were estimated at about $8.8 million overall, however, they are difficult to determine and vary in definition between organisations and hence are one source of variation.

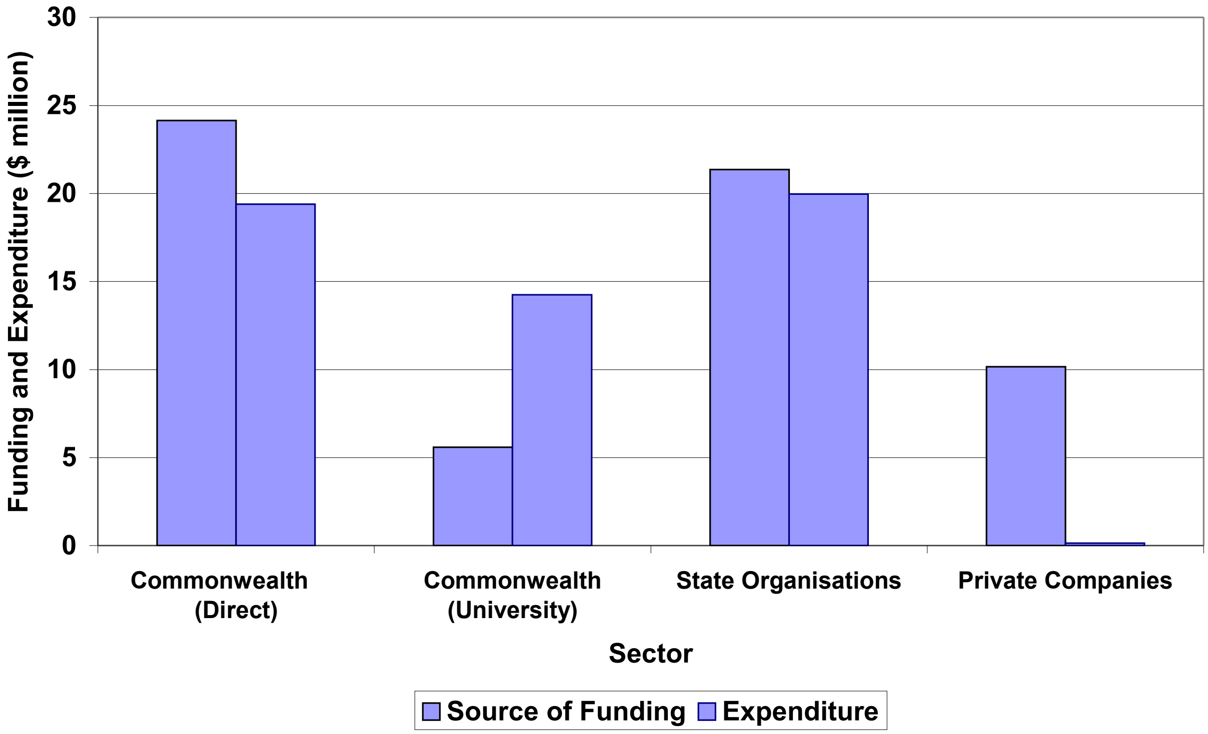


Figure 2. *Funding sources compared with expenditure according to sector for the 2007/08 year.*

- ***Categories***

Forestry research has been tracked in broad categories namely, exotic species plantations, native species plantations, native forest and environment. The environment category was originally identified for tracking research such as soil erosion and hydrology in both native forest and plantations, however, it mainly relates to native forest.

An estimate of surveys which relate to monitoring and surveys such as flora and fauna assessments and some inventory, was also undertaken. The reason for such an estimation was to ensure consistency as some organisations considered surveys to be research because the work was undertaken by the organisation's researchers, while others did not. The surveys have been reported separately to the estimates of forestry research.

The highest expenditure in 2007/08 was in the category of native species plantations (Table 2, Figure 3). This is the category where there has been the greatest expansion in recent times, although it is not reflected in terms of wood harvest or value. There has been a sharp increase in the last decade as a proportion of total expenditure. The expenditure on exotic species plantations and the proportion of this category in the total expenditure has again declined as in the previous assessment (2001/02) and this is also the case for the native forest category.

Table 2. *Broad areas of forestry research expenditure over the study periods from 1981/82 to 2007/08.*

	1981/82 * ($m)	***1985/86 * ($m)***	***1989/90 * ($m)***	***1994/95 * ($m)***	***2001/02 * ($m)***	***2007/08 * ($m)***
Exotic species plantations	*10.47*	*12.97*	*17.56*	*19.05*	*17.69*	*14.85*
Native species plantations	*0.61*	*1.04*	*1.95*	*5.61*	*15.86*	*29.92*
Native forest	*10.19*	*12.44*	*13.95*	*15.87*	*12.59*	*11.24*
Environment	*3.15*	*4.66*	*5.80*	*5.71*	*4.22*	*4.98*
Total research	***24.42***	***31.11***	***39.26***	***46.24***	***50.36***	***60.99***
Surveys	*0.55*	*0.91*	*1.96*	*3.26*	*5.41*	*7.48*

* *Previous data for 1981/82 (Standing Committee estimate); 1985/86 (Quick and Booth 1987); 1989/90 (Lambert and Turner 1992); 1994/95 (Turner and Lambert 1997); 2001/02 (Turner and Lambert 2005).*

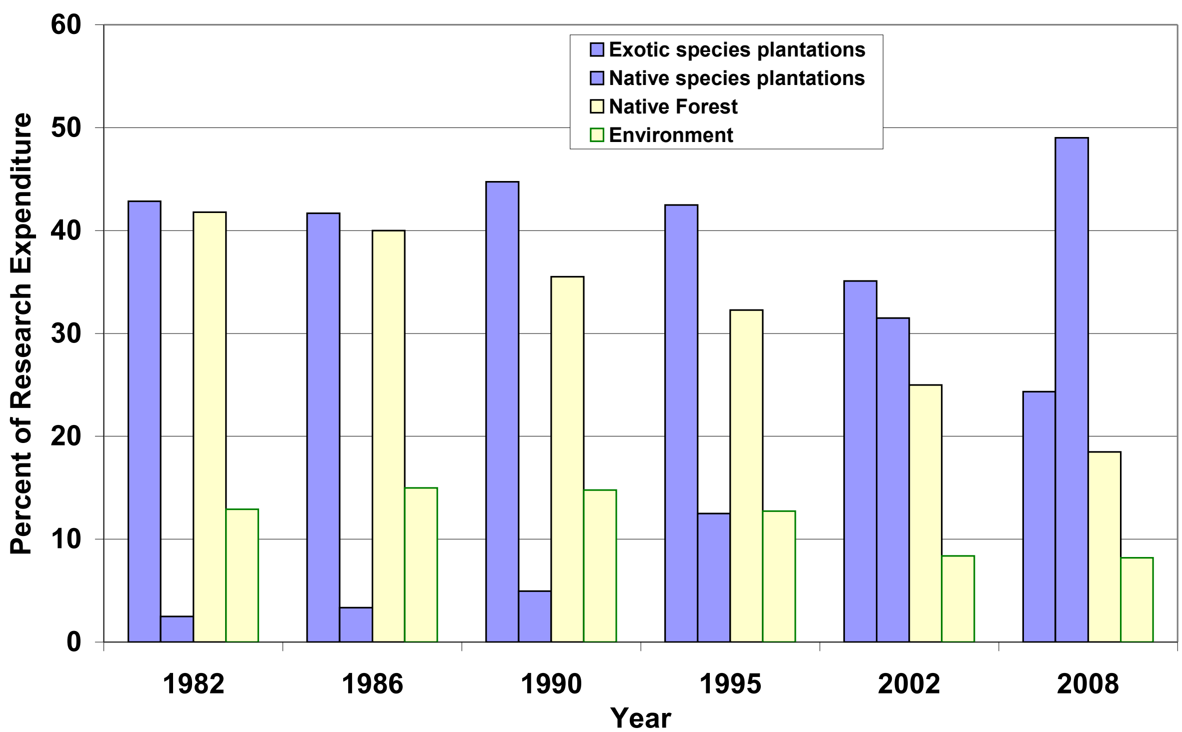


Figure 3. *Percentage of forestry research expenditure in broad research areas from 1981/82 to 2007/08.*

For each broad category, expenditure was calculated in terms of the total area of forests in that category, that is, in dollars per hectare. Areas of plantation were obtained from the Australian Forest Inventory (Parsons *et al.* 2006, National Forest Inventory 2007) and/or from ABARE estimates. In 2007/08, there was the equivalent of $14.8 per hectare spent on research in exotic species plantations and $36.9 per hectare on research in native species plantations (Figure 4). Expenditure on research in exotic species plantations is decreasing in expenditure per hectare, from a peak in actual dollars of $22.2 per hectare in 1994/1995 while research in native species plantations continues to increase. Expenditure on native forest research, including environmental research, is the equivalent of $0.99/ha and this is decreasing with time. The high point was measured as $1.23/ha in 1994/95. Additionally, there was expenditure of about $0.45/ha on surveys.

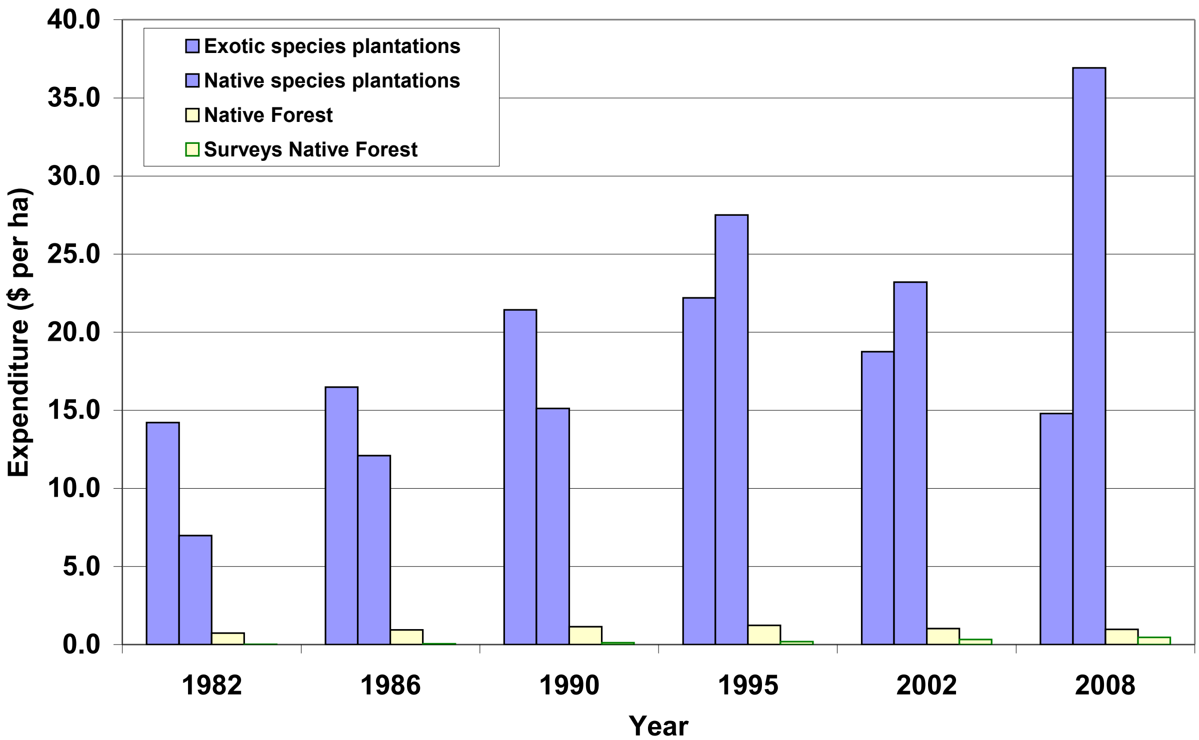


Figure 4. *Forestry research expenditure estimated in dollars per hectare according to category in the study periods from 1981/82 to 2007/08. The surveys appeared to be mainly undertaken in native forests.*

The pattern of research expenditure per unit area was adjusted to 1982 dollars (Figure 5) and the results indicated a long term decline in expenditure on exotic species plantations and native forest and an irregular increase in native species plantations. Expenditure on surveys in native forest also appears to be increasing.

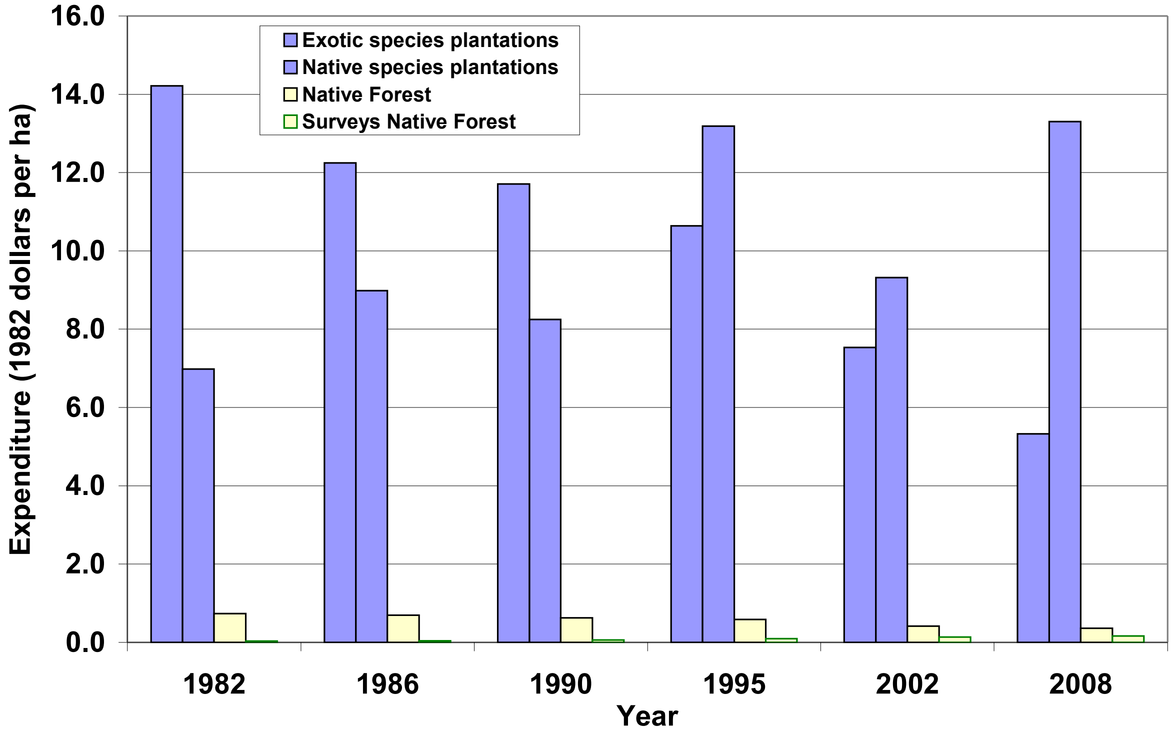


***Figure 5**. Forestry **r**esearch expenditure in 2007/08 according to category adjusted to 1982 dollars.*

Analyses were undertaken in terms of forestry research expenditure per cubic metre of wood (all wood) removed from each of the broad categories. In the early survey periods, wood removed from native species plantations was not differentiated, and while it was a relatively small quantity, it was pooled either with native forest or exotic species plantations. The results in 2007/08 (Figure 6) show (in unadjusted dollars) that about $1.02/m^3$ was spent on research in exotic species plantations, $7.4/m^3$ on native species plantations and $1.90/m^3$ on native forest.

Using the index of research expenditure per cubic metre, expenditure on exotic species plantations has been decreasing over time, basically due to the increasing removals from the plantations (an increase by 3.2 times between 1981/82 and 2007/08). The category of native species plantations has been rapidly decreasing from a high level at a time when timber removals from native species plantations were low. This category is now increasing greatly over time. Expenditure on research in native forest based on wood removals has remained reasonably similar over the period of the reviews.

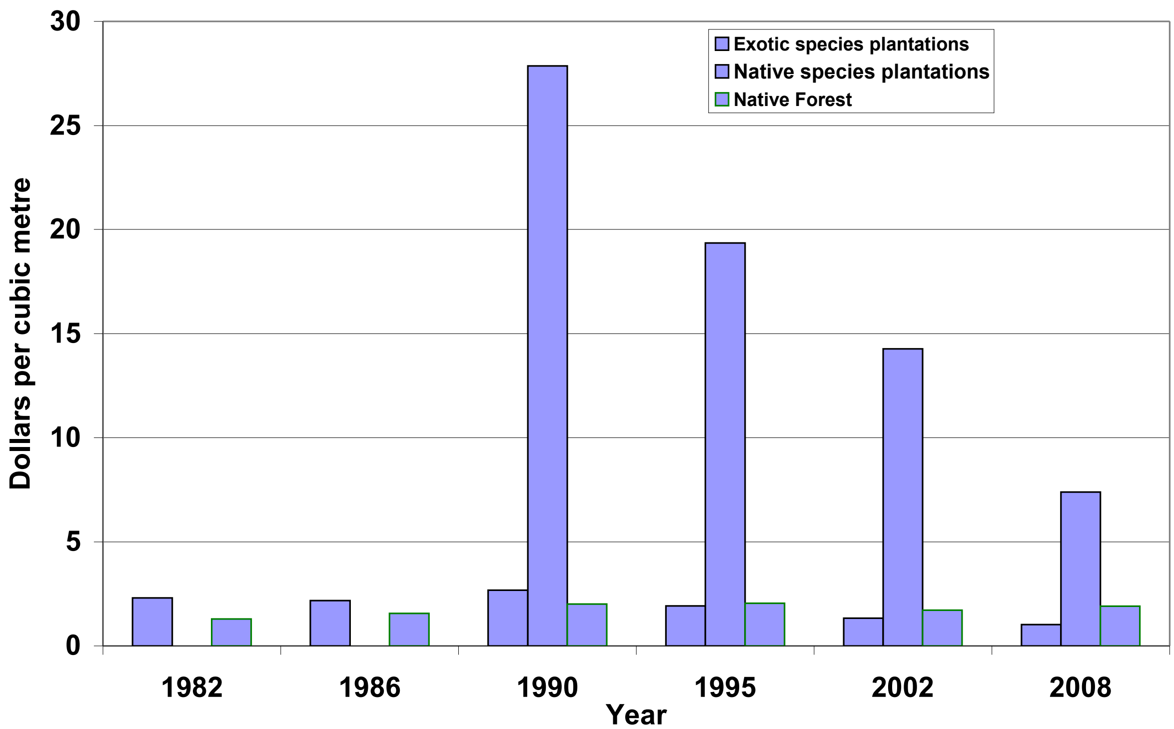


Figure 6. *Actual dollars spent on forestry research per cubic metre of wood harvested for each of the categories over the study period from 1981/82 to 2007/08.*

➢ *Forest Products Research Expenditure*

Assessment of expenditure on forest products research (Table 3) indicated that the total has increased from $19.73 million in 2001/2002 to $26.81 million in 2007/08. The total expenditure in 1981/82 was $14.3 million and the expenditure in 2007/08 was $26.81 million. Expenditure in 2007/08 was $9.66 million when adjusted to 1982 dollars. In the initial period (1981/82), private companies undertook the largest proportion of research (49.7%) followed by Commonwealth agencies (38.2%). However, by 2007/08 the Commonwealth organisations and private companies represented 46% and 24% of expenditure respectively. Estimates of the sources of funding for forest products research indicated that the Commonwealth Government provided (directly and indirectly) about $15.2 million through various agencies and Universities (Figure 7). The expenditure was about $16.2 million. State Governments provided about $2.98 million while expenditure was $4.27 million. Private companies provided $8.92 million and spent $6.37 million.

The estimates of forest products research do not include mill production runs and some other areas and hence, by comparison with other estimates (for example, the Montreal Process Implementation Group for Australia 2008) may appear to be conservative. Part of the increase from other years is the inclusion of research into the use of wood for bio-fuels. The focus of research has also changed with parts of the product work addressing wood properties to support the tree breeding work in forestry.

Table 3. Summary of e*xpenditure on forest products research between 1981/82 and 2007/08. The annual change is a simple arithmetic estimate.*

	1981/82 * ($m)	***1985/86 * ($m)***	***1989/90 * ($m)***	***1994/95 * ($m)***	***2001/02 * ($m)***	***2007/08 * ($m)***
Commonwealth	*5.46*	*5.85*	*6.18*	*9.47*	*9.13*	*12.33*
State Organisations	*1.27*	*1.41*	*1.77*	*2.16*	*1.41*	*4.27*
Universities	*0.46*	*0.56*	*0.63*	*0.59*	*2.37*	*3.83*
Private	*7.11*	*7.39*	*9.11*	*7.85*	*6.82*	*6.37*
Total	***14.30***	***15.21***	***17.69***	***20.07***	***19.73***	***26.80***
Annual change (%)	*1.6*	*4.1*	*2.7*	*-0.7*	*5.98*	
$/tonne harvested	*0.962*	*0.899*	*1.073*	*0.999*	*0.812*	*0.990*
$/hectare	*0.753*	*0.795*	*0.966*	*1.146*	*1.091*	*1.468*

* *Previous data for 1981/82 (Standing Committee estimate); 1985/86 (Quick and Booth 1987); 1989/90 (Lambert and Turner 1992); 1994/95 (Turner and Lambert 1997); 2001/02 (Turner and Lambert 2005).*

In general, expenditure on forest products research in 2007/08 equates to about $0.99 per tonne of harvested timber (Table 3). This figure has varied a little in previous assessments between $0.81 and $1.07 but there is no specific trend. While the actual dollar value on research has increased in each period so has the total quantity of timber harvested. When considered in terms of dollars per managed hectare of forest (the sum of plantations and native forest), the value in 2007/08 was $1.47/ha (Table 3) and this has increased from $0.75/ha in 1981/1982.

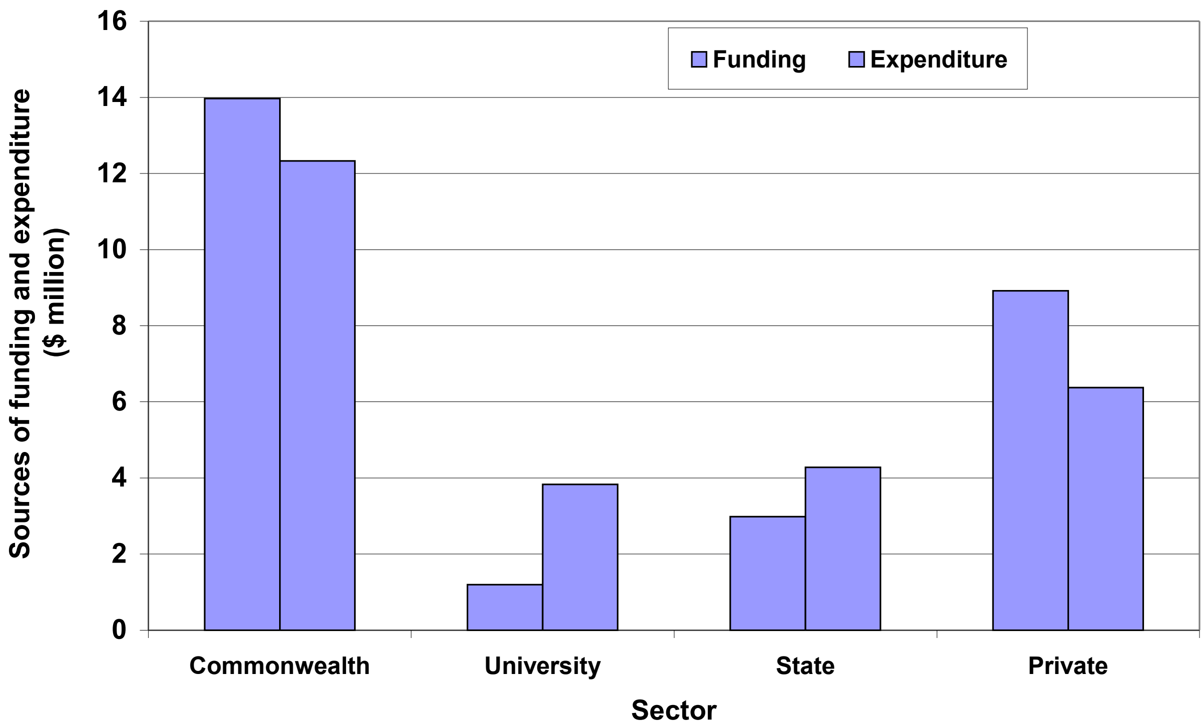


Figure 7. *Sources of funding and expenditure on forest products research in 2007/08.*

➢ *Discussion on Research Expenditure*

The total expenditure in 2007/08 on combined forestry research and forest products research was estimated as $87.80 million and this has steadily increased from the 1981/82 estimate of $38.6 million (Table 4). It was estimated that about $7.48 million was spent on various types of surveys within forests, these being tracked as they are often undertaken by the research section of an organisation. The figure may well be an under-estimate as some of this work is also undertaken in pre-logging assessments and may not have shown up in the research category. There is also an estimate of about $10.47 million spent on research administration and management. This figure does not include the costs of organisations associated with providing research funds. The overall research and technically related expenditure in Australia is about $105.75 million. The actual estimates indicate an increase in each of the assessment periods but when adjusted to a common base of 1982, there has been a general decline from about $44.5 million in 1981/82 to $38.00 million in 2007/08 (Figure 8). Fifty two per cent of research expenditure is provided directly or indirectly by the Commonwealth, 28% by State Governments and 20% by private companies.

Table 4. *Summary of total expenditure (unadjusted $m) in Australia on forestry research plus forest products research by all organisations together with administration/management and surveys in the study period from 1981/82 to 2007/08.*

	1981/82 ($m)	***1985/86 ($m)***	***1989/90 ($m)***	***1994/95 ($m)***	***2001/02 ($m)***	***2007/08 ($m)***
Forestry	*24.42*	*31.11*	*39.26*	*46.24*	*51.36*	*60.99*
Forest products	*14.30*	*15.21*	*17.69*	*20.07*	*19.73*	*26.81*
Total research	***38.72***	***46.32***	***56.95***	***66.31***	***71.09***	***87.80***
Administration / Management	*5.37*	*7.47*	*10.60*	*10.95*	*13.87*	*10.47*
Surveys	*0.55*	*0.91*	*1.96*	*3.26*	*5.41*	*7.48*
Grand Total	***44.64***	***54.70***	***69.51***	***80.52***	***90.37***	***105.75***

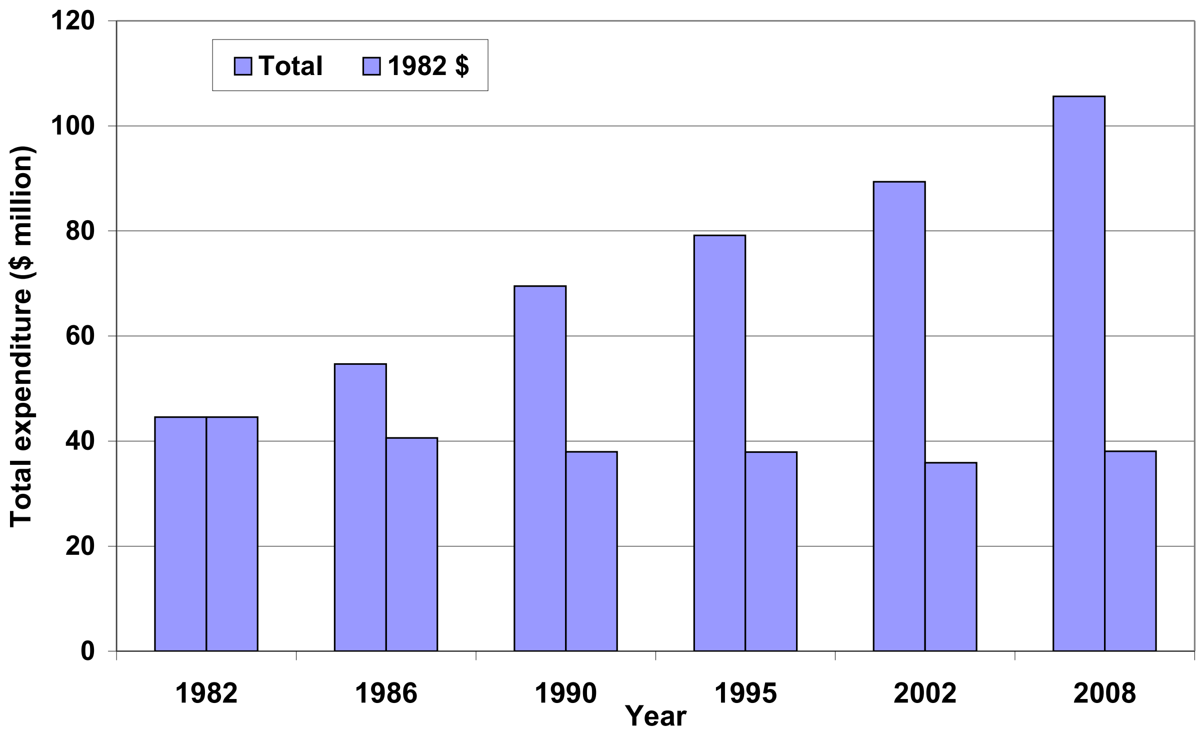


Figure 8. *Total of forestry and forest products research expenditure over the study periods from 1981/82 to 2007/08 in both actual dollars and adjusted dollars (1982 $).*

The total research expenditure has been evaluated in each period from 1981/82 to 2007/08 in terms of actual dollars spent per hectare of forest and per cubic metre of timber harvested (Figure 9). There was a general increase (in actual expenditure) in terms of the area of forests and this reflected an overall increase in expenditure with relatively small changes in the total which relates to monitoring and surveys such as flora and fauna assessments in areas of forests. In 2007/08, there was an estimated total expenditure of $5.78 per hectare. Total research expenditure in relation to timber harvested in 2007/08 was $3.90 per cubic metre. The pattern showed an increase in expenditure over the study periods from 1981/82 to 1989/90 and then a decline and tapering off. The pattern is related to the increasing quantities of timber removed from forests on an annual basis. Total research expenditure (including surveys and administration) represented about 6.2% of the total volume of wood harvested in 2006/07 (ABARE 2007) or 5.3% if research alone was considered. This is a decrease from 6.5% in 2001/02. Research expenditure estimated by the Australian Bureau of Statistics (ABS) and cited in the Montreal Process Implementation Group for Australia (2008) was about $198.9 million which is somewhat higher than the present estimates mainly due to the more specific definitions used in the present report. The ABS estimate represented 11.8% of the value of logs harvested and this would appear to be a high figure.

When expenditure was adjusted to the common base of 1982 dollars, there was a decline in expenditure in terms of category and timber harvested (Figure 10).

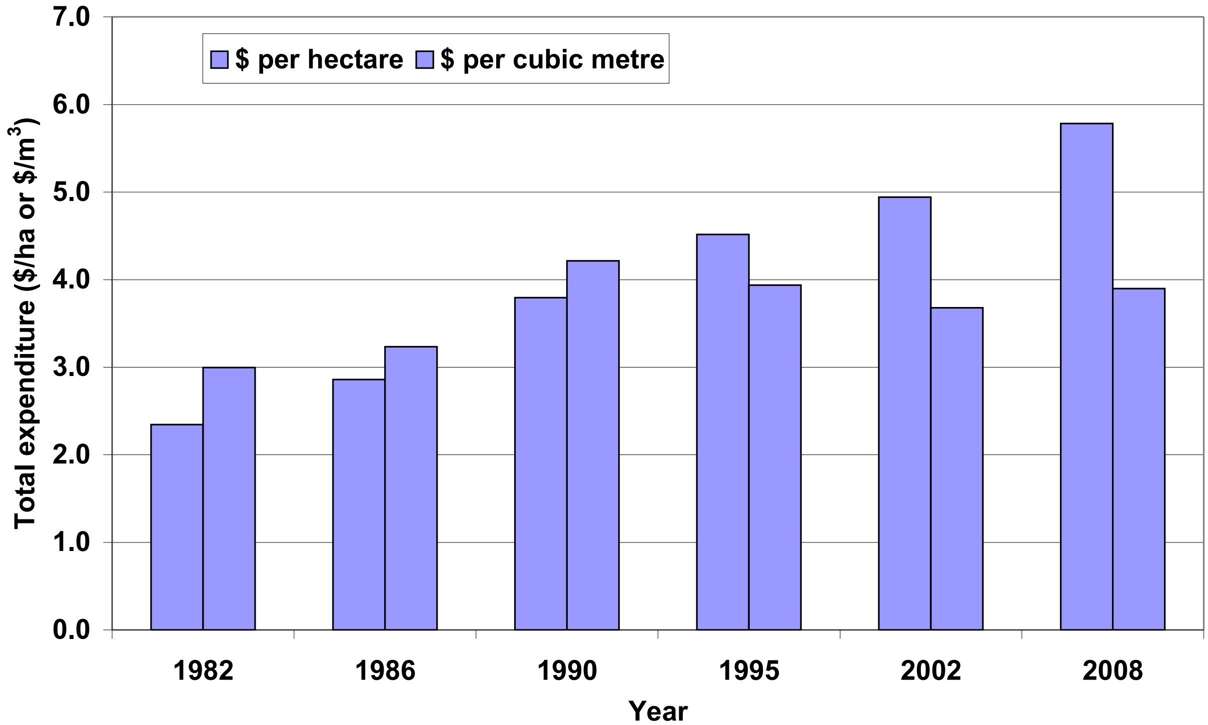


Figure 9. *Total expenditure on forestry research and forest products research over the study periods from 1981/82 to 2007/08, calculated as per hectare of managed forest and per cubic metre of wood harvested.*

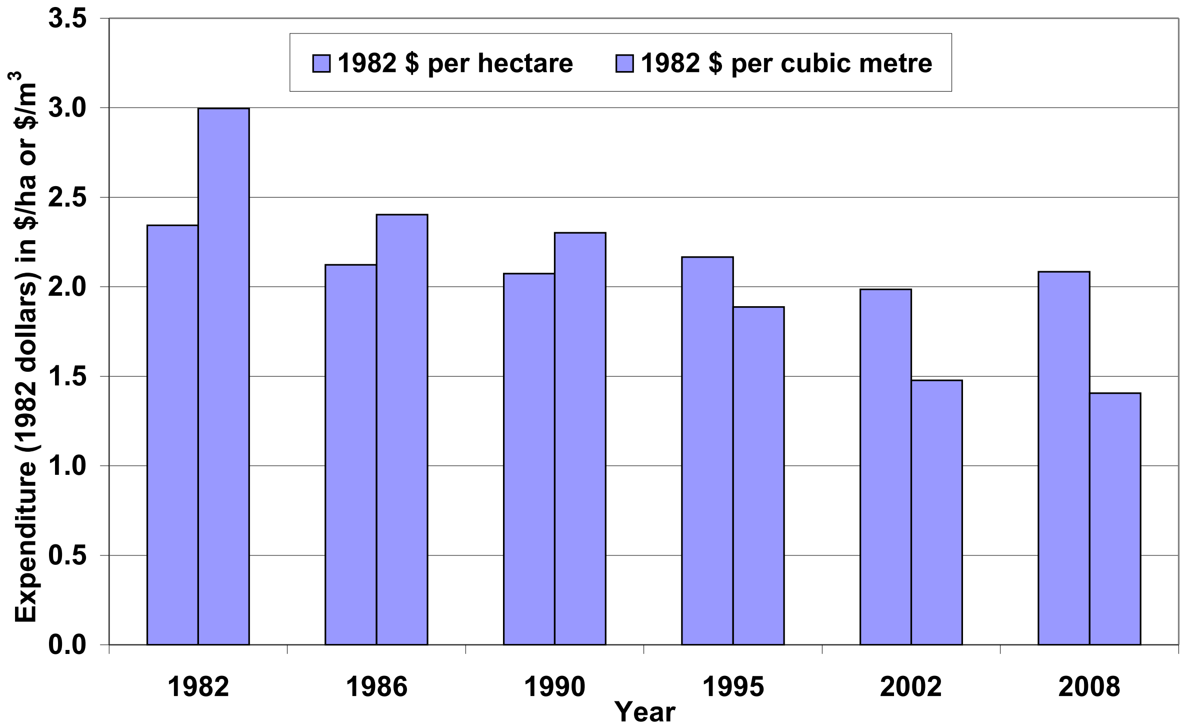


Figure 10. *Total expenditure on forestry research and forest products research in 1982 adjusted dollars for each study period from 1981/82 to 2007/08, calculates as per hectare of managed forest and per cubic metre of wood harvested*.

➢ *Research Capacity*

This analysis of research capacity and functioning is focused on research related to commercial forestry and has been considered in terms of the numbers of researchers, their skills and the overall structure of research. Other than using numbers of researchers and budgets, capacity and structure are difficult to quantify.

The general structure of research at a State level involves either State organisations or CSIRO with a significant concentration of researchers often supported by regional field crews. Most private companies are at a smaller scale and are operating either with one individual, or a very small group or they are associated with other organisations. Many of the Universities undertake research and with key exceptions (Melbourne University and the Cooperative Research Centre for Forestry), the research is largely undertaken through PhD programs which are on an individual basis and of a short term nature. The University research is significant but largely uncoordinated.

Structures and resources are considered here on a State/Territory basis as they basically relate to the forest resources. Private companies have not been identified specifically or discussed.

• *Australian Capital Territory*

Commercially managed forests within the Australian Capital Territory (ACT) are located in relatively small areas of pine (e.g. Kowen Forest) and little research is undertaken by ACT Forests itself.

The former CSIRO Forestry and Forest Products Division which was headquartered at Yarralumla represented a focus for forestry research nationally. Following a series of re-organisations and partnerships, the Division has been re-structured and amalgamated within CSIRO overall. That which was Forest Products, located at Clayton, is now within Materials, Science and Engineering and is discussed elsewhere. Part of the forestry research is undertaken within CSIRO Sustainable Ecosystems and part within CSIRO Plant Industry. Sustainable Ecosystems (about 22 scientists and 30 technical and support staff) is mainly centred in Canberra but has components within Tasmania, South Australia, Queensland and Western Australia. Research is mainly in the areas of hydrology, tree growth, carbon accumulation and physiology. The forestry component in Plant Industry has about 15 scientists with about 22 technical and support staff and a concentration on tree improvement. Some smaller projects are undertaken in specific programs in CSIRO Entomology.

The research undertaken by CSIRO is nationally important as the expenditure on forestry research is one third of the national total for forestry research while forest products research is more than forty percent of the national total for forest products research. One consideration with the current CSIRO re-structure is that it concentrates researchers within themes within CSIRO and basically enhances the expertise base, however, an alternative consideration is that without an obvious focus, forestry research will be lost within the broader objectives of the organisation. The processes for identifying research direction within the re-structured organisation are unclear (at least, from an external viewpoint) but need to be considered in relation to pressures from commercial forestry, other Government organisations (e.g. Greenhouse Office), funding bodies (such as ACIAR) and inputs to policy and regulation. The regional programs are relatively small with groups that interact and cooperate with State organisations and Universities.

Within the ACT, forestry research has been traditionally associated with the Forestry Department of the Australian National University in which there have been a number of researchers and related PhD programs in both forestry and forest products. The Department has been integrated within a larger School which appears to have a low focus on commercial forestry. Research is being undertaken on a number of projects, mainly by PhD students, but in relation to Australian production forestry in Australia, there does not appear to be the previous level of interaction with CSIRO and other organisations.

- ***New South Wales***

In New South Wales, there are very large and diverse forest resources with a range of coastal. tableland and inland native forests, State-owned and private exotic species plantations and native species plantations, and some specialty plantations which are developing.

The State, previously through the Forestry Commission of NSW and then State Forests of NSW, maintained a research organisation, investigating most of the research areas in both forestry and forest products. Through several restructurings, the research capacity in forest products has been largely reduced, and the forest resources are now managed as a commercial structure (NSW DPI Forests NSW) within the Department of Primary Industry (DPI). Forestry research is divided into that directly related to commercial forestry (Forests NSW) and that less directly related to commercial forestry and integrated into the research section of DPI (DPI Science and Research). The NSW DPI Forest Science Centre is maintained through a service level agreement between Forests NSW and DPI Science and Research , with funding from Forests NSW, Industry and the State Government CSO (Community Service Obligation). The research capacity of Forests NSW is geographically diverse and 10 researchers plus approximately 18 technical and support staff are located in Sydney, Bathurst, Tumut and Coffs Harbour. The Coffs Harbour Group is the largest with about 7 professionals and a focus on development of native species plantations (including improvement) but on its own, its long term viability could be questioned.

The head office of NSW DPI is located in Orange. but forestry research staff are located in West Pennant Hills, and on the South Coast (the total is approximately 36 staff). The research and technical work includes forest health, biodiversity, growth and aspects of carbon accounting. There are interactions with researchers in Forests NSW and with other sections in NSW DPI, CSIRO, CRCs, Industry, Universities but the structure and function in relation to commercial forestry research require further analysis.

No CSIRO researchers working on forestry or forest products are located within NSW; although some research on NSW forests has been undertaken (an example is the Bago State Forests project).

In a number of Universities in NSW, research in forestry-related areas is undertaken mostly by graduate students. They include Southern Cross University both in the Forestry School (part of Coastal Management) and the Centre for Plant Conservation Genetics, the University of New England (mainly related to biodiversity), the University of NSW (hydrology and timber engineering), the University of Technology Sydney (Timber Engineering), Wollongong University (fire and biodiversity), Charles Sturt University (forest water use), Sydney University (bushfire research through the Bushfire CRC) and Macquarie University (biodiversity). Contacts and interactions appear to be mainly on a personal basis and much of the work is undertaken by individuals, or if related to forest products, through industry related groups. From an industry viewpoint, there appears to be limited coordination

Research by private forestry companies is reasonably low key but is both developing and diverse. Research by private companies in the area of forest products is in specific locations and includes research on energy, timber conservation, paper and timber preservation.

- ***Queensland***

Commercial forestry in Queensland includes some native forests, a mature coniferous plantation estate including some high value species, and developing hardwood plantations. There is increasing interest in high value tropical species such as *Tectona* and *Khaya*.

The main research resource in Queensland is through the Horticulture and Forestry Science Unit within the Department of Primary Industries and Fisheries, which became part of the new Department of Employment, Economic Development and Innovation in March 2009. This organisation undertakes both forestry research (Forest Technologies Group - FT) and forest products research (Innovative Forest Products Group – IFP). FT has about 17 scientists and 11 technical staff, and a large proportion are currently located as one group at Gympie. The expertise covers tree improvement, silviculture and environmental studies. A small part of this group (forest health) is located at Indooroopilly and another small component is in Mareeba in North Queensland, working on tropical plantation forestry. The IFP Group of 10 scientists and 10 technical staff are mainly located in Indooroopilly working largely on timber product and process development, and on wood properties, in part supporting the tree improvement programs. A smaller number of the staff are at Salisbury at the large timber processing research facility.

The research organisation was split from the original forest plantation management area (which became Forestry Plantations Queensland, FPQ) and was reduced in numbers. Over the last five years, there has been a build-up of direct State funding for forestry and forest products research, and current staff numbers should remain stable. Increases would be with support from additional external funding. Key points are:

- The State research organisation does little direct work for the State forest management agency (FPQ). For example, most work is on hardwoods, with only limited wood quality work on pine for FPQ. They are funded directly by the Government or by external funds, with only a small amount by contract from the forest management agency).
- The main aim is well identified and is to maintain significant effort (critical mass) in key areas to support the developing hardwood plantation industry. In the future, some State employees will be working within the University of the Sunshine Coast to increase the critical mass in tree improvement, propagation and plantation modelling.
- Other research is undertaken by a small group from CSIRO at Cooroy and a small private industry group.

A significant amount of research is undertaken by the University of Queensland in several Departments (this covers a range of topics mainly related to native or exotic hardwoods). Other projects are currently undertaken (mainly by PhD students) at Griffith University, James Cook University and the University of the Sunshine Coast.

The overall structure of forest research involves a large central group interacting with several smaller groups and covering the main areas of hardwood tree improvement, silviculture, soils, health and agroforestry. This represents the main research effort in Australia on sub-tropical and tropical forestry.

- ***South Australia***

All of the forest estate in South Australia is plantation, of which 75% is coniferous, together with a well-established processing industry.

Most of the forestry research in South Australia is undertaken by Forestry South Australia (trading name Forestry SA) with a total research staff of approximately 24 (FTEs). This comprises 7 professional researchers and 17 technical and field staff. The staff are located at Mt Gambier with the exception of some located in the Adelaide Hills and the focus is on coniferous plantation research as well as some *E. globulus* and native forest research. The skills base is in the areas of silviculture, water use, growth and model development, health, and some wood properties work. This is probably where there is the main concentration of research on coniferous plantations in Australia at this time but the group is considered to be near the minimum size for longer term viability. Primary Industry Research South Australia (PIRSA), which was originally part of ForestrySA has primary responsibility for CSO works but has some capability for research, although most is contracted to ForestrySA.

Forestry SA cooperates with other organisations in the region including the Southern Tree Breeding Association with five research staff and a focus on tree improvement. The CSIRO presence has declined in the last few years with a small group working through CSIRO Sustainable Ecosystems on water use and growth (as of March 2009, they no longer exist). There are a number of private companies with small groups mainly working in the areas of tree improvement and silviculture. University-based research in this area appears to be minimal. Southern Cross University has a teaching program in the area but there does not appear to be a significant related research program.

The research program of Forestry SA is well structured and focused and closely aligned with industry requirements and is a major focal point on research into coniferous and *E. globulus* plantations and some native forestry research.

- ***Victoria***

Forest resources in Victoria include an extensive and variable native forest estate and extensive privately owned coniferous and hardwood plantations.

The research structure is probably the most diverse in Australia. When plantations were owned by the State Government, there was a large native forest industry and there was also a very strong research structure in the State (the Centre for Forest Tree Technology - CFTT). After the sale of the plantations, CFTT remained as a separate research organisation. Other research was also undertaken through the Arthur Rylah Institute. Approximately four years ago in conjunction with re-structuring, the CFTT became functionally part of the University of Melbourne. The main impetus for this was to broaden the expertise base and address critical mass issues and gain improved interaction with postgraduate students.

The State organisation managing native forests and also some private companies then contracted to the University for CFTT expertise and that of some other University Staff members. Structurally, the research does not appear to be a single entity working under direction but is a series of small groups working on shorter term applied research. In conjunction with this, research is also undertaken by graduate students. It may be described as a loosely structured organisation with about 49 scientists and 8-10 technical staff plus graduate students in 2007/08. Funding is obtained from diverse sources and this affects the directions of research. The expertise covers a wide range of areas including native forest ecology and management, plantation health and management, hydrology and forest products, however, the forest products research capacity has reduced somewhat since the CRC for Wood Innovations ended in June 2008. There are strong linkages, either in research cooperation or on a contractual basis, to other research organisations including CRCs, CSIRO and private companies. Some of the areas of expertise previously in CFTT have been reduced because staff retired or left the organisation.

While the current structure was established initially as one of convenience, it has potential value as one model for forestry research but there are some areas for concern. It would be of value to review the structure and function as a model for undertaking research in a number of areas and also for addressing critical mass. The forest catchment hydrology unit related to plantations is probably the strongest remaining since the end of the CRC on Catchment Hydrology.

Research is also being undertaken by CSIRO on forest products at Clayton and this remains the largest group in this field in Australia. Across various areas, there are approximately 26 scientists and 28 support staff. The research programs support industry areas and also work undertaken in the forestry programs of CSIRO Plant Industry and CSIRO Sustainable Ecosystems.

Private company research within Victoria is mainly undertaken by small groups or individuals. Research is also undertaken in forestry areas and forest products in Universities (in addition to the University of Melbourne) at Monash University and Swinburne Institute of Technology. This research is mainly through PhD students on individual projects.

Victoria has a significant resource undertaking research in forestry and forest products. The actual structure and function of this resource probably needs further analysis to better identify their directions and longer term viability.

- ***Western Australia***

The forest resources in Western Australia include moist and dry native forests, softwood plantations, extensive hardwood plantations and developing specialty plantations such as sandalwood.

State Government Research is undertaken by the Forests Products Commission (FPC) primarily on plantation forestry and products, and the Department of Environment and Conservation (DEC) into native forests and the environment. There are some areas of interaction and cross-over. FPC concentrates on plantation forestry with an overall staff of 20. They are located in diverse locations covering three broad areas (Research and Development, Tree Breeding, and Resources and Planning). The DEC is involved with native forest management and has an overall research staff of 24 plus some additional staff assisting with inventory.

CSIRO has a (small) presence in WA, mainly working on plantations and undertaking some cooperative research with FPC and universities. There are individual researchers within private companies and this has primarily been in relation to tree improvement, clonal forestry, operational research on existing plantations or developing areas. The research structures are quite diverse with limited interaction.

It was proposed previously that a State Government sponsored Forest Science Centre be established as a focus for forest research. This proposal was supported by forestry and forest research organisations as a way to focus efforts in key areas and develop a “critical mass” of research into commercial forestry. It is understood one proposal would have included State forestry and possibly some agriculture, CSIRO staff, several universities (Edith Cowan, Murdoch, Curtin and UWA) and possibly include some private company research with others supported by external funding. The proposal has not progressed at this time but must be seen as a valuable way to get the best value and outcomes from the resources available.

- ***Tasmania***

Tasmania has significant commercial native forest resources plus hardwood plantations and jointly owned (State-private) pine plantations.

Research is undertaken through the State organisation, CSIRO and the University of Tasmania and the CRC for Forestry has its headquarters in the State. Forestry Tasmania has a research group focusing on native forest and hardwood plantations. The group consists of 15 scientists with 13 technicians, two of whom are in field areas distant from Hobart. The group interacts with CSIRO and the University (4 of the scientists are from the University but are located at the State facility). The main areas of research are in nutrition, silviculture, hydrology and genetics. Work is undertaken in forest health and services are contracted to private companies. The programs are focused but the group is probably the minimum size to maintain viability in all key areas (that is, if staff are lost, so is an area of research or a function). Some research work is undertaken by the Forest Practices Board as part of its functions.

CSIRO has a small group within Tasmania, part of it falling within the Sustainable Ecosystems Division and cooperating with other groups in the area.

Significant research into forestry and forest products is undertaken at the University of Tasmania. The location of the CRC there and its inter-State interactions make numbers difficult to determine but it is estimated as more than 15 FTE in forestry plus a further 6 staff in forest products plus graduate students. The presence of the CRC provides greater direction, integration and interaction of graduate students than at many other universities.

Research is also undertaken by private companies other than the contributions to the CRC for Forestry and FWPA.

Overall, Forestry Tasmania has a focused research program covering issues in native forests and hardwood plantations undertaken in cooperation with CSIRO and the University of Tasmania.

- ***Discussion***

Overall, Australia invested about $100 million in forestry and forest products research in 2007/08. This research was undertaken by about 50 organisations or companies with an additional number of organisations providing funding. There were, more or less, 600 researchers and technicians involved in research in these organisations together with additional support staff and external contractors. The general impression is of substantial overall investment in forestry and forest products research but a significant proportion of the resources is fragmented with a consequent impact on output. While there are some structures (such as RPCC) which provide some coordination overall, each organisation determines its own research objectives, directions and levels of resources.

In terms of estimated effective full time research staff (excluding support staff), the numbers in 2007/08 in State, Commonwealth, University and Private organisations were approximately 247, 183, 182 and 129 researchers (scientists plus technicians) respectively. The numbers of staff in Universities were the most difficult category to estimate as there are mixtures of full and part term research staff and post graduate students at various stages in their programs.

- Research organisations and structures are a result of historical developments overlain with more recent re-structurings and changes. Considering a reference point of more than twenty years ago, forestry research was mainly undertaken by State organisations which had either forest research divisions and/ or significant forest products research capacity and by Divisions of CSIRO in both forestry and forest products. At that time, most forest resources were State-owned and much of the plantation expansion was Commonwealth-funded. With notable exceptions, there were only small research undertakings by private companies. The main Universities consistently undertaking research were Melbourne University and the Australian National University (ANU), and most Australian students were sourced from and partially supported by Government agencies and hence research was usually directed to the objectives of those agencies. There was significant coordination of research through the Research Working Groups (RWGs) and the Directors of the Research Committee to the then Standing Committee on Forestry. The main considerations of the RWGs were to identify and advise on deficiencies in research and possible consequences.

- In the intervening period, there have been significant changes in the structure of the forestry industry and they include the sale of State plantation resources and significant changes in accessibility to native forest resources. Many organisations, including their research divisions, have been re-structured and reduced in size and function, and direct linkages to industry have been modified. The number of Universities reporting some research involvement has increased greatly, but with some exceptions, research is not coordinated well from an industry perspective. [Possibly, the competitive funding requirements make cooperation difficult in some instances). The number of private companies (such as MIS companies) has increased significantly in plantation forestry and there has been a major shift in the species being planted and the locations of the planting efforts. Their cumulative research efforts have increased (directly or through CRC's). However, efforts in some areas appear to be fragmented and repetitive.

- A perception may be that the directions and strategies for the forest industry and related research may appear less clear than 20 years ago and it would appear that greater efforts are invested in non-production aspects of forestry research (for example, biodiversity, etc). The Research Priorities and Coordinating Committee (RPCC) is a coordinating and advisory body primarily representing Government Departments and has developed a research strategy (subsequently used as a framework for the FWPA strategy) where the focus is largely on policy and regulation rather than on commercial forestry (RPCC 2008).
- CSIRO is the most significant component of the forest research industry (both forestry and forest products) but it is no longer within a single Division in the CSIRO structure. This may allow resources and expertise to be derived from various sections of CSIRO to focus on forestry issues, however, there is also the risk of losing a forestry focus.

The analysis of expenditure on forestry and forest products research in 2007/08 indicates there is an increase over time since 1981, however, when this is considered in terms of a common base (A$ 1981) there has been a general decline. Recognising there are some variations in interpretation, approx. $100 million was spent on research-related areas in 2007/08 and approximately $85 million of this was directly spent on research. That is, about $5.58 was spent on every commercially managed hectare of forest or the equivalent of $3.90 for every cubic metre of wood removed from forests or about 6.0% of the value of logs harvested. There are no benchmarks to determine whether these estimates are high or low, but on face value there would appear to be a significant investment in research.

Funding for research is provided from various sources that have a number of different objectives and is expended by about 50 different organisations with differing sizes and structures, with in the order of a total of 600 researchers. How strategies and objectives are determined by each of these organisations has not been addressed nor has there been any attempt to consider how effective the expenditure has been in terms of research outcomes.

Estimates of the number of researchers indicate a steady decline since about 1990 in the Commonwealth and State Sectors, and increases occurring in the University and private Sectors. The increases in more recent times tend to be due to more organisations reporting research rather than an expansion of any particular research group. The expertise of each researcher has not been recorded, however, with regard to a decline, discussions with organisations indicate that some areas of research have been affected more than others (these areas are for example, forest health, forest silviculture, and hydrology). The reduction in research capacity is a concern but more so when capacity in some key areas is greatly diminished and risk is increased.

In an earlier analysis of forestry research in the United States, Giese (1988) reported a number of trends, such as the supply of new scientists for forestry research in the US declining for over 10 years (prior to 1987) as had general support for forestry research in financial terms. The decline was occurring despite an increasing long term need to understand ecosystem processes and economics associated with the use of forests. At that time, Giese concluded that the scientific community which traditionally had been available to deal with the issues as they arose, was being slowly but steadily dismantled. In the US Forest Service, the annual research budget (unadjusted for inflation) declined between 1977 and 1986 from US$ 129 million to US$ 100 million, and from 949 to 747 scientist-year equivalents. A comparable decline in federally funded expenditure for university forestry research occurred over the same period. In addition to actual resources, Giese (1988) identified the consequences of a deteriorating system of forestry research as:

- Loss of synergy that results from teams of diverse scientists working to solve large-scale and long-term problems.
- Knowledge gained through negative results or experiments, which is usually not published, and hence lost through cut-backs or retirements. The natural consequence is that in the future, experiments will be re-done.
- Forgoing of long-range benchmark projects, such as hydrological projects and the Hubbard Brook type ecosystem-level study, by providing funding for more fashionable research.
- Incapacity to address difficult emerging problems.
- Inability to identify and understand the cumulative long-term effects of the increasing demands for multiple use of forests.
- Lack of understanding of effects as part of a global economy and ecology.
- Inability of alternative disciplines (for example, agriculture) to answer specific forestry questions.

These issues are relevant to the declines being monitored currently in Australia.

Sutton (1986) addressed the issues of research structures and the stimuli for undertaking research by individual researchers in the three broad categories, namely basic, applied and developmental. Characteristics of basic research in forestry include longer term projects which are more widely applicable, and have higher risk and higher investment, but when successful, have the largest, longer term benefits. Also, such work is the most challenging and attractive to researchers. Alternatively, developmental research is generally shorter term, has low risk, is immediate, locally relevant, specific research and often is modifying or implementing previous research. Basic research is mainly focused in larger, structured, multidisciplinary organisations (related to facilities) whereas developmental is in smaller units with less available resources. Applied research falls somewhere between these descriptions. Larger organisations more probably have a balance of the various types of research. The changes in more recent times have led to a decline in the number of large facilities undertaking basic research. Much research is now undertaken in groups which can be described as at a minimum viable size. Any further decline means a loss in function or activity. This has been recognised by a number of organisations. In the case of the situation in Western Australia (WA), there have been proposals to develop a 'Forest Science Centre' which uses resources of multiple organisations under a common directorship, to accrue resources and expertise. It may be argued that the CRC structure had this approach as an objective but it appears there has been variable success while common direction has not always been successful.

Looking back across Australia, say for 10 years, there tended to be a balance of research with Commonwealth funding for CSIRO allowing basic research to be undertaken by CSIRO and in the larger facilities at the State level. Much of the research at the State level may have been considered to be applied research with some developmental research and as a broad generalisation. Private companies undertake some applied research but their research is largely developmental. Universities undertake applied research and this is mainly through PhD students. Decreases in the number of organisations and in resources and requirements for additional external funding generally require results in shorter time frames and with lower risks. Hence, basic research is reduced and there is greater emphasis on applied and developmental research, particularly using accumulated knowledge and information.

Essentially, forestry is a technically based industry which requires continual scientific inputs for development. It is long term by nature and much research requires results from a minimum period in order to be confident of the results, this period representing a significant proportion of the rotation length (e.g. one third to half a rotation length). That is, the length of many research programs will need to be for five to ten years as a minimum.

Forestry research needs to support the strategy and direction of the forestry industry. In the absence of a clear strategy, one approach is to ask the basic question of where would industry see itself (under optimum conditions) at some time in the future (say 10 or 20 years). Some outcomes will have no research applicability but it is direction that is required. If the answer can be provided now or in a short space of time. research is not required. Research of its nature has to look to the future. Analysis from a commercial forestry basis, rather than from a forest policy or regulatory viewpoint could include:

- A system of plantation development which has final production (per unit area) as a driver rather than the area planted. This would intensify productivity per unit area
- Forest industries, on a regional basis will be fossil-fuel user-neutral or there would be an excess of bio-energy. Forestry would consider solid and liquid bio-energy sources on a regional basis so that the industry fossil-fuel energy usage will be equal to or less than that from bio-energy (preferably from forestry sources).
- Key development in drier areas (including carbon) and systems to trade off water usage.
- Multiple species use (lower demands).
- Key sustainable indicators.
- Development of the use of summer low-flammability species (e.g. poplars) to increase protection.
- Development and application of forest type specific silviculture.
- Strong technical support for forest products certification.

Consideration has been given to the aim for a critical mass to enable a balance of basic, applied and developmental work to be undertaken together with the numbers and fragmented nature of the University system and private companies. One suggestion is to propose a national series of Forest Science Centres with a Scientist as Director and the staffing to include members of different organisations but located in central locations. The Centres would be coordinated and undertake a range of activities and each would focus on different specific areas, depending on location and the resource base. In many cases, this could involve the use of existing State facilities with additions of staff from CSIRO, private companies and Universities. One example is a focus on forestry in an extreme Mediterranean climate and including water use and selection of drier species for Western Australia, and another in South Australia where there could be a focus on radiata pine growth, water use and modelling. One objective would be to concentrate private company inputs and reduce overlaps. While such an approach would not match the directions in the present structure of CSIRO, the overall impact would provide more long term support for commercial forestry in Australia.

➢ *References*

ABARE (2007). Australian Forest and Wood Products Statistics. March/June Quarter 2007. ABARE, Canberra.

Cooperative Research Centre for Forestry (2008). Highlights and Achievements, Hobart, Tasmania.

Forest and Wood Products Australia (2008). Annual Report.

Forests NSW (2008). Social, Environmental and Economic (Seeing) Report 2007-08. NSW Department of Primary Industries.

Giese, R.L. (1988). Forestry research: an imperiled system. *Journal of Forestry* 86: 15-22.

Lambert, M.J. and Turner, J. (1992). Forest research expenditure in Australia. *In*: IUFRO Subject Groups S6.06 and S6.08 Conference Proceedings on “Forest research initiatives for the 1990’s”. (Eds. J. A. Kininmonth and G. L. Tarlton). pp. 66-74. Forest Research Institute, Rotorua, New Zealand. 7-11 October, 1991. 296 pp.

Montreal Process Implementation Group for Australia (2008). Australia’s State of the Forests Report. Bureau of Rural Sciences, Canberra. 250 pp.

National Forest Inventory (2007). National Plantation Inventory 2007 Update. Bureau of Rural Sciences, Canberra.

Parsons, M., Gavran, M. and Davidson, J. (2006). Australia’s Plantations 2006. Department of Agriculture, Fisheries and Forestry. Bureau of Rural Sciences, Canberra. 56 pp

Quick, J. and Booth, H. (1987). Personnel and funding applied to forestry and forest products research in 1985/86. Prepared for the Research Committee of the Standing Committee for the Forestry Council.

Research Priorities and Coordination Committee (2008). Forest Research Directions 2008-2011 (Forestry and Forest Products Committee).

Sutton, W.R.J. (1986). Management of applied research – one scientist’s perspective. *N.Z. Forestry* August 15-18.

Turner, J. and Lambert, M.J. (1997). Expenditure on forestry and forest products research in Australia. *Australian Forestry* 68: 202-210.

Turner, J. and Lambert, M.J. (2005). Expenditure on forestry and forest products research in Australia 1981-1982 to 2001-2002. *Australian Forestry* 60:1-6.

- ***Acknowledgements***

Forest and Wood Products Australia are gratefully acknowledged for their interest in and financial support for this project. The authors are grateful to the organisations listed below for both the provision of information and their generosity in providing their time for discussions of the issues.

- ABARE
- A.C.T. Forests
- Australian Greenhouse Office
- Australian National University
- Australian Plywood Association
- Boral
- Carter Holt Harvey
- CRC for Bushfire Research
- CRC for Functional Communication Surfaces
- CRC for Forestry
- CRC for Wood Innovations
- CSIRO, Entomology
- CSIRO, Material Sciences & Engineering
- CSIRO, Plant Industry
- CSIRO, Sustainable Ecosystems
- Department of Environment and Conservation WA
- Forest and Wood Products Association (FWPA)
- Forest Enterprises Australia
- ForestrySA
- Forestry Tasmania
- Great Southern Plantations
- Gunns Plantations Ltd
- Hancocks Victorian Plantations
- Hyne and Sons
- Integrated tree Cropping

- James Cook University
- Laminex
- Midway Forests Ltd
- Monash University
- Murdoch University
- Norske Skog
- Northern Territory Department of Natural Resources
- Northern Tropical Timbers
- NSW Department Primary Industry and Forests NSW
- Primary Industry Research South Australia (PIRSA)
- Queensland Department of Primary Industries & Fisheries (now Primary Industries and Fisheries within the Department of Employment, Economic Development and Innovation)
- Rural Industries Research & Development Corporation (RIRDC)
- Southern Cross University (forestry program)
- Southern Tree Breeding Association
- Sydney University
- Tasmanian Forest Practices Board
- Timbercorp
- University of Melbourne
- University of New England
- University of NSW
- University of Queensland
- University of South Australia
- University of Tasmania
- University of Technology, Sydney
- University of Western Australia
- Victorian Department of Natural Resources & Environment
- Visy
- Western Australia Forest Products Commission

- Willmott Forests Pty Limited
- Wollongong University

National primary industries research, development and extension (RD&E) framework

RD&E strategy for the forest and wood products sector

National primary industries research, development and extension framework

RD&E strategy for the forest and wood products sector

This document has been compiled on the basis of extensive stakeholder consultation with representatives of the forest and wood products sector, government, and the providers and funders of forest and wood product RD&E.

February 2010

ISBN 978-1-920883-95-9

Further inquiries

Ric Sinclair
Forest & Wood Products Australia
Level 4, 10–16 Queen Street
Melbourne VIC 3000
AUSTRALIA
Ph (03) 9927 3200
Fax (03) 9927 3288

CONTENTS

Figures

Tables

Box

ACRONYMS

ABARE	Australian Bureau of Agricultural and Resource Economics
AFCS	Australian Forest Certification Scheme
ANU	Australian National University
BRS	Bureau of Rural Sciences
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFF	Department of Agriculture, Fisheries and Forestry
DCC	Department of Climate Change
DEC	Department of Environment and Conservation (Western Australia)
DECCW	Department of Environment, Climate Change and Water (New South Wales)
DEEDI	Department of Employment, Economic Development and Innovation (Agri-Sciences Queensland)
DERM	Department of Environment and Resource Management (Queensland)
DEWHA	Department of the Environment, Water, Heritage and the Arts
DoR	Department of Resources (Northern Territory)
DPI	Department of Primary Industries (Victoria)
DPIPWE	Department of Primary Industries, Parks, Water and Environment (Tasmania)
DSE	Department of Sustainability and Environment (Victoria)
FPC	Forest Products Commission (Western Australia)
FPQ	Forestry Plantations Queensland
FFPC	Forestry and Forest Products Committee
FSC	Forest Stewardship Council
FT	Forestry Tasmania
FTE	full-time equivalent
FWPA	Forest and Wood Products Australia
I&I NSW	Industry and Investment NSW
I&I NSW-S&I	Industry and Investment NSW, Science and Innovation
MIG	Montreal Process Implementation Group for Australia
Mt	Million tonnes
NRETAS	Department of Natural Resources, Environment, The Arts and Sport (Northern Territory)
PEFC	Programme for the Endorsement of Forest Certification schemes
PIMC	Primary Industries Ministerial Council
PIRSA	Department of Primary Industries and Resources South Australia
PISC	Primary Industries Standing Committee
R&D	Research and development
RD&E	Research, development and extension
RPCC	Research Priorities and Coordination Committee
RRDC	Rural Research and Development Corporations
RWG	Research Working Group
SCU	Southern Cross University
UM	University of Melbourne
UTAS	University of Tasmania
UTS	University of Technology, Sydney

EXECUTIVE SUMMARY

Australia's forest and wood products sector directly employs 76,000 people and generates an annual turnover of more than $21 billion. The sector's resource base — plantation forests, and part of the native forest estate — is managed in accordance with internationally accepted norms of sustainability to ensure the continued supply of a wide range of wood products and environmental services.

The longer-term outlook for the forest and wood products sector is very positive. In the next decade and beyond, it can increase its already substantial contribution to national social, economic and environmental goals, including through new opportunities created by demand for carbon sequestration services and biomass for renewable energy, and by market expansion for wood products driven by population growth and social trends. At the same time, however, the sector must cope with an increasingly complex and competitive production and market environment, evolving climate-change policy, and the need to realise and demonstrate sustainability. To meet these opportunities and challenges, effective and efficient research, development and extension (RD&E) is essential.

This document forms part of the National Primary Industries RD&E Framework developed under the Primary Industries Ministerial Council. It initiates a process of strategy development designed to ensure that RD&E meets the future needs of the forest and wood products sector and the Australian public.

The forest and wood products sector RD&E effort currently comprises about 500 researchers and support staff across 50 organisations at an estimated annual cost of $104 million. While, historically, RD&E has served the sector well, there is clear evidence that capacity has become increasingly dispersed and is declining significantly due to an aging demographic among researchers in some disciplines, restructuring and redirection by RD&E providers, and a diminution of resources. Since 1982 there has been a real decline both in total research funding and in research intensity (i.e. research expenditure as a percentage of industry turnover). Combined with other sector drivers, these trends suggest an increasing need for an RD&E effort that is more nationally coordinated and aligned.

The process to develop a National Primary Industries RD&E Framework provides an opportunity to gain greater recognition for the challenges facing RD&E capability in the forest and wood products sector and to develop coordinated approaches for addressing investment levels, sustaining or developing research capability, improving information sharing and ensuring cost-effective and efficient RD&E.

This document presents an initial view of future RD&E capability requirements in the forest and wood products sector and sets out key actions that need to be taken. It also proposes the establishment of a national-level Forest and Wood Products RD&E Forum to promote cooperation and coordination in the provision of RD&E to the sector and to assist in the alignment of investment in key research priorities. By bringing together key funders, providers and users of RD&E, the Forum will provide a mechanism for reviewing priorities, monitoring capability, and developing common performance measures for effective and efficient RD&E.

INTRODUCTION

Australia's native forests are globally unique and the nation also has a significant forest plantation resource. The management of Australia's wood-production forests, both native and planted, takes place within strong regulatory frameworks and, overall, these forests are among the world's best managed.

Forests provide society with a diversity of products and environmental services. The sustainable management of both native forests and plantations is central to realising broader natural resource management goals and the delivery of critical environmental services, and ensuring the economic future of the forest industry.

Wood is an easily worked, versatile, environmentally friendly and aesthetically pleasing material with a very diverse range of end uses. It has been described as a 'natural plastic', the 'concrete of the 21st century', and the new biofuel.

In the next decade and beyond, the forest and wood products sector, which grows, harvests, processes and markets wood and wood-fibre products, has the potential to increase its already substantial contribution to Australia's economy and environmental sustainability. The sector also has opportunities to develop new tree crops for carbon sequestration, energy, and other products.

To embrace these opportunities, the sector must remain competitive with alternative materials, imported products, and other land-uses. One key to this competitiveness is effective and efficient research, development and extension (RD&E).

Integrated RD&E will ensure that the sector can compete effectively in the face of rapid technological, social, economic and environmental change. It will assist the sector to manage the risks associated with such rapid change and to maintain and expand its traditional markets and to embrace new ones. It will also provide a scientific basis for the sector's economic and environmental sustainability, which underpins its social licence to operate.

This document forms part of the National Primary Industries RD&E Framework (see box). It sets out a process of strategy development designed to ensure that RD&E in the sector is well-targeted, effective and efficient and can adapt to the changing needs of the sector and the community.

Background to the National Primary Industries RD&E Framework

Australia has a wide range of co-existing primary industries. While approaches to RD&E vary by industry, all involve rural R&D corporations or industry-owned R&D companies, state and territory governments, CSIRO, universities, and private providers. To optimise productivity and sustainability across the primary industry, the deployment of RD&E investment, which exceeds $1 billion annually, should be focused, efficient and effective.

In April 2005 the Primary Industries Ministerial Council (PIMC) endorsed the concept of 'National R with Regional D&E'. The concept recognises that basic and strategic research can be provided from a distance, with regional adaptive development and local extension required to improve the uptake of innovation by industry. In 2009 PIMC agreed to a statement of intent on a national primary industries RD&E framework[1] to facilitate further cooperation between agencies and industry for improving the efficiency and effectiveness of the national RD&E capability. The framework will be a broad national plan to provide a more comprehensive, structured approach, spanning:

- **fourteen primary industry sectors**: beef, cotton, dairy, fisheries and aquaculture, forests, grains, horticulture, pork, poultry, sheepmeat, sugar, wine, wool, and new and emerging industries

- **seven cross-industry sectors**: animal biosecurity, animal welfare, biofuels and bioenergy, climate change and variability, food and nutrition, plant biosecurity, and water use in agriculture.

Each of these sectors is developing RD&E strategies, of which this strategy for the forest and wood products sector is one.

The implementation of the framework is expected to lead to a primary-industry RD&E effort that is more collaborative, more specialised and less fragmented. Overall, despite the additional costs that might be incurred by strengthening national linkages and support for regional and local delivery, efficiency and effectiveness will be improved. Agencies will retain and build capability in fields strategically important to their jurisdictions and industries while also collaborating effectively with others.

[1] National Primary Industries Research, Development and Extension Framework Statement of Intent June 2009.

SECTOR SCOPE

Forests are managed both for environmental outcomes and for the production of wood and non-wood products. The growing and harvesting of trees for wood and wood fibre is analogous to other primary industries such as cropping, horticulture and fisheries.

Taken as a whole, the forest sector is broader than many other primary industries, encompassing forest-growing, forest-related natural resource management, the production, marketing and use of non-wood forest products, forest-contact industries (such as tourism and national park management), and wood harvesting, processing, manufacturing, market use and product performance. The sector's resource — plantation forests, and part of the native forest estate — and the industries associated with it are diverse. Forests provide important environmental services such as the regulation of water yield and flow, carbon sequestration, the maintenance of soil and water quality, and the conservation of biodiversity. In several regions of Australia the forest sector is a vital part of rural economies, providing employment in forest-growing and management, harvesting, wood-processing, manufacturing, and related service industries.

This strategy focuses on the sector's forest-growing, wood-harvesting and wood-processing components, and the marketing and use of wood products in construction and other applications, called here the forest and wood products sector. The strategy also integrates the management of the sector with sustainable natural resource management and the multiple environmental and social benefits of forests. Major products in the sector include primary-processed wood products used in building and construction and the manufacture of furniture and other higher-value products; pulp and paper products; bioenergy and biomaterials; and engineered wood products.

INDUSTRY PROFILE

The resource base of the forest and wood products sector comprises public and privately owned natural forests and plantations used in wood production (Table 1), as well as areas of more-specialised tree crops such as sandalwood and oil mallees.

Table 1: Forest area used for wood production, and volume produced

Resource	Area (million hectares)	Annual wood production, 2007–08 (million m^3)
Multiple-use public native forests	9.40	6.9
Native forests on private land*	38.0	2.0
Softwood plantations	1.01	14.9
Hardwood plantations	0.95	4.6
TOTAL	**49.36**	**28.4**

*An estimated 3–5 million hectares of these native forests on private land are actively managed and a further 5 million, predominantly in Queensland, New South Wales and Tasmania, have the potentially to be available for management for timber products (Australian Forest Growers pers. comm., 2009).
Source: Montreal Process Implementation Group for Australia (MIG) (2008); Gavran and Parsons (2009); P. Sledge (Australian Bureau of Agricultural and Resource Economics — ABARE) pers. comm., 2010.

The sector makes an important contribution to the national economy: in the 2007–08 financial year, turnover was $21.4 billion, which was approximately 0.6% of Australia's gross domestic product.[2]

Australia has an overall trade deficit in wood-fibre products. In 2007–08:

- Imports of wood-fibre and wood products were worth $4.41 billion.
- The value of Australia's wood-fibre and product exports was $2.47 billion.
- The trade deficit in wood-fibre products, therefore, was more than $1.9 billion.

Total RD&E investment relative to industry value is low compared, for example, to the dairy, pork and wine sectors (Table 2).

Table 2: Size of selected primary industry sectors

Sector	Annual value*($ million, 2006–07)	Direct employment (FTEs)	Annual RD&E investment	RD&E investment as % of annual value
Forest and wood products	21 400	76,800	$104 million (2007–08)	0.47
Dairy	11 500	40,500 (farm and post-farm)	$95 million (pre-farmgate)	0.83
Pork	3420	7900	$23.5 million	0.69
Wine	6300	31,000	$59 million (annual recurrent, 2007–08)	0.94

*Total annual value of sales and service income; for pork this was taken to be 10% of meat-processing and 85% of cured meat and small goods.
Source: Australian Bureau of Statistics Manufacturing survey 8221 (2006–07); P. Sledge (ABARE) pers. comm., 2010; L. Kooymans (Australian Pork Limited) pers. comm., 2010; various national RD&E strategies, 2009.

[2] Figure excludes the value of finished products such as doors, windows and furniture; www.daff.gov.au/forestry/national/industries, viewed September 2009.

Total direct employment in the forest and wood product sector in 2007–08 was estimated to be 76,800 full-time equivalents (FTEs), comprising 13,200 people in the forestry and harvesting sectors and 63,600 people in the wood and paper manufacturing sectors.[3] The sector also supports a range of remanufacturing industries; the inclusion of these increases the total employment estimate to about 120,000 FTEs.[4]

The forest and wood products sector makes a substantial contribution to some key regional economies. In Western Australia's Great Southern region, for example, the forest plantation industry directly employed about 500 people in 2004; indirect employment creation there is estimated to be about 0.7 jobs for every direct job. In the Green Triangle of south-eastern South Australia and western Victoria, the forest and wood products sector:

- employs (directly and indirectly) an estimated 8,760 people[5]
- contributes an estimated 30% of the gross regional product of all primary industries combined and 23% of regional employment on a land base of about 10% of the region[6]
- supports a vocational education and training program for secondary school students and a four-year forestry degree in the region.[7]

Australia's commercial firewood sector, which draws on wood-production forests, is worth about $240 million per year and Australian households consume an estimated 4.5–5.5 million tonnes of firewood annually.[8] The non-wood forest product industries — such as the forest-based apiary industry (with annual revenues of about $65 million), and the sandalwood oil industry (with annual revenues of at least $40 million) — are also economically important.[9]

The inclusion of forest carbon credits in current and potential emissions trading schemes could increase the competitiveness and diversity of the sector. The New South Wales Greenhouse Gas Reduction Scheme, for example, which commenced in 2003, enables the sale of carbon credits from forests. Under this scheme the price of carbon has fluctuated widely, from as high as $23 per tonne (carbon dioxide equivalent) in 2007 to below $5 per tonne in mid 2009.[10] The introduction of a national emissions trading scheme or other mechanisms that place a price on carbon emissions in Australia may provide incentives to increase the area and type of plantations, alter rotation lengths, and increase the volume of wood in long-term use.

[3] MIG (2008).
[4] ibid.
[5] ibid.
[6] FITNET et al. (2008).
[7] MIG (2008).
[8] ibid.
[9] ibid.
[10] Buchanan et al. (2008); www.environmentalmanagementnews.net/storyview.asp?storyid=1003054, viewed December 2009.

The benefits of RD&E

Investments in RD&E are made for a wide range of reasons that can be broadly categorised as:

- the discovery of new knowledge
- the creation of development opportunities, new products and markets, and more efficient processes
- the maintenance and growth of a pool of knowledge and expertise to enable effective responses to future challenges
- risk mitigation.

In the last three decades, private and (mainly) public investment in RD&E in the forest and wood products sector has had substantial positive private and public benefits. For example:

- Advances in genetic improvement, site selection, silviculture and site resource management have:
  - greatly improved the productivity of softwood plantations in diverse environments, thereby ensuring continued supply to the multi-billion-dollar softwood-processing industry
  - underpinned a significant expansion of the hardwood plantation estate.
- Australia's softwood industry has been a leader in the introduction of new technologies such as kiln drying, machine grading and the development of engineered products such as laminated veneer lumber, I-beams and open-web floor joists, all of which have expanded markets and added to the profitability of the industry.
- Significant advances in the understanding of water catchment management and wildlife management in native forests have led to improvements in aspects of forest management — such as road construction and stream buffer protection, the retention of habitat trees, and reductions in the size of logging coupes — that have protected water quality and yield and maintained biodiversity in managed forests.
- RD&E investment in biosecurity has helped ensure that potentially devastating pathogens such as guava rust and pine pitch canker have not entered Australia, and enabled the effective management of native and exotic pests such as *Dothistroma*, *Sirex* and *Creiis* species, limiting their impacts in Australian plantations.
- An understanding of the physiological processes and functioning of Australian forest ecosystems has enabled the development of world-class process-based eco-physiological models, which, among other uses, will underpin forest-based responses to climate change.
- Innovative multidisciplinary approaches that modelled species distribution, identified and classified old-growth forests, and designed reserve systems helped in the development of regional forest agreements — a major forest policy initiative to resolve long-standing conflicts over the use of native forests — in New South Wales, Tasmania, Victoria and Western Australia.

- RD&E within the sector supported the introduction of multi-residential timber framing to Australia with such success that this framing technique has become a major approach to residential building construction in the country. In 2003–04, for example, ongoing building systems RD&E was estimated to have contributed to an extra $35 million in annual timber framing sales.[11]

The economic and social benefits, including spill-over effects, of RD&E investments are difficult to quantify. To provide a consistent approach, the Council of Rural Research and Development Corporations developed an assessment methodology in consultation with a wide range of stakeholders. Using this methodology, a study of 25 R&D projects funded by the Forests and Wood Products Research and Development Corporation[12] estimated the economic, social and environmental benefits from each project and compared these to the total financial investment. It calculated the overall benefit/cost ratio for the total investment to be 11 to 1.[13]

Despite these and other successes, however, there is, in some quarters, an apparent lack of acknowledgement of the role of RD&E in industry profitability and sustainability. Nevertheless, the following analysis of sector drivers makes it clear that effective and efficient RD&E will be essential if the Australian forest and wood products sector is to compete in the global marketplace in the future. To be successful the sector will need to embrace a culture of innovation, including knowledge generation and adoption, education, skill development, continuous improvement, and international best practice in a consistent, continuous and sustained manner.[14]

---

[11] Forest and Wood Products Research and Development Corporation (2004).
[12] Agtrans Research (2007).
[13] At a discount rate of 5% and based on assumptions developed in association with industry.
[14] Cutler (2008).

SECTOR DRIVERS

Competitiveness

The wood-based manufacturing sector includes:

- higher-value building, furniture and decorative products, such as engineered wood products and veneers
- products of intermediate value-adding, such as structural timber and paper packaging
- lower-value-added products such as logs and woodchips.

Currently, the supply of forest and wood products in Australia is driven largely by the demand for construction materials, especially in the domestic housing sector, but it is also influenced by domestic and international demand for consumer and industrial papers.

As the relative importance of manufacturing to Australia's economy has declined, the contribution of services has expanded considerably.[15] While the wood-based manufacturing sector remains strong — with gross employment, for example, relatively stable — the sector is likely to be increasingly affected by competition from imported products in some product categories. Australian paper manufacturers, for example, face increasing competitive pressure from producers in countries with lower labour costs, sometimes lower environmental standards, and capital subsidies from national governments.[16]

Nevertheless, Australia offers a number of competitive advantages for wood and wood-fibre manufacturers, including:

- a stable political and investment climate
- the reasonable size and relative stability of the domestic economy
- competitive energy prices
- the availability of wood fibre, especially for reconstituted products.

But the sector is vulnerable to:

- competitive pressures such as those created by an appreciation of the Australian dollar
- the economies of scale that can be achieved by some large international operations
- substitute materials, especially in housing construction
- low investment in RD&E and weak adoption of innovation.

Australia has always been a net importer, by value, of wood products: a large part of its exports are in the form of relatively low-value products such as woodchips and recovered paper, while imports are primarily of higher-value manufactured products, particularly printing

---

[15] ibid.
[16] Pulp and Paper Industry Strategy Group (2009).

and writing paper. Combined, imports of paper, paperboard, paper manufacture and pulp were worth just over $3 billion in 2007–08 (69% of total imports). Sawnwood imports were worth $784 million (18%) and wood-based panel imports were worth $482 million (11%).[17]

The ownership of plantations has been shifting from government to the private sector. In mid 2009, governments owned about 37% of the country's timber plantation estate (some of which was in joint ventures with the private sector), managed investment schemes owned 34% of the estate, superannuation funds 11%, timber industry companies 9%, and other private owners 9%.[18] The trend towards the private ownership of plantations is expected to continue, with implications for the funding of RD&E.

Competition from substitutes: Wood has also come under increasing competition from substitute products such as steel, aluminium, concrete and plastics in a range of end-uses. Many factors will determine the extent to which wood can retain or increase market share in the future. Potential opportunities for expanding wood use in the housing sector, for example, include:

- an increase in demand for materials that are less energy-intensive in their manufacture
- adoption of new wood composites and engineered wood products
- changes in demographics, which are likely to lead to new residential construction demands in cities and coastal areas.

Potential threats to wood use in the housing sector include:

- a decline in home alterations and additions
- the introduction of adverse environmental specifications and building regulations
- advances in steel and concrete technology.[19]

The mix of factors that determine market preferences for materials and their application can change rapidly. The industry will remain strong as long as it is able to respond effectively to issues such as life-cycle performance, affordability, recyclability, reliability and quality.

When building codes and regulations are conducive, the development of new wood-use technologies can greatly increase the range of uses to which wood is put in the construction sector. This will require the timely assessment, analysis and dissemination of market and product information matched by effective engagement with regulators, standards bodies, specifiers, designers and product innovators.

The development and deployment of new technological innovations in wood-fibre processing is most likely to take place internationally and the challenge will be to obtain and implement such new technologies in a profitable way. In other subsectors, domestic innovation will be required because of the nature of the resource and the environments in which the products will be processed and deployed.

[17] ABARE (2009).
[18] Gavran and Parsons (2009).
[19] Jaakko Pöyry and Four Scenes (2006).

Competition for land and water: Land is in demand for a wide range of uses, including the production of food, fibre and biofuels, carbon sequestration, biodiversity conservation, rural amenity, urbanisation and mining.

There is much uncertainty around the nature of such competition and its effects on the forest and wood products sector. It could, for example, increase the price of land and therefore the cost of wood production. Challenges for the sector include how it can complement and integrate more effectively with agricultural production at the landscape level, and how it can maintain its competitiveness as a land use. The development and application of broader landscape planning and management approaches may help to address forest-use conflicts and resource expansion constraints in the future. RD&E is vital in assisting the industry to compete for land by ensuring that the industry selects the most appropriate land and uses it as efficiently as possible to produce the greatest amount of wood sustainably.

The importance of water security in Australia is heightened by recurring drought and uncertainty about future water demand and availability due to population growth, land-use change, competition, and the potential impacts of climate change. Forest-related issues include:

- the impact of plantation establishment on catchment water flows and in comparison with other land uses
- the impact of fire and wood-harvesting in forested catchments on water quality and quantity
- the sustainability of plantations in lower-rainfall areas and in a potentially warmer and drier climate
- the role of forests in mitigating land and water degradation, including problems such as salinity.

The Intergovernmental Agreement on a National Water Initiative was signed in 2004 by the Australian Government and most state and territory governments[20] (the governments of Tasmania and Western Australia signed in 2005 and 2006 respectively). Its overall objective is to achieve a nationally compatible market-, regulatory- and planning-based system for managing surface and groundwater resources for rural and urban use that optimises economic, social and environmental outcomes. Among other things, the agreement specifies that, in areas where water is already fully allocated or over-allocated, proposals for additional water interception activities, such as forest plantations, above an agreed threshold will require a water access entitlement. Such a requirement could have significant impact on further development of the plantation sector.

In some regions, particularly where agricultural crops are irrigated from groundwater, plantation forests are viewed as competitors for water resources, and conflict over water may constrain the expansion of wood-growing.

[20] Intergovernmental Agreement on a National Water Initiative between the Commonwealth of Australia and the Governments of New South Wales, Victoria, Queensland, South Australia, the Australian Capital Territory and the Northern Territory, seen at http://www.nwc.gov.au/resources/documents/Intergovernmental-Agreement-on-a-national-water-initiative.pdf, July 2009.

RD&E can also play a role in minimising conflicts over water use by, for example, providing a knowledge base for water-allocation mechanisms, evaluating the impact of forests and other land uses on the quantity and quality of water resources, and optimising forest water-use efficiency through genetic resource development, site selection, and adaptive management regimes.

Changing nature of the resource

A significant difference between the forest and wood products sector and other primary industries is the changing nature of its resource base. Historically, most of Australia's hardwood supply has been obtained from publicly owned native forests, but access to this resource has been restricted by government land-use decisions. The area of publicly owned native forest available for timber production was 9.4 million hectares in 2005–06 compared to 11.4 million hectares in 2000–01, a reduction of 18%. Over the same period, the area of public nature conservation reserves (in which timber harvesting is not permitted) increased from 21.5 million hectares to 23 million hectares.

In 1999 the Government of Queensland initiated a 25-year transition in which public native forests in the state's southeast — its major timber-producing area — will be withdrawn from timber harvesting and recategorised as nature conservation reserves. New South Wales, Victoria and Western Australia have reported recent declines in their allowable wood harvest in multiple-use public native forests.[21] Overall, the prescribed sustainable yield in public native forests has halved since 1995.[22]

The decline in allowable harvest from public native forest has been accompanied, in some regions, by an increase in the harvest from the private native forest estate. The ongoing risk of access to this resource and sustainable management regimes being applied needs continued attention.[23]

Australia's plantation estate is now nearly 2 million hectares in size (Table 1).[24] This estate produces about two-thirds of Australia's log supply and the proportion is expected to increase in the future. The softwood plantation estate is mature and, without a change in the economics of the long-term rotations required for the supply of solid wood products, the estate is not expected to expand significantly.

The total area of the hardwood plantation estate, and wood production from it, are both increasing. Nevertheless, results from the first rotation, and substantial ownership changes, are likely to lead to some rationalisation of the short-rotation hardwood plantation resource.

The decline in the volume, log size and quality of the harvest from native forests will continue to pose a challenge for solid-wood processors and their key customers. Most of the hardwood plantation estate is devoted to a small range of species (mainly Tasmanian blue gum — *Eucalyptus globulus*) grown predominantly for wood fibre for pulp and paper. RD&E providers in several states, especially Queensland and Tasmania, have pursued research to develop alternative uses for plantation hardwoods. The vast majority of the current hardwood

---

[21] MIG (2008).
[22] I. Ferguson pers. comm., 2010.
[23] Australian Forest Growers pers. comm., 2010.
[24] Gavran and Parsons (2009).

plantation estate, however, will not produce logs suitable for a profitable solid-wood-products industry.[25]

An issue for the future, particularly in the plantation sector, is how to improve linkages in the marketplace between growers and processors in relation to log/product quality. Such linkages are currently most direct in relation to pulpwood, which generally sells on pulp yield. In the solid-wood subsector, silviculture and genetics are directed to growing trees with desirable wood properties but sales are generally made on the basis of volume/mass rather than wood quality. Overall, a number of structural and transactional issues in the sector ultimately result in a lack of alignment of interests in added-value production; overcoming those issues and increasing the integration of RD&E from forest to market are significant challenges for the sector.

Climate change

Predicted climate change will pose challenges but will also create opportunities for Australia's forest and wood products sector. The industry can, for example, play an expanded role in reducing Australia's greenhouse gas emissions. According to *Australia's State of the Forests Report 2008*[26], forestry is one of the most greenhouse-friendly sectors of the Australian economy — it was, for example, the only industry sector to be carbon-positive in 2005. Rapidly growing forests capture carbon, and mature forests, as well as wood products, store carbon until biological decay or fire returns the carbon to the atmosphere.

- According to one estimate[27], existing post-1990 plantations combined with new forest plantations dedicated to carbon sequestration could reduce carbon emissions by about 200 megatonnes (Mt) carbon-dioxide equivalent per year.[28]
- In 2005, about 90 Mt of carbon were stored in wood products in long-term service. An additional 136 Mt of carbon was stored in end-of-service-life wood products disposed of in landfill.[29]
- In 2005, Australian plantations and commercial native forests removed a net 43.5 Mt carbon-dioxide equivalent from the atmosphere.
- Plantations offset about 3.5% and managed native forests about 5.5% of total Australian greenhouse gas emissions in 2005. Additional storage in wood products offset a further 1% of emissions.[30]

Wood can be used as a carbon-neutral bioenergy substitute for fossil fuels, in the manufacture of a range of plastics and other chemicals, and as a low-carbon-emissions alternative to materials such as steel, aluminium and concrete. Thus, forests and wood products can sequester carbon, provide energy substitution, and result in avoided emissions.

[25] Nolan et al. (2005).
[26] MIG (2008).
[27] Buchanan et al. (2008).
[28] This level of carbon sequestration in forest plantations would have significant investment and land-use implications; in reality, therefore, forest plantations are likely to make a significant but smaller contribution to carbon sequestration.
[29] FWPA and CRC for Greenhouse Accounting (2006).
[30] MIG (2008).

Maximising the carbon benefits of the sector will require RD&E for, among other things, the development and adoption of more efficient technologies and work practices, the increased use of wood in long-term applications, and the integration of processes in the production of solid wood, wood fibre, energy and chemicals. It will also require policy settings, both nationally and globally, that recognise and encourage the important contribution of the forest and wood products sector to climate-change mitigation.

Climate change will also have implications for forest productivity and adaptation. Under some climate-change scenarios, for example, Australia's temperate forests could experience a greater incidence of drought, which would exacerbate problems caused by pests and fire. An analysis of regional climate-change scenarios, for example, has suggested that plantation productivity could decrease in:

- *P. radiata* plantations in southern New South Wales and possibly at the western edge of the estate
- the eastern and northern extents of the *E. globulus* and *P. radiata* estates in Western Australia.[31]

On the other hand, growth rates could increase in some forests due to the fertiliser effect of an increased atmospheric concentration of carbon dioxide and to favourable changes in climate. For example, increases in production have been predicted for:

- *E. globulus*, *E. nitens* and *P. radiata* in Tasmania
- the mid-to-lower northern regions of the hybrid pine estate
- *P. radiata* and *E. globulus* plantations in East Gippsland and higher-altitude parts of central and north-eastern Victoria.[32]

Realising and demonstrating sustainability

Society increasingly demands that its goods and services are provided from demonstrably environmentally sustainable sources. The forest and wood products sector, therefore, needs to continually demonstrate its sustainable management of ecological assets, including land, water and biological resources, the effective management of fire and other potential threats, and the maintenance of ecological processes in forested landscapes (Figure 1).[33]

In contrast to many other primary industries, the Australian forest and wood products sector has a sustainability reporting framework at the state, territory and national levels, with linkages to well-established global intergovernmental forest assessment systems.

As part of this, Australia participates in an international approach to forest sustainability known as the Montreal Process[34], which has developed criteria and indicators to characterise and measure the essential components of sustainable forest management. Australia has adapted the Montreal Process's criteria and indicators to report on the state of

[31] Battaglia et al. (2009).
[32] ibid.
[33] URS Australia (2007).
[34] The Montreal Process Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests comprises countries with temperate and boreal forests.

its forests every five years.[35] The continued development of the criteria and indicators, and their periodic measurement, is an important task of RD&E.

Demand for information on the sustainability of forest management is also being met by forest certification. Certification is a process whereby the sustainable management credentials of a forest are independently investigated and certified. Certification schemes typically require forest management practices that are more stringent than provided by law alone, and they encourage forest managers to display their sustainability credentials when marketing their products. Two major forest certification schemes operate in Australia — the Australian Forest Certification Scheme (AFCS), which is accredited by the international Programme for the Endorsement of Forest Certification schemes (PEFC), and the Forest Stewardship Council (FSC)'s scheme.

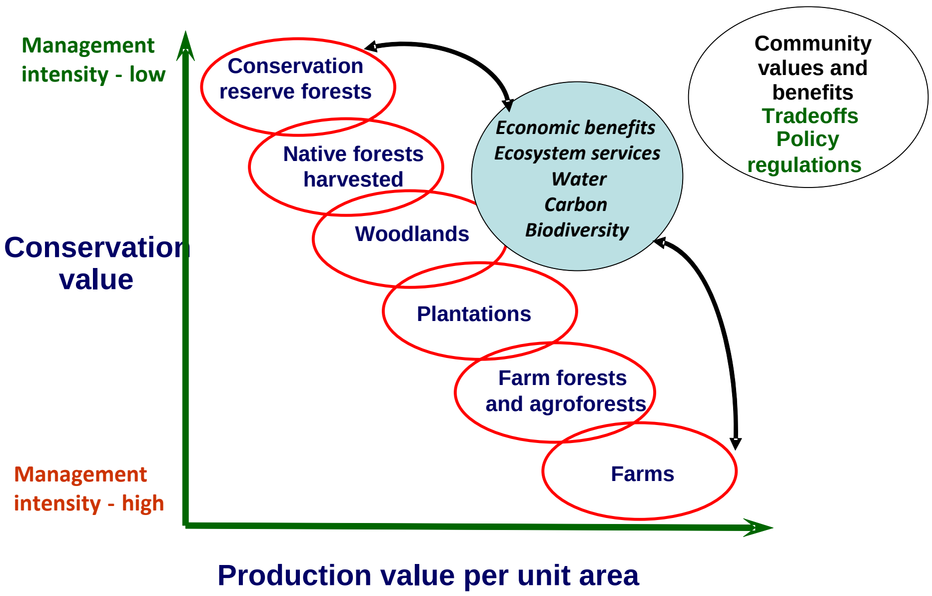
In addition to certification, most multiple-use public forests and some private forests are now managed in accordance with codes of forest practice and externally accredited environmental management systems, which provide a structured approach to the planning and implementation of measures to protect the environment.

Balancing competing demands for forests, and understanding community attitudes towards the Australian forest and wood products sector, including the use of wood products, requires strong community engagement. RD&E is needed, therefore, to assure society of the sector's responsible use of forest resources, the long-term sustainability of forest management, and the environmental credentials of wood products.

For many decades, wood production was the central focus of forest management and elements such as water catchment management, cultural and heritage issues, biodiversity and, more latterly, climate change, were addressed as part of a multiple-use management regime. In recent years, however, such issues have been the focus of considerable attention and their management has, in many cases, assumed priority over wood production, especially in native forests. This shift in emphasis is illustrated in Figure 1. The forest and wood products sector has been proactive in adapting to this new reality but will no doubt need to continue to adapt as new opportunities and challenges arise.

[35] The most recent report was MIG (2008).

Figure 1: The forests and natural resources continuum



Source: Modified from Nambiar (1996), Nambiar pers. comm., 2009.

Opportunities for wood and wood fibre

Beyond the maintenance and expansion of existing markets for wood products there is increased global interest in the greater use of woody biomass to replace fossil-fuel-derived products and energy in a carbon-emissions-constrained world. Opportunities for wood and fibre products exist across the value spectrum, from bioenergy to biomaterials. Many of these opportunities are enabled by climate-change mitigation imperatives; others reflect technological advances and changing social preferences.

The Australian Bioenergy Road Map, published by the Clean Energy Council in 2008, sets a target contribution of bioenergy towards electricity generation in Australia of about 3.7% by 2020, which is more than four times the current contribution of 0.9%. Australia's current electricity generation from biomass is significantly lower than that of leading European countries, where bioenergy is already contributing 4–14% of total electricity generation, more than half of it from wood. While wood is arguably better used as a source of industrial and domestic heat/steam than as a source of electricity alone, under the Australian Bioenergy Road Map wood-related wastes (e.g. sawmill and pulp mill residues) would supply about 28% of the target electricity production, and urban biomass (including demolition timber) would supply about 7%.

Pyrolysis technology offers energy and product streams such as biogas, biochar, bio-oil and chemical feedstock. Advances in pyrolysis technology indicate the potential for it to be deployed at less-capital-intensive scales using feedstock of wider technical specification than in the past. The efficiency and cost-competitiveness of the direct production of liquid fuel (ethanol or methanol) from woody biomass is also being progressively improved. Such technologies may gain increased market acceptance in response to government policy instruments such as renewable energy certificates and emissions trading schemes.

Using a combination of biotechnology applications and new industrial processes, residues from traditional forest operations and new forest plantation resources can be used in the production of new products such as bioplastics, chemicals and pharmaceuticals.

In North America, the development of integrated forest biorefineries has been proposed as a way in which the pulp and paper industry can fully integrate forest biomass for the simultaneous production of several marketplace products, including fibre for pulp and paper products as well as chemicals and energy, thereby creating additional revenue streams.[36]

The introduction and strengthening of renewable energy regulations in Australia indicates a need for RD&E on wood-based biofuels to identify the best commercial and energy outcomes.

[36] e.g. see www.bio.org/worldcongress/applications/breakout/PrintSingle.aspx?pID=22&appID=3494.

RD&E RESOURCE ANALYSIS

Expenditure

Forest and wood products R&D[37] is conducted in about 50 public and private organisations across Australia. Investment in such work can be divided into two broad categories:

1) forest R&D, which includes research mainly related to species selection and breeding, and the management and protection of wood-production forests, including plantations

2) wood products R&D, which includes research on primary wood conversion, product and market development (including paper products), and timber engineering.[38]

In the 2007–08 financial year about $59.6 million was spent on forest R&D and about $26.8 million was spent on wood products R&D. If administrative costs are included, total expenditure was about $104 million. In unadjusted dollars this represents an increase of about 4.7% per year since 1981–82. When expenditure is adjusted to 1982 dollars, however, there was a real decline in total expenditure of just under 0.6% per year over the period, despite a slight increase since 2002 (Figure 2).

Since 1982 there has been an overall real decline in expenditure per unit area and per unit harvested wood volume. There has also been a decline in expenditure as a percent of industry turnover — from about 0.56% in 1994/95 to 0.47% in 2007–08.

Major funding sources in 2007–08 were:

- Australian Government (44% of total funding)
- state agencies (28.5%)
- private sector (20%)
- universities (7.5%).

Figure 3 shows the source and expenditure of funds by the major contributors. In broad terms, the Australian Government contribution to research funding has increased over time while that of the states has declined.[39] Private industry investment, as reflected in the Forest and Wood Products Australia (FWPA) levy of approximately 0.20% of gross value of production, is lower than many other primary industry sectors.

Research undertaken on native forests and softwood plantations has declined in recent years, whereas that on hardwood plantations — which have been increasing significantly in area — has grown. Funding for wood products research increased in real terms between 2001–02 and 2007–08, due partly to investment in CRC Wood Innovations.[40]

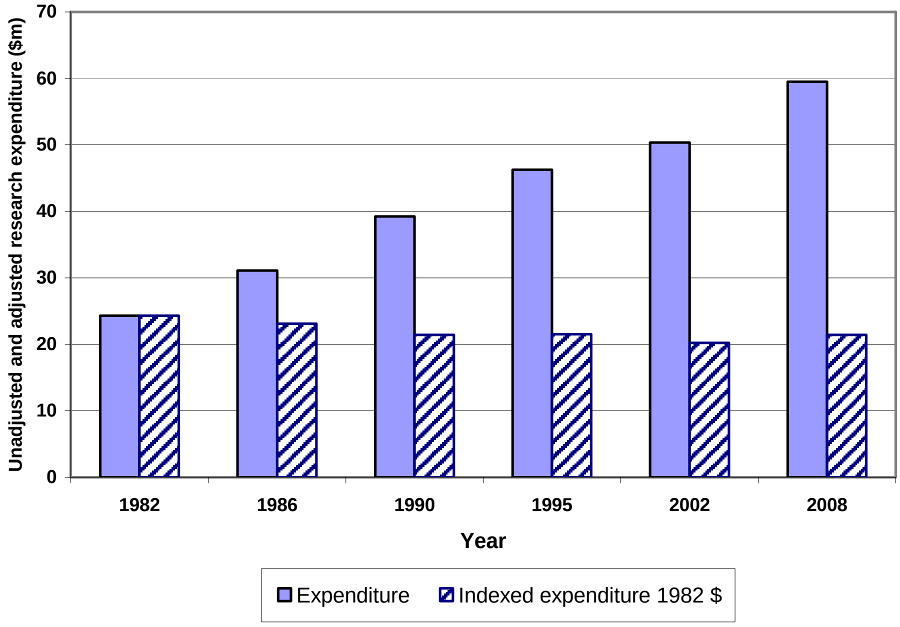
Capacity and structure

In 2007–08 an estimated 500 FTE researchers, technicians and other support staff were involved in R&D in the forest and wood products sector in state and federal agencies, universities and private organisations. Most private RD&E providers are at a relatively small

[37] Historically, ‘extension’ has not been measured in surveys of R&D expenditure. The data presented in this section, therefore, exclude the extension component of RD&E.
[38] This section draws on Turner and Lambert (2009) for estimates of R&D expenditure and capacity.
[39] See the longitudinal studies conducted by John Turner, Marcia Lambert and others, reported most recently in Turner and Lambert (2009) and also in Turner and Lambert (2005).
[40] Turner and Lambert (2009).

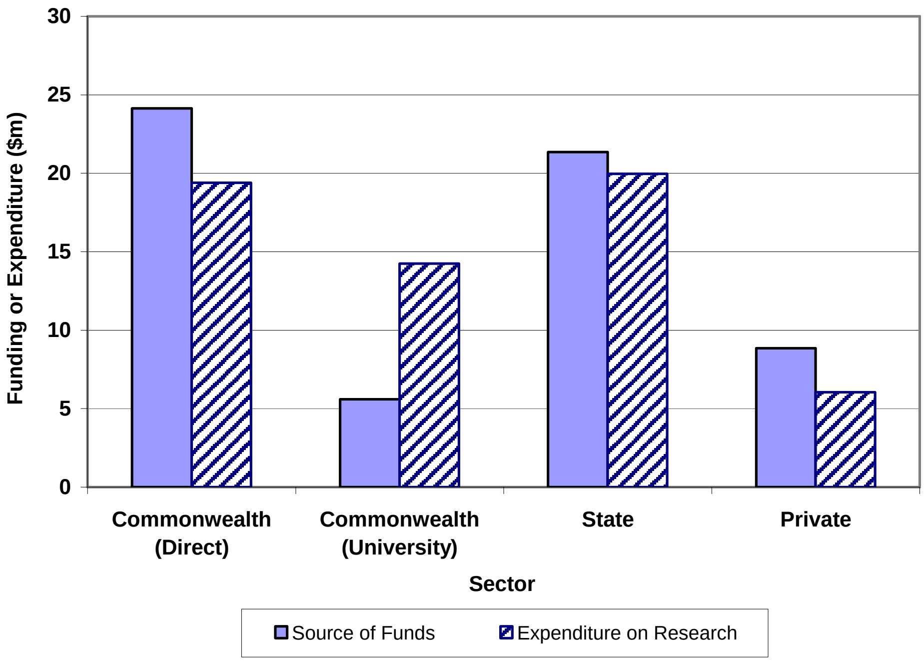
scale and work as individuals or in very small groups, or are associated with other organisations.

Figure 2: Actual and real expenditure on forest and wood products R&D, 1981–82 to 2007–08



Source: Turner and Lambert (2009).

Figure 3: Sources of funding and expenditure on forest and wood products R&D, 2007–08



Source: Turner and Lambert (2009).

Table 3 shows the breakdown of capacity by state and federal agencies and universities and by major area of activity.

Table 3: Estimated R&D capacity by major public agency, and key areas of activity, 2009

State or territory	Institution*	Capacity (FTE researchers, technicians and other support staff)**	Major resource focus and key R&D areas
ACT	CSIRO (various divisions; note that CSIRO is a national agency with capacity to operate in different forest regions)	143	Native forests and plantations — hydrology, forest growth and physiology, tree improvement, predictive modelling, climate change, wood products
	Australian National University	14	Native forest ecology and management — socioeconomics/policy, carbon sequestration
NSW	Forests NSW	21	Softwood and hardwood plantations — tree improvement, silviculture, wood properties
	I&I NSW-S&I	32	Native forests and plantations — forest health, biodiversity and ecology, forest growth, carbon accounting, recycled organics, climate change
	Southern Cross University	10	Native forests and plantations — socioeconomics, genetics, wood properties, ecology, extension
	University of Technology Sydney	5	Wood engineering
NT	n.a.	n.a.	n.a.
Qld	Department of Employment, Economic Development and Innovation (Agri-Sciences Queensland)	28	Hardwood plantations — tree improvement, physiology, productivity, modelling, forest health
		20	Plantation-grown wood properties, processing, timber products, performance enhancement
SA	Forestry SA	24	Softwood plantations — productivity management growth and model development, forest health, wood properties
Tas.	Forestry Tasmania	28	Native forest management, hardwood plantations — forest protection, hydrology, silviculture
	University of Tasmania	21	Native forest management — ecology, wood products
Vic.	Department of Forest and Ecosystem Science/University of Melbourne	59	Native forest ecology and management, plantations — forest protection and management, forest operations, tree improvement, hydrology, climate change, wildfire, wood products
WA	Forest Products Commission	20	Hardwood and softwood plantations — tree breeding, hydrology, forest growth, carbon sequestration
	Department of Environment and Conservation	24	Native forest management — conservation biology
Total		**449**	

* Note that the CRC for Forestry and FWPA contribute to the funding of a significant number of R&D personnel through partner organisations, including some of those listed in this table.

** Table excludes private organisations, graduate students, institutions with small capacities, and some small localities in larger organisations. The capacity shown, therefore, is less than the total national estimated capacity. These are the best-available estimates, but the sector is undergoing major change and more detailed analysis will be required in the future.

Source: Adapted from an unpublished supplementary survey by J. Turner, D. Flinn & M. Lambert, 2009; K. Crews (University of Technology Sydney) pers. comm., 2009; P. Kanowski (Australian National University), pers. comm., 2009; J. Vanclay (Southern Cross University), pers. comm., 2009.

The RD&E architecture has changed considerably over the last decade. This is particularly so at the state level as a consequence of land-use decisions, including through regional forest agreements, which have led to the division of native forest management responsibilities between a range of agencies and the corporatisation or privatisation of plantation forests.

Historically, state governments have had a significant role in commercial forest-growing and resource ownership and, in some instances, in the downstream processing of wood. This is in contrast to agriculture, where governments have traditionally provided policy and sector services such as RD&E without themselves being in the business of agriculture. As noted above, however, the role of government in the forest and wood products sector is changing, with evident long-term impacts on RD&E capacity.

Except in Tasmania, the traditional model of state forest agency with its own in-house research group to address business needs has virtually ceased to exist. It has been replaced by a range of models, including stand-alone research groups partly supported by government appropriation, the integration of RD&E capability and capacity into larger primary industry research groups, and the splitting of such capability and capacity between conservation and forest business agencies.[41]

The net effect of structural changes at the state level has generally been a reduction in forest and wood product RD&E capability and capacity and an increase in organisational complexity. As noted above, in many jurisdictions, responsibilities for different aspects of RD&E are now often distributed between several agencies (Table 4).

In recent years CSIRO has changed its direction towards investing more on strategic research areas that are addressing broader national priorities while moving away from research areas that are directly assisting industries, particular in some near-to-market areas or where industry is not well placed to capture research outcomes. As a result, CSIRO’s capacity and capability in the forest and wood products sector has been significantly downgraded and some of its staff either absorbed by the Sustainable Ecosystems, Plant Industry, or Material Science and Engineering divisions or retrenched. If there are functional engagement mechanisms with industry, it could increase the breadth of expertise available to the forest and wood products sector.

The number of universities with RD&E activities has increased, although they lack coordination and are potentially in direct competition with each other. The University of Melbourne has become a major R&D provider — significantly funded by contracts with Victorian state agencies — by combining existing university research capability with former state-agency capability.

The number of private companies (such as managed investment scheme companies) investing in plantation forests has increased. Combined, their research efforts have also grown, particularly through the use of cooperative research mechanisms. Also within the private sector (although some government agencies may also be involved), are a number of national representative, technical associations and state-based industry or promotion

[41] Compared to traditional agriculture, the forest and wood products sector deals with fewer commercial species that are grown in defined geographical ranges. Typically, forest R&D occurs within commercial forests rather than at dedicated research stations. Therefore, opportunities to rationalise infrastructure by combining programs or reducing research stations are less readily available within the sector than in some other primary industry sectors.

organisations; some of these may be both research providers and/or funders, depending on circumstances.

Table 4: Roles and responsibilities of state and national government investors in forest and wood products sector RD&E

Role and responsibility	NSW	NT	Qld	SA	Tas.	Vic.	WA	Aust government/ national
Forest industry and production, forest policy	I&I NSW, Forests NSW	DoR	DEEDI	PIRSA	DIER	DPI	DEC, FPC	DAFF
Land and forest management policy	I&I NSW, DECCW	NRETAS	DERM	PIRSA	DIER, DPIPWE	DSE	DEC	DAFF (DCC), DEWHA
Production forest management and marketing	Forests NSW	-	FPQ/ DERM	ForestrySA	FT	Vic Forests	FPC	-
Forest research — primary investor	I&I NSW-S&I, Forests NSW, SCU, UTS	DoR	DEEDI	PIRSA, Forestry SA	FT, UTAS	DSE, UM	DEC, FPC	ABARE, ANU, BRS, CSIRO

Note: neither the CRC for Forestry nor FWPA is listed in this table because they work predominantly through partner organisations. Nevertheless, they establish direction and provide resources in a number of research fields.
ABARE = Australian Bureau of Agricultural and Resource Economics; ANU = Australian National University; BRS = Bureau of Rural Sciences; CSIRO = Commonwealth Scientific and Industrial Research Organisation; DAFF = Department of Agriculture, Fisheries and Forestry; DCC = Department of Climate Change; DEC = Department of Environment and Conservation; DECCW = Department of Environment, Climate Change and Water; DEEDI = Department of Employment, Economic Development and Innovation (Agri-Sciences Queensland); DERM = Department of Environment and Resource Management; DEWHA = Department of the Environment, Water, Heritage and the Arts; DIER = Department of Infrastructure, Energy and Resources; DoR = Department of Resources; DPI = Department of Primary Industries; DSE = Department of Sustainability and Environment; DPIPWE = Department of Primary Industries, Parks, Water and Environment; FPC = Forest Products Commission; FPQ = Forestry Plantations Queensland; FT = Forestry Tasmania; I&I NSW = Industry and Investment NSW; I&I NSW-S&I = Industry and Investment NSW, Science and Innovation; NRETAS = Department of Natural Resources, Environment, The Arts and Sport; PIRSA = Department of Primary Industries and Resources South Australia; SCU = Southern Cross University; UM = University of Melbourne; UTS = University of Technology, Sydney; UTAS = University of Tasmania.
Source: Adapted from Research Priorities and Coordination Committee minutes, May 2009.

The major cooperative RD&E mechanism in the forest and wood products sector since 1991 has been the cooperative research centres program. The CRC for Temperate Hardwood Forestry, created in 1991, was superseded by the CRC for Sustainable Production Forestry in 1997; this, in turn, was superseded by the CRC for Forestry in 2005, which is due to terminate in 2012. The CRC for Hardwood Fibre and Paper Science (1993–99) and the CRC for Wood Innovations (2001–08) were major initiatives in forest product R&D. Overall, the CRCs act or have acted as focal points for coordinated RD&E in specific areas.

The CRC for Forestry, if extended beyond 2012, will continue to coordinate RD&E on some key issues, including processing and adding value to the plantation resource, improving supply-chain performance and profitability, and addressing management challenges for forest estates that are arising across an increasing array of values, including carbon. Funding from the CRC Program to support these activities is leveraged from outside the sector, making it an important addition to recurrent RD&E funding in the sector.

Many RD&E providers identify dispersal of research effort, and a lack of recruitment to replace an ageing workforce, as significant issues in the sector. A lack of a critical mass of researchers could jeopardise the long-term viability of some providers or of some research areas. CSIRO has provided capacity and some national leadership in RD&E in the sector in the past but, given the restructuring there, this seems less likely in the future.

Research can be categorised as incremental and strategic: incremental research is usually conducted in short-term projects to address immediate RD&E needs and strategic research addresses longer-term trends and concerns. The increasingly dispersed nature of RD&E in the forest and wood products sector potentially encourages incremental research at the expense of strategic research. In the long term, this would hinder the processes of knowledge production and application and, therefore, could pose a risk to the viability of the forest and wood products sector.

Data on expenditure and the number of people employed in extension activities — that is, the effort devoted to raising awareness of and promoting the adoption of research outputs, leading to impacts on productivity, the efficiency of processing, etc. — in the sector are lacking. The forestry subsector has never had an extension service along the lines of that supported by agricultural agencies and extension activities have been far less formalised.

On the other hand, a number of regional timber development associations provide detailed and regular extension services to timber-users in the broad construction marketplace and to the production industry through technical and research extension. This capacity has declined significantly in Queensland and Victoria, but the Timber Development Association of New South Wales and the Tasmanian Timber Promotion Board remain active. Wood Council Australia was formed recently by timber development associations, timber producers and merchants to help coordinate timber-related extension and R&D.[42] FWPA supports and manages a wood promotion campaign directed at consumers and specifiers that contains a extension element.

Until recently, the main users of state-based forest RD&E were within the state agencies that maintained the research capacity and there was less focus on external customers. CSIRO had wider linkages with both forest growers and the wood-processing industries in terms of undertaking R&D and promoting adoption. In recent years the CRC for Forestry has provided some new extension capacity. Private consultants may also be involved in extension activities. Traditionally, the sector has relied predominantly on the scientists themselves to promote and aid the adoption of research outputs.

Current capability

The categorisation of current research capacity and capability by research area has not previously been attempted for the sector. A preliminary analysis using 15 research categories has been undertaken to obtain an initial assessment (Table 5, Figure 4). This approach identified just over 280 full-time or part-time researchers (excluding technicians and other support staff) in the public and private sectors. Table 6 shows the adequacy of current RD&E capability, as rated by RD&E providers, using the same research categories.

Overall, the strongest capability in terms of numbers is in ecology, forest soils/productivity, forest health, genetic improvement, and wood science and technology and the most limited capability is in harvesting and transport, socioeconomics and policy, timber engineering and extension. While no data are available on the age profile of researchers, anecdotal evidence

[42] G. Nolan, pers. comm. 2010 ; http://woodcouncil.org.au

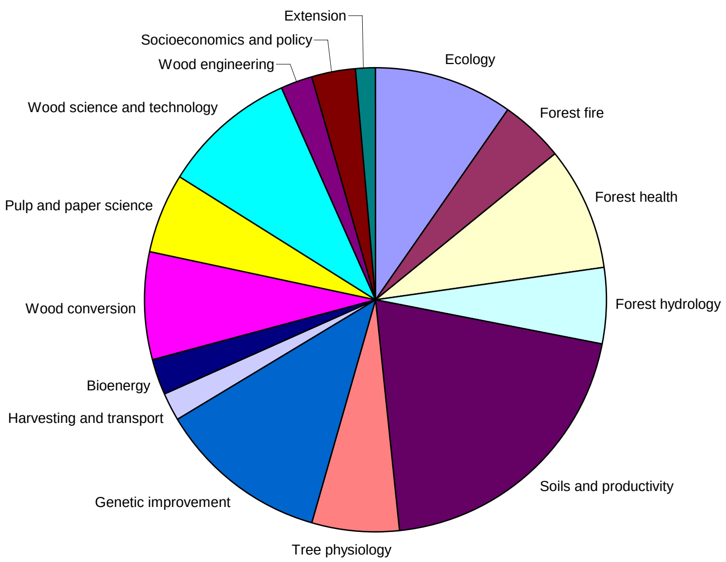
suggests that it is skewed towards the older age groups. Whilst these figures and views reflect historical development more detailed analysis of this type will be required in the future to endeavour to match work force needs with industry opportunities.

Table 5: Current public and private research capacity and capability, by research area and jurisdiction

Research category	ACT*	NSW	NT	Qld	SA	Tas.	Vic.	WA	Total
Ecology	2	7	0	1	0	4	12	4	30
Forest fire	3	1	0	0	0	2	6	2	14
Forest health	4	5	0	6	1	3	4	3	26
Forest hydrology	3	1	0	0	0	5	6	2	17
Soils and productivity	13	11	1	4	5	8	15	5	62
Tree physiology	6	4	0	2	0	4	2	1	19
Genetic improvement	7	4	1	4	6	9	4	2	37
Harvesting and transport	0	1	0	0	0	2	3	0	6
Bioenergy	1	5	0	0	0	0	2	0	8
Wood conversion	0	0	0	7	0	0	15	1	23
Pulp and paper science	0	11	0	0	0	0	6	0	17
Wood science and technology	0	3	0	6	0	0	18	2	29
Wood engineering	0	4	0	0	0	1.5	1.5	0	7
Socioeconomics and policy	4	2	0	0	0	1	3	0	10
Extension	1	0	0	0	0	2	1	0	4
Total	**44**	**59**	**2**	**30**	**12**	**41.5**	**98.5**	**22**	**309**

Where ‘Bioenergy’ = Bioenergy (conversion of wood to energy and other products — pyrolysis, pellets, liquid fuels); ‘Education and extension’ = persons involved in education research or extension; ‘Forest fire’ = Fire behaviour and management; ‘Forest health’ = Forest health and biosecurity; ‘Soils and productivity’ = Forest soils and productivity, including silviculture and management; ‘Tree physiology’ = Tree physiology/ecophysiology; ‘Genetic improvement’ = Tree selection and genetic improvement; ‘Wood conversion’ = Wood conversion (sawmilling, drying, veneering, fibre products); ‘Wood science’ = Wood science and technology, including measurement of wood properties, relationship of wood properties to management and genetics, resource assessment.
*Relates primarily to CSIRO and the Bureau of Rural Sciences, which both have a national role.
Jurisdictional totals in this table may not tally with those in Table 3 because they may include national-level personnel, such as those working for CSIRO. Moreover, technical and support staff are omitted from this table.
Source: Unpublished supplementary survey by J. Turner, D. Flinn & M. Lambert, 2009; personal communications.

Figure 4: Broad distribution of public-sector and private-sector researchers, by research category



Source: Unpublished supplementary survey by J. Turner, D. Flinn & M. Lambert, 2009; personal communications.

Table 6: Adequacy of current RD&E capability, based on a survey of key RD&E providers

Capability	1	2	3	4	5	6	7	8	9	10
Ecology										
Forest fire										
Forest health										
Forest hydrology										
Soils and productivity										
Tree physiology										
Genetic improvement										
Harvesting and transport										
Bioenergy										
Wood conversion										
Pulp and paper science										
Wood science and technology										
Wood engineering										
Socioeconomics and policy										
Extension										

Source: Based on an unpublished supplementary survey by J. Turner, D. Flinn & M. Lambert, 2009 and a survey of key RD&E providers.

National coordination

A number of bodies have been created to improve communication, coordination and representation in the sector, or within specific elements of the sector. Very few of these bodies have a primary focus on RD&E, although they may deliberate on issues that impact on RD&E.

Intergovernmental policy coordination is conducted through the Forestry and Forest Products Committee (FFPC), which is an advisory committee to the Primary Industries Standing Committee (PISC) and the Primary Industries Ministerial Council (PIMC). In 2009 the Australian Government Minister for Agriculture, Fisheries and Forestry established the Rural Research and Development Council as the Australian Government's key strategic advisory body on rural R&D.

The Research Priorities and Coordination Committee (RPCC) reports to the FFPC and provides coordination of forest research conducted by state and federal governments and has strong links with other research providers. It advises the FFPC on research-related issues, research needs and technology transfer relevant to maximising forest productivity and managing a range of forest values within the context of sustainable forest management. In June 2008 the FFPC adopted a strategic directions document prepared by the RPCC, the aim of which is "to provide a clear statement of research needs to inform future research investment decisions in all areas of the sector"; it sets out a number of research priority areas presented within five themes (Appendix 1).[43] The RPCC manages a number of research working groups (RWGs) that consist of key researchers drawn from government agencies, universities, CSIRO and other research providers. It has traditionally played a research coordination role rather than a research planning or research policy role.

A key national body with a focus on RD&E funding is FWPA, a not-for-profit industry-services company established in 2008. One of its key services is to identify, prioritise and provide funding for key RD&E and capacity-building activities that have the widest benefit for the forest and wood products industry (domestic growers, processors and importers). FWPA's mandate is determined by its members — wood processors, private and government forest growers, and Australian importers of forest products. FWPA operates four skills-based advisory groups covering the growing, processing and marketing functions of the sector (excluding pulp and paper).

The Australian Government matches eligible R&D expenditure by FWPA subject to conditions specified in a statutory funding agreement. Total RD&E expenditure by FWPA is less than 10% of the sector total, indicating that it is a less dominant player in funding compared to some other rural research and development corporations (RRDCs) or industry-services companies operating in other primary industry sectors.[44]

FWPA recently adopted a strategic plan comprising four strategies and a number or priority themes (Appendix 2). It has also identified 13 investment priorities for its R&D activities and is progressively developing 3–5-year investment plans for each of these priorities to ensure

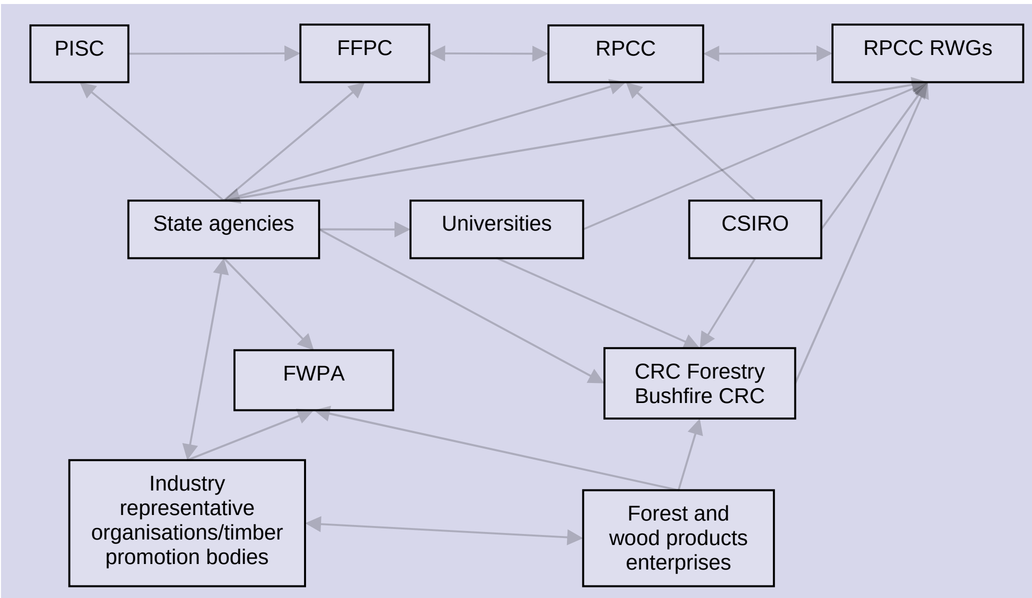
[43] RPCC (2008).
[44] e.g. Dairy Australia contributes about 20% of total RD&E funding in that sector (source: www.dairyaustralia.com.au/Research-and-Innovation/Research-Funding.aspx, viewed November 2010, and Table 2), and the Grape and Wine Research and Development Corporation contributes about 35% of total RD&E funding in that sector (source: Grape and Wine Research and Development Corporation 2008 Annual Report and Table 2).

that the investments can be clearly linked to specific industry outcomes. FWPA is the only RRDC that receives funding (and draws membership) from state government agencies and the importer sector.

Some of the RD&E providers in Australia's forest and wood products sector have, or have had in the past, advisory and working groups comprising forest-sector researchers and managers. There are also joint organisations consisting of individual companies, representative associations and government agencies to improve communication and provide advice to state and federal government ministers. At the national level, the most prominent body is the Forest and Wood Products Council, a forest-industry advisory body to the Australian Government Minister for Agriculture, Fisheries and Forestry. At times, these bodies may be involved in the establishment of specific research priorities.

Figure 5 illustrates the existing network that facilitates the exchange of information between organisations. The figure shows that, while there are many options for coordination and collaboration, there is no single overarching body or group that provides policy and guidance for RD&E at the national level. It also shows that there is no clear pathway for the flow of information that might be used in the development of coordinated RD&E strategies.

Figure 5: Interactions of RD&E providers through existing structures



Note: Directional arrows indicate the involvement of one entity type in another by participation in a board or advisory group.

Where key organisations see their contributions

As part of its deliberations in developing RD&E sector strategies, the PISC R&D Committee compiled, for all sectors and cross-sectors, a summary of how state agencies and CSIRO perceived their future roles in RD&E. The responses of PISC member agencies related to the forest and wood products sector are shown in Table 7. This table suggests a basis for interagency discussion on RD&E coordination.

Table 7: Future forest RD&E priority focus for PISC agencies

	NSW	NT	Qld	SA	Tas.	Vic.	WA	CSIRO
Tropical	Support	Link	Major	N/A	N/A	N/A	Support	Support
Temperate	Major (carbon) /support	N/A	Link	Link	Major	Link	Major	Support

Major: Agency will take a lead national role by providing significant R&D effort.
Support: Agency will undertake R&D but other agencies will provide the major R&D effort.
Link: Agency will undertake little or no R&D. Instead it will access information and resources from other agencies.
Source: Adapted from a PISC-generated table on future RD&E priority focus across primary industry sectors.

Challenges facing the sector

Despite the apparently considerable capacity and availability of funds, there is widespread concern within the sector that RD&E capacity is in a perilous state. Ongoing resource cutbacks and greater dispersal of the capacity between agencies will potentially reduce both the impact of RD&E and communication between key stakeholders.

As noted above, the RD&E effort in the forest and wood products sector is distributed between a large number of agencies (sometimes within the same state), CRCs, universities, CSIRO (where it is spread over a number of divisions) and the private sector. Coordination at the project level, and at the level of individual researchers, is often good, and the basis for current arrangements is often robust. During the preparation of this plan, however, there was widespread recognition that, in a time of rapid policy, regulatory and technological change, there is a need for improved coordination and planning at the national and strategic levels.

There is concern that research priorities are not being determined by a sufficiently iterative process between industry, RD&E providers and other stakeholders and therefore do not adequately reflect the changing needs of the sector. To some extent this may be a natural outcome of the heterogeneous nature of the sector, but it reduces the capacity to drive research prioritisation at the national level.

Table 8 presents a strengths, weaknesses, opportunities and threats analysis for RD&E in the forest and wood products sector. From this, several key needs have been identified, including:

- strengthen the coordination and planning of RD&E capacity and capability at the national level to address national sector priorities
- enhance the critical mass of investment and resource utilisation to better deliver RD&E outcomes to the forest and wood products sector
- explore new models for the cost-effective delivery of RD&E
- identify capability needs and build capability in RD&E through a nationally coordinated approach that provides researchers with attractive career paths, a creative research environment, and adequate resources
- ensure that RD&E findings and opportunities are used effectively by developing extension programs to communicate R&D findings to research users, policy makers and the broader community
- encourage international networking to ensure that the forest and wood products sector is well placed to take advantage of innovations created internationally.

Table 8: Strengths, weaknesses, opportunities and threats analysis of RD&E in the forest and wood products sector

Strengths	Opportunities	Weaknesses	Threats	Implied needs
The forest and wood products sector has shown itself capable of innovation, with the capacity to adapt to a changing resource and competitive environment. Good existing regional coverage, with RD&E resources in many of the major wood production areas. A long history of forestry research, including investment in long-term forest sites. A history of collaboration in wood products research. High-quality research capability in some areas in the sector. Existing national coordination of government-funded forestry R&D. A diversity of R&D providers.	Increased coordination between RD&E providers, and regional consolidation. Availability of compatible skills in other sectors. Development of new career pathways and incentives to attract young researchers. The adoption of a more effective model of RD&E provision and coordination in the sector. The role of forests and wood products in mitigating climate change. A large increase in the supply of wood fibre from plantations suitable for reconstituted products. The wider societal values associated with native forests and plantations compared to alternative land uses. Consolidation of the wood-production sector into larger and potentially more research-responsive companies.	Overall decline in investments in sector RD&E. The ageing, declining number, and fragmentation of the R&D workforce, resulting in a decline in capability and capacity and a lack of succession planning. Limited and declining capacity in the extension of R&D across the supply chain. Apparent lack of acknowledgement in industry of the role of RD&E in industry profitability and sustainability. Lack of industry engagement with the community on the environmental costs and benefits of production forests. Lack of industry engagement with the community on the environmental benefits of the full range of forest products. A tendency to focus on short-term applied research rather than longer-term, more strategic research, and a loss of long-term research sites as a result of restructuring. Limited national-level coordination of RD&E involving private and public providers, users and funders. A lack of key performance indicators of RD&E effectiveness. The commodity focus of the wood-fibre-growing and processing sectors. A lack of RD&E coverage in some regions, especially the tropics. Reduced policy focus and fragmentation of responsibility for forests, leading to declining support for production RD&E.	Poor public perception of the sector could reduce the use of wood and RD&E investment. Funding for RD&E could be cut further. Competition from overseas RD&E providers could reduce funding for local researchers. The contribution of some RD&E providers could be reduced because of poor industry engagement. Loss of coordination role of CRCs, if discontinued. Some RD&E providers might shrink to a point where they no longer have a critical mass for effective RD&E. Failure to strengthen extension efforts could further reduce the benefits of innovative research. RD&E capacity could be further fragmented. Low higher-degree enrolments, with consequences for RD&E and the sector's succession planning.	Strengthen the coordination of RD&E at the national level. Reverse the real decline in investment in RD&E. Create a mechanism for effective communication between providers, users and funders of RD&E in the forest and wood products sector, and to ensure a balance in RD&E between the policy needs of governments and the innovation needs of industry, and to strengthen the commitment of industry to RD&E. Develop performance indicators for RD&E in the forest and wood products sector. Develop new models for the cost-effective delivery of RD&E. Encourage the sharing and storage of information and data between RD&E providers. Develop a nationally coordinated approach to increase extension capacity in three main areas: – extension to forest growers, including in regions of low-to-medium-rainfall suitable for commercial forestry, to ensure they support the development of and adopt innovative forest-growing and forest management practices – extension to producers, to assist them to improve their production capability – extension to wood users, particularly in the construction sector, to ensure that design and engineering needs are met. Encourage international networking to ensure that the forest and wood products sector is well placed to take advantage of innovations created internationally. Build capacity in RD&E through a nationally coordinated approach that provides researchers with attractive career paths, a creative research environment, and adequate resources.

FRAMEWORK FOR A NATIONAL RD&E STRATEGY

Innovation in the forest and wood products sector involves a complex web of private and public organisations that provide funding and supply RD&E services. Two of the key benefits of developing a national RD&E strategy for the sector[45] are to identify opportunities for improving the leadership and delivery of RD&E to meet the changing needs of the industry and other stakeholders, and to ensure strong public support for a productive and sustainable forest and wood products sector.

Underlying this RD&E strategy is a vision of profitable, innovative, competitive and sustainable forest industries. Key areas where the strategy will contribute to industry outcomes, which, in turn, will help achieve this vision, are:

- enhanced competitiveness of forest products vis-à-vis other materials based on performance and environmental footprint
- sustainability measures that are scientifically robust, operationally feasible, easily understood and relevant to the community and broader user groups
- capacity and capability for resource expansion and the utilisation of new wood resources
- adoption of improved forest management practices through a culture of continuous improvement and learning
- a biosecure forest industry
- increased accessibility of information through a variety of mechanisms.

Sector-wide common objectives

For the purpose of this RD&E strategy, the sector-wide research priorities endorsed by the FFPC in 2008 (Appendix 1) have been condensed into a smaller set of 21 agreed objectives or priorities to serve as a basis for cooperation and collaboration between RD&E providers and industry (Table 9). The objectives are grouped in three areas across the sector business chain, integrating the elements of production, use and sustainability.

Table 9: Objectives of RD&E, forest and wood products sector

FOREST AND LANDSCAPE MANAGEMENT
• Improve plantation and native forest productivity and product quality • Improve technology adoption and efficiency in harvesting and transport • Improve the protection of forest assets from fire • Improve the biosecurity of forest assets • Expand the ability to predict and manage forest water use and carbon stocks and dynamics • Assist the design of robust and resilient mixed-use landscapes, from socioeconomic and conservation perspectives • Improve the capacity to respond to climate change, for both mitigation and adaptation

[45] Ideally this would be linked to a forest and wood products sector industry plan, but such a plan remains to be developed.

PRODUCT DEVELOPMENT AND USE

- Increase the value recovered from available forest resources
- Adopt/adapt best-available technology to optimise production and profitability
- Improve recovery rates and wood use from the by-product and secondary product streams and the post-consumer and urban green waste streams, including as biofuel
- Identify new and emerging market opportunities
- Understand the life-cycle impacts of wood use and opportunities for improvement in sustainable construction
- Demonstrate the capability of wood products to meet the performance requirements of building construction

INDUSTRY ADAPTATION AND RESPONSIBILITY

- Improve investment models for industry development, resource security and sustainability
- Enhance sustainability accountability and freedom to operate
- Sustain current and future employment opportunities
- Enhance foresight on and adaptation to emerging issues and market opportunities, including the response to climate uncertainty and changes in construction demand
- Assist the development of robust and sustainable built environments
- Improve the role of forest management and forest products in mitigating and adapting to climate change
- Demonstrate the competitive environmental advantages of using forests and wood products

Meeting the challenge: future capabilities

To gain an insight into the demand for future RD&E, 13 RD&E providers[46] were asked to forecast future capability needs over the next five years against the same research capability areas used in the analysis of current capability.

While this analysis can only be regarded as indicative, Table 10 shows that capability is projected to decline in biosecurity and forest health, genetic improvement, wood science, and pulp and paper science. Projected declines in some key areas where capacity is already assessed as inadequate (e.g. wood engineering) should raise significant concerns with industry. Priorities for increased capability were seen in bioenergy, forest harvesting and transport, and hydrology.

Further analysis would increase confidence in these projections as well as the understanding of their implications for the sector and for national RD&E coordination and cooperation. Nevertheless, the table highlights the need for deeper thinking in the sector about future skills needs and the availability of appropriate future RD&E capability and its alignment with R&D priorities and sector development opportunities

[46] ANU, CRC for Forestry, CSIRO, DEEDI, UM, FPC/DEC, ForestrySA, Forestry Tasmania, Forests NSW, I&I NSW-S&I, NAFI, SCU, UTAS.

Table 10: Projected RD&E capability, 5 years into the future, based on a survey of key RD&E providers

	Decreasing emphasis					Stable	Increasing emphasis				
	-5	-4	-3	-2	-1		1	2	3	4	5
Ecology											
Forest fire											
Forest health											
Forest hydrology											
Soils and productivity											
Tree physiology											
Genetic improvement											
Harvesting and transport											
Bioenergy											
Wood conversion											
Pulp and paper science											
Wood science and technology											
Wood engineering											
Socioeconomics and policy											
Extension											

Are existing coordination mechanisms adequate?

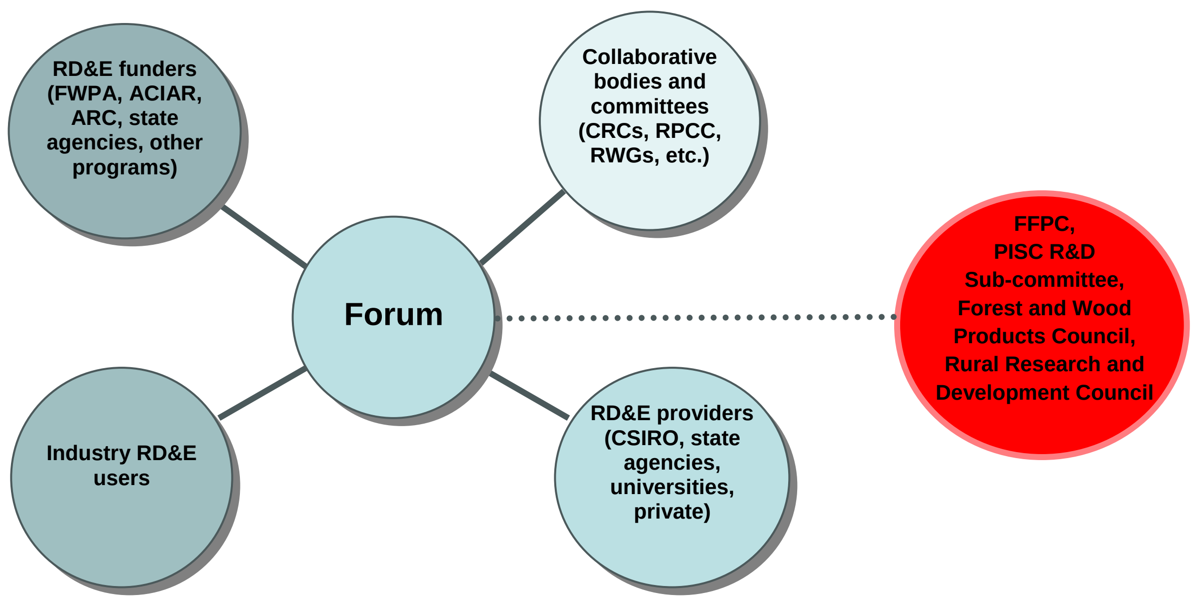
Throughout the development of this strategy there was general agreement among contributors on the need to explore options for change; align investment; and integrate service delivery wherever possible. Existing mechanisms were seen as providing inadequate engagement for this purpose, leading to proposals for a forum with suitable terms of reference that would engage in a level of ongoing detailed discussion and action on collaboration and coordination between funders, providers and users that has not been seen as necessary in the past.

No other strategic idea gained significant traction with stakeholders. Moreover, it is likely that other possible changes in RD&E arrangements will be successful only if supported broadly and workshopped through such a Forum. Thus the Forum is seen as a necessary first step in a longer process.

Forest and Wood Products RD&E Forum

On endorsement of the strategy, therefore, a national-level Forest and Wood Products RD&E Forum will be established consisting of key funders, providers and users of forest and wood products sector RD&E. The chairmanship of the Forum will rotate between the three main groupings (i.e. funders, providers and users) on an annual basis, and a part-time coordinator will be employed to service the needs of the Forum. Depending on interest in participation there may be a need for a Forum executive group to provide continuity in directing the work of the Forum. Participants will pay their own costs of participation as well as a small subscription fee (on the basis of cost-recovery) to fund a part-time coordinator. Other Forum-initiated work will be funded on a project basis. Figure 6 shows the proposed arrangement and linkages for RD&E coordination.

Figure 6: Proposed arrangement and linkages for RD&E coordination



The Forum will be established for an initial three-year period, with the possibility of extension. During the initial period the Forum will consider options for a further restructuring of coordination and cooperation mechanisms in the forest and wood products sector with a view to achieving greater consolidation of and efficiency among existing mechanisms and, at the end of the period, will recommend its preferred option(s). During the preparation of this strategic framework there was considerable discussion about which organisation should take responsibility for, and provide a home for, the Forum. As RD&E is intimately linked to industry futures, an industry body was seen as more appropriate than policy committees such as the PISC R&D Sub-committee or the FFPC, although there needs to be in communication with them. The industry options were considered to be FWPA and the CRC for Forestry. As the latter is time-bound it was concluded that FWPA would be the most representative and appropriate host agency.

FWPA will convene the Forum in consultation with other key players in the sector, including the CRC for Forestry, FFPC and universities. The initial meeting will decide on the process for appointing the part-time coordinator and on subsequent financial and administrative arrangements. Participants in the initial meeting will also consider and finalise the Forum's modus operandi and governance structure.

The Forum will:

1. Be responsible for the continued development and implementation of the forest and wood products sector national RD&E strategy
2. Provide a national forum for consultation, communication and coordination between the forest and wood products industry and RD&E funders and providers
3. Provide input to FFPC, the Australian Government Minister's Forest and Wood Products Council, PIMC, PISC, the Rural Research and Development Council, and other forums of relevance to RD&E
4. Monitor and work to maintain forest and wood products sector RD&E capability, investment and cost-effectiveness, including by defining the research capability needed in the sector and developing mechanisms to deliver this
5. Review, on an ongoing basis, common priorities for RD&E in the sector
6. Communicate RD&E outcomes to policymakers and the general public
7. Ensure communication between other primary industry sectors on RD&E priorities, particularly with respect to farm forestry.

The Forum will operate on the basis of:

- a willingness to engage in coordination, collaboration and communication
- delivery of benefits to industry and researchers
- integration across the sector's value chain
- efficient operation and minimal administrative burdens and transaction costs
- acknowledgement of the importance of innovation, RD&E coordination at the national level, and consideration of the needs of RD&E customers, funders and providers.

The Forum will act to promote negotiation among its participants over opportunities in RD&E. It will be inclusive, participatory and voluntary, and will promote a diversity of approaches to and ideas about innovation.

Initial actions

Key elements of the RD&E agenda for change will form the initial actions of this strategy to be promoted and overseen by the Forum. They are:

- Expand the sharing of strategic objectives and plans between relevant parties as a basis for developing new collaborative initiatives on a state, regional, or national level (or any other appropriate basis, such as species, discipline or commodity) and to minimise individual organisational changes that prejudice national capability and capacity in RD&E.

- Support the continuity of existing collaborative research bodies such as the CRC for Forestry and the Bushfire CRC and the development of potential new collaborative opportunities through state or federal government funding, such as Australian Research Council centres of excellence.

- Support greater engagement and coordination between the FWPA and the CRC for Forestry, as two organisations with national scope and responsibilities for RD&E with a focus on forests and wood products.

- Review the availability of and access to research infrastructure to support future knowledge development in the sector and consider initiatives to focus investment in key nodes.

- In areas identified for national collaboration, seek to maintain or build nationally coordinated (but not necessarily nationally managed or led) programs using internal and external resources.

- Encourage research providers and industry to regularly assess opportunities/broker coordinated participation in broader research funding initiatives that, while not necessarily sector-specific, can deliver benefits to the sector in terms of resources and knowledge.

- Consolidate and review material available across agencies (including but not restricted to cost–benefit analyses) that can demonstrate the benefit of investment in RD&E in the sector.

- Explore options for additional contributions to FWPA for special programs to receive matching funding from the federal government.

- Identify capability gaps and strategies for filling them, including by strengthening links with ForestWorks and other relevant skills-development agencies.

- Develop more strategic approaches to international science collaboration and the rapid introduction of new technology that can assist the competiveness of the sector by focusing on key areas of sector interest through cooperation between providers and funders.

- Assess options for, and the feasibility of, improving the storage, analysis and sharing of nationally relevant R&D data.

What will be different in three years?

Assuming agreement to establish the Forum is reached in the first quarter of 2010, by 2013 the Forum will have facilitated the following changes in the national coordination of RD&E:

- improvement in national, state and regional collaboration in existing and emerging areas
- development of new initiatives to address capability gaps
- more coordinated capacity in the sector to respond to new directions in knowledge need and to derive benefit from new funding initiatives
- publication of a new, sector-wide research priorities analysis
- publication of a full analysis of national research capability, and regional development and extension capabilities, including gap analyses
- adoption or refinement of within-sector performance measures for RD&E.

REFERENCES

ABARE (2009). ABARE forest and wood products statistical tables, March and June quarters 2009, Australian Bureau of Agricultural and Resource Economics, Canberra. Found at http://abare.gov.au/publications_html/data/data/data.html, accessed January 2010.

ABS (2008). *Manufacturing industry Australia 2006–07*, Australian Bureau of Statistics, Canberra.

Agtrans Research (2007). *Evaluation of Benefits Delivered from FWPRDC Sponsored R&D Projects PR07.5058*, summary report to Forests & Wood Products R&D Corporation, Agtrans Research, Brisbane.

Battaglia M, Bruce J, Brack C and Baker T (2009). *Climate Change and Australia's Plantation Estate: Analysis of Vulnerability and Preliminary Investigation of Adaptation Options*, draft report, CSIRO Sustainable Ecosystems, Hobart.

Buchanan G, Tulloh C and Ford M (2008). *The Potential Impacts of Climate Change on the Forest and Wood Products Manufacturing Sector in Australia*, Garnaut Climate Change Review, Canberra.

Clean Energy Council (2008). *Australian Bioenergy Road Map*, Clean Energy Council, Melbourne.

Cutler T (2008). *Venturous Australia: Building Strength in Innovation*, Cutler & Company Pty Ltd, Melbourne.

FFPC (2008). *Forestry Sector Research Strategic Directions 2008–2011*, Prepared by the Research Priorities and Coordination Committee, Forestry and Forest Products Committee, Melbourne.

FITNET, TAFESA and the Green Triangle Regional Plantation Committee (2008). *Forestry Green Print Forest Industry Workforce Requirements Green Triangle Region: 2006–2011.* Forest Industry Training Network Inc, Mount Gambier.

Forest and Wood Products Research and Development Corporation (2004). *Annual Report 2003–04.* Forest and Wood Products Research and Development Corporation, Melbourne.

FWPA and CRC for Greenhouse Accounting (2006). *Forests, Wood and Australia's Carbon Balance,* Forest and Wood Products Australia and Cooperative Research Centre for Greenhouse Accounting, Melbourne.

Gavran M and Parsons M (2009). *Australia's Plantations 2009 Inventory Update*, National Forest Inventory, Bureau of Rural Sciences, Canberra.

Jaakko Poyry and Four Scenes (2006). *Scenarios for Selected Timber Markets*, draft report, JP Management Consulting (Asia-Pacific) Pty Ltd & Four Scenes Pty Ltd.

MIG (2008). *Australia's State of the Forests Report 2008*, Bureau of Rural Sciences, Canberra.

Nambiar E K S (1996). Sustained productivity of forest is a continuing challenge to soil science. *Soil Science Society of America Journal* 60, 1629–1642.

Nolan G, Washusen R, Jennings S, Greaves B and Parsons M (2005). *Eucalypt Plantations for Solid Wood Products In Australia: a Review*, Forest and Wood Products Research and Development Corporation, Melbourne.

Parsons M, Frakes I and Gavran M (2007). *Australia's Plantation Log Supply 2005–2049*, Bureau of Rural Sciences, Canberra.

Pulp and Paper Industry Strategy Group (2009). *Issues Paper*, Commonwealth of Australia, Canberra.

Turner J and Lambert M (2005). Expenditure on forest and forest products research in Australia 1981–1982 to 2001–2002. *Australian Forestry* 68:3, 202–210.

Turner J and Lambert M (2009). *Expenditure on Forestry Research and Forest Products Research in Australia 2007–2008*, report prepared for Forest and Wood Products Australia, Melbourne.

URS Australia (2007). *Australia's Forest Industry to 2020*, report prepared for the Department of Agriculture, Fisheries and Forestry, Canberra.

CONTRIBUTORS

A3P — Richard Stanton, Peter Juniper

Australian Forest Growers — Warwick Ragg

Australian National University — Lyndall Bull, Peter Kanowski, William Nikolakis

Bureau of Rural Sciences — Tim Clancy, Stuart Davey

Bushfire CRC— Gary Morgan

CRC for Forestry — Gordon Duff, Mark Hunt

CSIRO — Michael Battaglia, Jamie Haig, Stuart Matthews, Philip Polglase, Simon Potter

Department of Agriculture, Fisheries and Forestry

Department of Primary Industries (Vic.) — Bruce Kefford, Luke Wilson

Department of Sustainability and Environment (Vic.) — Lee Miezis

Department of Employment, Economic Development and Innovation (Qld) — Michael Kennedy, Simon Lawson

Department of Primary Industries and Resources SA — Mike Powell, Stuart West

Forest and Wood Products Australia — Chris Lafferty, Ric Sinclair

Forest Enterprises Australia Ltd — Trevor Innes

Forest Products Commission (WA) — Paul Biggs, John McGrath

ForestrySA — Brian Farmer, Charlma Phillips

Forestry Tasmania — Hans Drielsma, Steve Read

Forests NSW — Ross Dickson

Industry and Investment NSW, Science and Innovation — Robert Eldridge

National Association of Forest Industries — Allan Hansard, Mick Stephens

Southern Cross University — Jerry Vanclay

Southern Tree Breeding Association — Tony McRae

University of Melbourne — Gerd Bossinger, Ian Ferguson, Rod Keenan

University of Tasmania — Greg Nolan

University of Technology, Sydney — Keith Crews

Wespine Industries Pty Ltd — Ron Adams

Wood Products Victoria — Alastair Woodard

Glen Kile, Andy McNaught, Sadanandan Nambiar, Roger Sands, Alastair Sarre

ORGANISATION ENDORSEMENT

<table>
<tr><td colspan="3">National Primary Industries Research, Development & Extension Framework
RD&E STRATEGY FOR THE FOREST AND WOOD PRODUCTS SECTOR</td></tr>
<tr><td>Organisation</td><td colspan="2"></td></tr>
<tr><td colspan="2" rowspan="2">Does this organisation have an interest in the strategy? (Please circle)</td><td>Yes</td></tr>
<tr><td>No</td></tr>
<tr><td colspan="3">Organisation position (please circle, and, for options 2 and 3, provide comments)</td></tr>
<tr><td colspan="3">1. Endorsed</td></tr>
<tr><td>2. Endorsed with comments</td><td colspan="2"></td></tr>
<tr><td>3. Not endorsed</td><td colspan="2"></td></tr>
<tr><td colspan="3">Signature block</td></tr>
<tr><td>Name</td><td colspan="2"></td></tr>
<tr><td>Position</td><td colspan="2"></td></tr>
<tr><td>Signature</td><td colspan="2"></td></tr>
</table>

APPENDIX 1: *Research Priorities and Coordination Committee Forestry Sector Research Strategic Directions 2008–2011*

Mitigation of and adaptation to climate change in Australia

Outcome 1.1

Policy makers, communities and industry are aware of and understand the positive impacts of forest management on the carbon cycle, and the role of forests in ameliorating the impacts of climate change

Key strategies

1.1.1 Produce research outputs that better inform policy makers, communities and industry of the significant potential contribution that forests and forest products make to the amelioration of climate change through carbon sequestration and through the production of renewable energy sources from sustainable managed plantations and forests.

1.1.2 Develop research to demonstrate that climate change provides an opportunity for better integration of forestry into Australian landscapes and society in a range of environments

1.1.3 Strengthen linkages between tree growers and the forest products sector in the context of the carbon cycle and emissions management.

Priority research

- Continue to investigate the potential for climate change mitigation through reforestation and changes to forest management, considering limitations of productivity, competition for land and, especially, competition for water.

Outcome 1.2

The forest industry is adequately prepared for a carbon trading environment at local and national levels

Key strategies

1.2.1 Continue research and development into carbon accounting systems to provide industry with the knowledge and tools suitable for use at scales appropriate for effective and efficient carbon trading.

1.2.2 Build capacity in socio-economic analysis for assessment of the efficiency and effectiveness of policy, including market-based instruments, in mitigating the impacts of climate change.

1.2.3 Provide accurate scientific data and information to support efficient and effective implementation of market-based instruments such as carbon penalties or emissions trading, that increase the relative costs of using emission-intensive technologies and encourage uptake of alternative technologies such as biomass energy generation. Financial incentives, performance and emissions standards and information programs can also be used to encourage the use of energy-efficient and low-emission technologies.

Priority research

- Further develop carbon accounting tools (models and systems) suitable for use at a regional scale that provide forest managers with the knowledge to engage in carbon trading, supported by refinements to models of forest growth that underpin these tools

- Understand the changing risks of pests and diseases, cyclone, drought and fire so that the appropriate level of risk can be factored into forest management and carbon accounting systems

Outcome 1.3

Biomass energy production systems enhance energy security and reduce carbon emissions

Key strategies

1.3.1 Support development of biomass energy technologies in line with introduction of carbon emission trading in 2011-12.

1.3.2 Investigate social and biodiversity social impacts of biomass energy generation. These impacts may be different for communities near the source of production and from those at more distant locations. For example, issues such as local air quality and road traffic congestion need to be included among the costs and benefits of biomass energy, together with employment creation and reliable power supply.

Priority research

- Develop economically and socially feasible, and ecologically appropriate, biomass energy production systems and integrated timber and biomass production systems for different forest production conditions for a range of energy consumers.
- Research to mitigate potential impacts of increased biomass utilisation on biodiversity, forest productivity and other forest values.

Adapting forest management to climate change

Outcome 1.4

Forest and water resource managers can predict and manage the impact of climate change on water yields from forested catchments.

Key strategies

1.4.1 Focus research efforts in forested catchments that supply water to Australia's major population centres to assess the impacts of changed rainfall patterns and increased temperatures on future water supplies.

1.4.2 Develop tools to predict, monitor and measure climate change impacts on fire regimes in water supply catchments and their potential impacts on water yield and quality.

1.4.3 Assess the impact of predicted changes in climate on water resources for timber plantations and other land uses in selected regions.

Priority research

- Develop calibrated and tested process-based models and other landscape-level analytical tools to explore likely changes in water use by important forest types (including plantations) in key regions of Australia under different climate change scenarios, different types of management strategies and different fire regimes.
- Analyse the interaction of alternative forest management options, including timber harvesting and the use of prescribed fire, and impacts of climate change on water yield and quality

Outcome 1.5

Fire management systems are adapted to changed climate conditions

Key strategies

1.5.1 Evaluate possible economic, environmental and social impacts of altered fire regimes associated with changed climatic conditions, rising temperatures and changing rainfall patterns.

Priority research

- Conduct a detailed study of the elements that determine fire risk and how they are projected to change under future climate scenarios
- Analyse climate change scenarios to assess the extent to which climate change alters the risk of bushfires in different regions of Australia.
- Determine appropriate management options to reduce bushfire risks to forests, plantations, biodiversity and the community under changed climatic conditions.

Outcome 1.6

Landscapes are designed and managed for resilience

Key strategies

1.6.1 Understand the vulnerability of forest species and ecosystems to climate change, for example, those with relatively narrow spatial distributions within areas characterised by relatively uniform climatic conditions. Develop management strategies for vulnerable native and plantation species and ecosystems.

1.6.2 Assess the impact of more frequent or prolonged drought on establishment, survival and growth of trees planted for commercial or environmental purposes in both traditional and dryland regions.

1.6.3 Evaluate consequences of the effects on biodiversity of disturbances induced by climate change, such as changed fire regimes, prolonged drought and increased prevalence of pests and diseases.

Priority research

- Studies of vulnerability of native and plantation forest ecosystems to climate change and factors limiting species distributions (such as extreme climatic events or other correlated factors such as the incidence of fire), to identify species or ecological communities at greatest risk.
- Identify possible management options to minimise the adverse effects of climatic changes including “assisted migration” of species to new habitats that may become suitable under changed climatic conditions
- Identify areas where plantations with currently marginal water supply have been established and with the aid of climate models analyse the impact of future climate scenarios on plantation productivity and water availability in these regions
- Determine the impact of management responses, such as thinning and fertility management, on stand survival
- Evaluate alternative species that may be suitable for plantations in areas now or soon to become available for planting, as climate change begins to take effect.

Quality and yield of Australia’s water resources

Outcome 2.1

A balanced and equitable basis for allocating water that does not unfairly impede growth of the forestry sector and recognises the economic and environmental benefits that forests provide

Key strategies

2.1.1 Provide the knowledge base for water allocation mechanisms that account for the total environmental and economic impacts of plantation forests within a catchment or region relative to the environmental and economic impacts of other land uses including those dependent on irrigation. This can be achieved through collaboration among all stakeholders supported by, multi-disciplinary research

2.1.2 Strengthen capacity in modelling and related areas, especially for scaling up plot-based data and information to catchment and regional scales to estimate water use by different land uses.

Priority research

- Develop full water-balance accounts to evaluate the impact of forests and other land uses on the quantity and quality of water resources, in the context of other environmental factors including biodiversity, salinity and carbon sequestration as well as economic and social outcomes of changes, This requires accounting for interactions between climate change, hydro-geological processes, local and regional water interception and social and economic processes

Outcome 2.2

Native and planted forests are managed in a sustainable manner using information based on knowledge of limitations within a changing climate.

Key strategies

2.2.1 Develop improved knowledge of growth performance of plantation species' growth performance to optimise productivity per unit area and optimise water-use efficiency.

2.2.2 Develop improved understanding of native forest water use under current and future climate conditions and different types of management regimes.

Priority research

- Species selection for environments with variable rainfall which have suitable wood properties for industrial use and which generate competitive returns
- Develop plantation design and management systems that maximise water availability and optimise water-use efficiency. Focus on water-use efficiency under a range of environments with particular emphasis on management systems for drier environments.
- Research on native forest water use at tree, site and catchment scales.

Policies and processes to strengthen the capacity of forests to deliver multiple objectives

Outcome 3.1

Better-informed policy decisions to-meet the multiple demands on forests

Key strategies

3.1.1 Determine future demand for goods and services from Australia's native and planted forests, including where and how they can be effectively and efficiently provided and what supply risks are likely to occur.

3.1.2 Develop monitoring and reporting mechanisms for forests to demonstrate the outcomes of active forest management

Priority research

- Investigate opportunities for expansion of Australia's plantation estate based on analysis of economic, environmental and social research inputs.

- Research to support a more comprehensive approach to risk management for forests, identifying key risks to the different forest resources and development of suitable treatments to effectively manage those risks
- Efficient tools for monitoring the different values and uses of forests.
- Evaluate socio-economic impacts of alternative land management systems involving forest plantations.

Outcome 3.2

The contribution of active forest management to biodiversity conservation at different scales is understood by communities, governments and industry

Key strategies

3.2.1 Develop knowledge and information about landscape-scale effects of particular land-use options and management strategies to inform public debate about forest use. Values to be considered should include wood production, biodiversity, visual amenity, catchment management, water yield and quality and other values and services.

3.2.2 Develop and implement improved methods for monitoring and quantifying the impacts of timber production and other management practices on forest biodiversity.

3.2.3 Develop and demonstrate more effective management and mitigation of negative impacts of timber production.

3.2.4 Assess the response to disturbance and recovery by native plants and fauna

Priority research

- Conduct multi-disciplinary analyses of strategies, and develop decision support tools, to integrate or segregate production and conservation at different scales and in different forest types.
- Research into improved monitoring and reporting for forest biodiversity and habitat surrogates.
- Long-term, operational-scale, ecological and management experiments to determine the effects of repeated cycles of forest management activities, and time to recovery, for sensitive species of plants and animals.

Outcome 3.3

Forest management is physically, economically and environmentally integrated into agricultural production systems

Key strategies

3.1.1 Assess the economics of integrated farming systems where trees are grown in association with agricultural crops and grazing systems for short-term and long-term forest product options

3.1.2 Develop catchment-scale and farm-scale models of integrated agroforestry systems

Priority research

- Investigate systems to integrate short-rotation and long-rotation tree species grown in association with cropping and grazing production systems for increased economic, environmental and social benefits
- Research on plantation designs, configuration and placement in the landscape to maximise biodiversity outcomes in rural landscapes

Protecting the health and biosecurity of Australia's forests

Outcome 4.1
Australia's natural and planted forests are included in national and state biosecurity plans jointly supported and implemented in a proactive and integrated manner by governments and industry

Key strategies
4.1.1 Develop a national biosecurity plan for native forests to complement the existing plantation industry plan. The transfer of management responsibility for native forest from production forestry to conservation and environment agencies, places an onus on those agencies to address forest biosecurity. These agencies must contribute to the national biosecurity framework and to development of a better understanding of threatening processes and their potential impacts and the development of contingency plans.
4.1.2 Forest biosecurity issues that can impact on non-traditional forest industries are identified and better understood.
4.1.3 Ensure that forestry is addressed in state biosecurity plans and all forest management agencies are engaged and investing in coordinated research and development and contingency planning to address biosecurity threats.
4.1.4 Evaluate models for national engagement of agencies to support forest health and biosecurity research such as the Industry Pest Management Group (IPMG) and Sub-Tropical Forest Health Alliance (SFHA)

Priority research areas
- Analysis of the potential impacts of pests and disease threats on non-commercial values (biodiversity, recreation, water and other values) in forests.
- Investigation of appropriate policy and management arrangements across jurisdictions and forest ownerships to effectively respond to biosecurity risks.

Outcome 4.2
Forest managers are equipped with biologically, economically and environmentally effective tools for managing pest and disease threats within Australia.

Key strategies
4.2.1 Effective control strategies are developed for the large number of pests and pathogens that threaten forests. New control strategies may be needed to replace existing strategies made redundant by environmental or economic factors.
4.2.2 Use scientific research to assist in identification of threats and in risk assessment and management for plantation and natural forests . As genetic diversity in planted forests declines the risk profile changes. Climate change and international trade patterns also change the likelihood of pest and disease incursions.
4.2.3 Build capacity in critical areas of detection and diagnosis of pests and diseases in relation to biosecurity
4.2.4 Explore interactions between silviculture, disease management, wood production and wood quality

Priority research
- Research into risk management and development of predictive models to help forest managers and owners improve preparation and mitigation strategies. This research should embrace assessment of costs and benefits of different strategies.

- Improved methods for surveillance and early detection of exotic and established or indigenous forest pests and pathogens, including spatial analysis and environmental data to target resources, sentinel/hazard site surveillance and trapping technologies
- Continue development of remote sensing technology coupled with ground survey, to provide methods to support health surveillance programs across native forests and plantations
- Research on the life cycle, impacts and responses to priority pests and diseases in forest and wood products

Forest product development and use

Outcome 5.1

Timber resources are of sufficient quantity and quality for profitable value-adding within Australia.

Key strategies

5.1.1 Declining availability of natural forest hardwood timber resources is increasing pressure to add value to available resources within Australia. The best available technology should be used to optimise production from these resources.

5.1.2 Improve recovery rates and utilisation of wood from waste streams to maximise the use of the available resource. Negative perceptions associated with re-use and recycling wood can be addressed through education programs.

Priority research

- Quantify the wood utilisation characteristics of the younger plantation resource, which has very different properties to mature native-forest wood.
- Investigate the relationships between genetics, site conditions and silvicultural management, and wood production and quality with the objective of maximising the capacity to add value to the resource.

Outcome 5.2

The opportunity to add value to Australia's wood fibre resource is enhanced by access to harvesting and processing techniques and technologies.

Key strategies

5.2.1 Increase the proportion of forest products research investment going to projects with longer-term, higher-value and more widespread benefits for the Australian forest sector.

Priority research areas

- Investigate opportunities to add value to timber from both plantations and natural forests, particularly for smaller regrowth logs
- Develop replacements for increasingly unacceptable preservative systems, adhesives and coatings (e.g., metal components, emissions of volatile organic compounds)
- Support development of modified or novel products and/or processes that are more suited to the known properties of the near-term and medium-term future resource, including development of non-pulp products capable of being produced from hardwood plantations, providing a financial incentive for longer rotations and higher plantation management costs (e.g. thinning, pruning)
- Develop new timber composite products with higher added value
- Develop improved, intelligent, efficient harvesting and processing technologies for the current resource, to reduce transport and processing costs and improve recovery and product value, including reduced energy consumption in harvesting, transport, sawing, drying, machining and protection systems.

Outcome 5.3

Value-adding to wood resources in Australia is optimised in social, economic and environmental terms

Key strategies

5.3.1 To move the product focus further along the value chain and maximise opportunities for adding value in Australia. To achieve this, a number of constraints have to be overcome, by investment in efficient wood processing infrastructure; community acceptance of large-scale processing locally and nationally, compliance with strict environmental codes and standards in line with product demand, and overcoming competition from low-cost wood processing in developing countries. This will critically define where Australia’s competitive advantage lies in wood processing.

Priority research

- Development of integrated approaches to value-added processing, utilisation and end-use for Australian forest products.
- Whole-of-life comparisons between wood and substitute materials and systems, including durability models leading to the development of design-based solutions to minimise the environmental impacts of various construction systems
- Research to support market mechanisms that better connect growers and processors and provide for widespread participation in forest product markets, including for small-scale growers and for environmental services.

Outcome 5.4

Australia's timber industry strengthens its position in the construction market by aligning itself with future opportunities determined by climate, economic, political and social change.

Key strategies

5.4.1 Develop better information on the green credentials of timber construction in terms of greenhouse gas footprint of wood products relative to other construction materials

Priority research

- Investigate the potential benefits of timber relative to non-wood building materials, in relation to embedded energy, greenhouse gas emissions and other aspects of environment, community health and sustainability
- Develop and adopt multi-disciplinary approaches to sustainable housing, embracing skills in the areas of architecture, energy consumption, renewable natural resources, resistance to natural disasters, and recycling capacity[47]

[47] Source: RPCC (2008). *Forestry Sector Research Strategic Directions 2008–2011*, Forest Research and Coordination Committee, Melbourne.

APPENDIX 2: *FWPA investment strategies*

Thirteen investment priorities, reflecting the interests of the FWPA members across the value chain, have been developed to ensure R&D results will either increase productivity, improve the value chain or reduce risk.[48] Other needs, outside the 13 priorities, may arise and will be considered on a case-by-case basis.

Defining the investment priorities ensures that the research community is aligned to the same issues and outcomes as industry. The priorities list illustrates the connection between the segments of the industry as they are categorised according to where they sit in the value chain, moving from the market through processing back to the resource.

1. **Information, analysis and interpretation of domestic and export markets**

   This knowledge allows industry to provide products that anticipate and satisfy market needs. Activities include detecting and monitoring trends and purchasing behaviour at specifier, trade and consumer levels.

2. **Timber construction in residential buildings**

   Research is required to assess the residential design and construction market needs and ensures that the industry is aware of, and responds to, changes in building codes and regulations. This knowledge will also help building professionals to work more efficiently with timber, and industry and the supply chain to respond better to issues as they arise.

3. **Timber construction in commercial and industrial buildings**

   Despite the strength of the Australian market and the quality of Australian timber products, and contrary to the emerging international trend, there has been limited use of wood as a construction material in buildings higher than three storeys. Investment in research in this area will lead to the knowledge, technology and products needed to develop this relatively untapped market.

4. **Appearance timber products and markets**

   Reliable information on the supply and demand for products such as furniture and flooring will ensure that future requirements can be anticipated and met. Research into maintenance and performance, the appearance of woods and methods of installation will help the industry to build on the increasing awareness of the environmental advantages of wood.

5. **Wood products in sustainable buildings**

   Carbon footprints, thermal values and environmental considerations are playing a greater role in building codes and policies — and creating opportunities for wood. This topic has been the subject of the initial FWPA investment plan. The four-year program is examining, for example, life cycle analysis for residential construction — completion of a comparison of the environmental impacts in embodied and operational energy for different types of construction. The investment plan aims to achieve voluntary or regulatory preferred specification of timber products over alternative materials.

[48] Source: *Forest and Wood Products Australia Annual Report, 08/09*.

6. **Development of secondary products and markets for them**

   Improving and increasing the use of the whole tree through developing value-added secondary products will minimise waste and maximise the return from each tree harvested. R&D investments in this area are identifying and analysing secondary products and their markets.

7. **Solid wood, engineered wood and pulp and paper products: Performance and yield**

   Recognising and responding to market needs enables the forest and wood products industry to design efficient systems and maximise production of appropriate products. This supports the wood industry's aim to create a better product by optimising production systems for energy use, drying, cutting, grading and sorting of wood. Developing quality control systems will give the end user a more consistent product, particularly for structural applications. For example, improved measuring and grading for strength and elasticity, and more accurate display of these qualities encourages broader use of wood and increased market acceptance.

8. **Maximising product yields and values from current resources**

   Increasing the yield of commercial products from each tree will increase profitability and reduce waste. Research into the characteristics, properties and variability of wood resources and identifying the most commercially viable applications and products realises maximum value and reduces unnecessary processing. Practices such as non-destructive testing to screen logs before processing, and segregation techniques at the mill gate can help maximise yields.

9. **Improving wood quality and yield, and tools for forest management**

   Forest managers need to optimise their forest management systems to make logs that processors value. Increasing the efficiency of inputs such as fertiliser and pesticides adds value to the industry. Improved management of forests — spacing, pruning and species choice — leads to better products and increased volume. Breeding and management can increase yield and thus the financial return to growers. Developing tools to measure or more accurately predict the quality and volume of standing forest reduces risk, and increases the usefulness and value of the product.

10. **Genetic improvement and delivery for increased wood yield and quality and for managing risks**

    Planting is the first opportunity to control the quality and volume of commercial timber. This investment priority focuses on genetic-based tree breeding which can significantly reduce the time it takes to improve a strain. Better selection techniques such as cross-breeding, screening, breeding programs for desirable traits and to improve fitness in the environment have lowered the time required to improve a planting. R&D will also investigate how new strains are deployed in plantations, as seedlings or seeds, faster generation of planting stock and a choice of clonal or progeny reproduction combine to produce the improved products sooner, reducing risk for growers.

11. **Water-use efficiency, access to resources and balanced policy outcomes**

    Increased awareness of climate trends and projections are resulting in industry requiring more information about water. Ensuring that water policy is informed by science maximises the volume of wood produced by a given volume of water. Data on how the industry sources and uses water for silviculture will generate value throughout the chain and increase awareness of environmental impacts. It will also identify opportunities for efficiencies in site selection and silviculture.

12. Forest biosecurity and preparedness

Increased international trade and production resources concentrated into discrete regions will increase risk. Risk can be reduced by an awareness of the immediate environment and its own risks, and the available controls, including biological controls. Developing risk profiles of pests and forest diseases will lead to informed risk management strategies. Developing responses to prioritised risks will ensure the best outcome for industry and the environment. Pest and disease outbreaks affect both commercial forests and public reserves so the application of the outcomes to multiple-use forest landscapes is an additional benefit of this priority program.

13. Mitigation of, and adaptation to, climate change and the management of the carbon cycle in plantation and native forests

Assessing the impact of climate change on plantation productivity will increase understanding of the non-commercial values of carbon in plantation and native forests, and help industry make its long-term planning decisions. Measuring the carbon in forests and increasing the understanding of the carbon cycle can help industry adapt to, and plan for, the forecast climate changes. Combining the data with economic modelling, and using it to generate maps of the effects of climate on growing conditions for established forests, will give the industry information that it needs to prepare for and manage any change.

Report

FWPA R&D Program Evaluation

29 JUNE 2010

Prepared for

Forest and Wood Products Australia

Level 4, 10-16 Queens Street
Melbourne VIC 3000

42807496

URS

Project Manager:

....
Lili Pechey
Senior Economist

URS Australia Pty Ltd

Level 6, 1 Southbank Boulevard
Southbank VIC 3006
Australia
T: 61 3 8699 7500
F: 61 3 8699 7550

Project Director:

....
John Tredinnick
Senior Principal Consultant

Author:

....
Lili Pechey
Senior Economist

Date:	**29 June 2010**
Reference:	42807496/01/02
Status:	Final

Table of Contents

Tables

Appendices

Executive Summary

Introduction

Forest and Wood Products Australia (FWPA) directs investment into research and development (R&D) projects that aim to increase the competitiveness and profitability of the forest and wood product-based industries. Since January 1996, FWPA has invested in 423 projects within 14 investment priority areas.

According to the protocol developed by the Council of Rural Research and Development Corporations Chairs (CRRDCC) has committed to regularly undertaking an evaluation of its investment program by considering a representative sample of projects and scaling this up to reflect the overall benefits of FWPA's R&D investment program.

This report contains the results from the evaluation of nine of FWPA's research projects.

Methodology

Six projects from each of FWPA's major investment categories (growing, processing and marketing) were randomly selected. These were then shortlisted to three projects, which represented high, low and average cost projects, all of which commenced after April 2002 and which were completed and delivered before July 2009. The short-list was discussed with FWPA to help refine the selection. The final selection of nine projects is contained in Table 1. Note that some projects have been combined and reviewed as a single project because the project benefits could not be readily attributed to a single project.

Table 1 Projects that have been included in the review

Major Grouping	Project Number	Project Title
Growing - high	PN03.1915	An advanced genetic evaluation system for forest tree improvement (TREEPLAN)
	PN07.4025	Genetic gain optimisation in tree breeding (MATEPLAN) and deployment (SEEDPLAN)
Growing - medium	PN04.3003	Genetic variation in wood properties of *E. dunnii* relevant to solid wood products
	PN06.3017	Improving dimensional stability in plantation-grown *E. pilularis* and *E. dunnii*
Growing - low	PRC072-0708	Fertiliser usage in forestry: current status and prospects for increasing its efficiency and profitability
Processing - high	PN04.2004	Wood quality initiative
Processing - medium	PNC053-0708	Standing tree measurement of acoustic velocity as a predictor of kraft pulp yield in *E. nitens* across 2 sites
Processing - low	PN04.2002	Treatment correction factors for capacitance meters with radiata pine and slash pine
	PN07.2045	Moisture meter corrections for ACQ treated pine
Marketing - high	PN03.1213	A risk based approach to enhancing the perception of timber as a suitable construction material in termite prone areas
Marketing - medium	PNA020-0809	Strategy for large span second storey timber and wood products
Marketing - low	PNA014-0708	Assessing the ability of a large-scale fire test to predict the performance of wood poles exposed to bushfires and the ability of fire protective formulations to reduce loss of wood poles exposed to severe bushfires

Benefit cost analysis (BCA) has been used to undertake the evaluation of each project. The BCA framework involves defining a base case (or counterfactual) against which the project impacts can be assessed in terms of the projects' Net Present Value (NPV), Benefit Cost Ratio (BCR) and the Internal Rate of Return (IRR).

The BCAs consider the total funds invested in a given project relative to the total benefits that the projects have conferred to Australian society, rather than just those costs (and benefits) incurred by FWPA. In addition to FWPA's funding, most of the projects have also obtained additional funding through either in-kind contributions or third-party investment. Environmental outcomes from the projects have been identified and quantified where possible. None of the projects were considered to have any quantifiable social value.

Project leaders and key industry contacts were consulted to inform the evaluation, with supporting information and data obtained through desktop research.

The project level evaluations have been 'scaled up' using the estimated benefit cost ratios to estimate the program level benefits.

Results

Project level results

Table 2 contains the summary results for the projects. For each project, results are evaluated through to 50 years after the project was completed, using a five percent discount rate. A 50 year timeframe was considered appropriate for forestry projects where the benefits often accrue only after trees are grown and harvested. Monetary values are reported in 2009 dollars. It was not possible to estimate the benefits of the medium value growing and processing projects and the high value marketing project in quantitative terms. Further details about the assessment of these projects are contained in Appendices A - I.

Table 2 Results of project analysis

	Project value		
Project	**Low**	**Medium**	**High**
Growing			
BCR	1.4	NA	15.4
IRR	3%	NA	21%
Processing			
NPV ($ 000)	$346	NA	$14,717
BCR	3.1	NA	5.5
IRR	16%	NA	26%
Marketing			
NPV ($ 000)	$702	$821	NA
BCR	4.9	6.4	NA
IRR	42%	48%	NA

* Note that all BCRs are evaluated over 50 years, using a 5% discount rate. Values are reported in 2009 dollars.
Source: URS estimates.

All projects for which the benefits were quantified provided a positive NPV. There is significant variation in the NPVs associated with the projects and the BCR's ranging from 1.4 to 15.4.

Program level results

The results obtained for each category have not been aggregated to obtain a measure of the overall benefits achieved from FWPA's entire investment portfolio. This was based on the assessment that such aggregation would not be reflective of the potential benefits. Rather, aggregation has been undertaken at the category level (i.e. growing, marketing, and processing). Table 3 contains the estimated benefit and weighted average BCR, aggregated for each investment category.

Table 3 Evaluation: category level aggregation

	Number	Total value invested ($ 000)	Value of sample projects ($ 000)	Sample projects as % of total	Weighted average BCR	Estimated benefits from total investment ($ 000)
Growing category	33	$16,694	$2,626	16%	14.8	$247,894
Processing category	58	$35,150	$3,004	9%	5.4	$189,550
Marketing category	47	$18,924	$594	3%	2.4	$45,061

Note that all BCRs are evaluated over 50 years, using a 5% discount rate. Values are reported in 2009 dollars.
Source: URS estimates.

The BCRs across the categories are all positive, ranging from 2.4 to 14.8, with the growing category projects providing higher weighted average BCRs than processing or marketing projects Applying these BCRs to the total value invested provides an indication of the benefits that may be expected in each category. However, the aggregation required to calculate these potential benefits means that the estimates should be treated with a significant degree of circumspection. Not every project within these categories can be expected to achieve the estimated BCR.

Sensitivity analysis results

Table 4 contains the results from the sensitivity analysis, reflecting both high and low estimates. The results continue to be positive for all but the low-value growing project. Further information about the assumptions that underpin the sensitivity analyses are contained in the relevant appendices.

Table 4 Sensitivity analysis - project results

	Benefit Cost Ratio*	
Project	**Low estimate**	**High estimate**
Growing - low	0.7	4.8
Growing - high	6.8	32.8
Processing - low	2.0	7.1
Processing - high	4.4	7.3
Marketing - low	2.8	15.2
Marketing - medium	2.9	12.2

* Note that all BCRs are evaluated at over 50 years, using a 5% discount rate.
Source: URS estimates.

Discussion

The results suggest that the "growing" research provides the greatest return on investment, despite the long time horizons before some benefits are accrued. The primary reason for this is that projects resulting in genetic gains will increase yields from a given area of land without any substantial change in the costs of managing that land during the rotation. Benefits are therefore transferred straight to the bottom line of growers at the time of harvesting. This contrasts to the processing projects where the potential to increase revenue from quality improvements is limited by the commodity nature of the product and volume based costs associated with production.

The research projects associated with the growing sector also produced information with the potential to be readily applied across both the softwood and hardwood plantation industries. In addition, adoption of research outcomes in the growing sector is expected to be rapid as the beneficiaries of the research are a relatively small group.

The marketing research appears to provide the lowest estimated return on investment. However, this does not necessarily mean that this area of research is not worthwhile for the forest industry. Rather, it is likely that this result reflects a conflict between the methodology for assessing the benefits in this analysis and the charter of the FWPA in funding marketing projects. While the FWPA will fund projects to maximise the value of returns to the timber industry at the expense of other competitive industries (e.g. steel), the Cost Benefit Analysis assesses the benefits to society as a whole. As such, any increase in the market share of timber is valued only in terms of the net cost saving to society, not the increase in revenue to the timber industry. In marketing projects the ‘technology’ transfer (i.e. extension and marketing activity) also needs to be directed at a much broader audience than for the other research categories, which makes it particularly difficult to maximise the impact of a given marketing project.

Environmental and social impacts

Environmental and social impacts were considered for all projects; however, environmental benefits could be estimated quantitatively for only one of the projects. This was the ‘Assessing the ability of a large-scale fire test to predict the performance of wood poles exposed to bushfires and the ability of fire protective formulations to reduce loss of wood poles exposed to severe bushfires’ project (PNA014-0708), which was assumed to result in the substitution of wooden poles for steel or concrete equivalents. In this case there was technical information available to assess the differences in embodied energy between the alternative products and some early signals on carbon prices (although this market has not yet been established. For other projects, the environmental and social impacts of the research (relative to the base case) could not be accurately quantified. There are a number of reasons for this:

- Of the projects selected for evaluation, many were considered to have no, or very limited, direct environmental or social impacts.
- For some projects that could potentially have environmental or social impacts, quantifying the impacts with any confidence was not possible because of the lack of technical or market price information.
- For other projects, many of the environmental and social benefits are already captured in the benefits derived from improved efficiency. In these cases, estimating the environmental and social benefits would result in double-counting of the project benefits.

Although direct environmental and social impacts have not been identified or estimated for a number of the projects, it is important to recognise that there may be secondary environmental and social benefits associated with projects that result in productivity improvements. Through such improvement, fewer resources are required to produce the same volume of output, potentially resulting in a smaller ecological footprint and, hence, in environmental benefits. Society also benefits through the improved living standards that result from productivity improvements.

It is also important to recognise that there is a broader benefit to society from maintaining research capacity that is capable of tackling future research needs. Research capacity, particularly in terms of scientists, engineers and technicians, cannot be established quickly. Reduction in research capacity could mean that potential productivity improvements are foregone and that Australia becomes increasingly reliant on the international research effort. Both outcomes could reduce the competitiveness and performance of Australia's Forest and Wood Products sector.

Limitations

Project level results

There are a number of qualifications associated with the results:

- Estimates of costs and benefits are contingent on a number of assumptions. The assumptions underpinning our estimates have been based on discussions with project leaders, industry contacts and professional judgement; however they are nonetheless subjective and should be considered indicative of the order of magnitude rather than the actual value of research.
- For many of the projects that were reviewed, identifying the counterfactual (or base case) was not always clear and it is possible that the project benefits will be either under- or over-estimated.
- Even where the assumptions about the costs and benefits have been estimated with relative certainty, the extent to which the research results are adopted by industry will have a significant bearing on the projects' overall impact. In the short term (e.g. in the five years after a project is completed), it is generally easier to consider the adoption rate, because market conditions are more certain. In the longer term, adoption is more difficult to assess as there are likely to be a number of unforeseen factors that may affect adoption. Long term adoption rates also depend on assumptions regarding whether or not industry participants would have undertaken their own research and reached similar conclusions in the absence of FWPA investment.
- Generally speaking, research results are but one factor influencing the market for timber products and the competitiveness and profitability of businesses operating in the forest and wood products industry. Movements in the exchange rate, the price of alternative products, and residential housing starts are all factors that have a significant influence on the timber products market. It is often difficult to distinguish the effects of research from these other influences.

Program level results

The projects that were selected for evaluation were done so as to be consistent with the CRRDCC requirements of representativeness and randomness. Taken literally, these two objectives are mutually exclusive as representativeness cannot be achieved if the selection process is strictly random. The approach taken in this review was to select projects from each of FWPA's broad investment categories and within these, to randomly select projects to represent high, medium and low value investments.

These estimated benefits should not be considered reflective of the actual benefits associated with the investment that has been made in each of these categories, because of the variability in BCRs that is evident at the project level. Rather, the results could best be considered as a tool for guiding the investment between and within the three broad categories.

Introduction

Forest and Wood Products Australia (FWPA) directs investment into research and development (R&D) projects that aim to increase the competitiveness and profitability of the forest and wood product-based industries. Since January 1996, FWPA has invested in 423 projects within 14 investment priority areas.

According to the protocol developed by the Council of Rural Research and Development Corporations Chairs (CRRDCC) FWPA has committed to regularly undertaking an evaluation of its investment program by considering a representative sample of projects. This specific program evaluation will also contribute to FWPA's submission to the recently announced Productivity Commission inquiry into Rural Research and Development.

URS Australia Pty Ltd (URS) has been engaged to undertake this evaluation and this report outlines the process employed to undertake the work and the results of the analysis. Section 2 of the report outlines the evaluation methodology and Section 3 provides the program-level evaluation results. A discussion of the results is presented in Section 4. Appendices A to I contain a detailed description of the projects that were assessed to inform the program-level results.

Methodology

Benefit cost analysis (BCA) has been used to undertake the evaluation of each project. The BCA framework involves defining a base case (or counterfactual) against which the project impacts can be assessed in terms of the project's Net Present Value (NPV), Benefit Cost Ratio (BCR) and the Internal Rate of Return (IRR).

The BCAs consider the total funds invested in a given project relative to the total benefits that the projects have conferred to Australian society, rather than just those costs (and benefits) incurred by FWPA. In addition to FWPA's funding, most of the projects have also obtained additional funding through either in-kind contributions or third-party investment. Environmental outcomes from the projects have been identified and quantified where possible. None of the projects were considered to have any quantifiable social value.

Project leaders and key industry contacts were consulted to inform the evaluation, with supporting information and data obtained through desktop research.

The following section describes the methodology in further detail, starting from the identification of the project population from which the sample was drawn.

2.1 Project population

FWPA requested that only projects initiated from 1 April 2002 and which had been completed and delivered before July 2009 should be included in the evaluation. Projects selected for funding after this date were subject to a standardised project approval and management system. The number of projects that have commenced since this date is 188.

In addition, the FWPA has suggested that its 14 investment priority areas should be aggregated into three broad 'working' investment categories: growing, processing, and marketing. Table 2-1 includes summary information about the population from which the projects were selected. Reference to cost is to the total investment in the R&D project regardless of the source of funds.

Table 2-1: Summary of project population

Projects with 2002-09 commencement date	Priority area			Total
	Growing	Processing	Marketing	
Number of projects	41	77	70	**188**
% of total projects funded	22%	41%	37%	**100%**
Total cost	$16,826,937	$35,149,734	$18,924,126	**$70,900,796**
% of total project cost	26%	41%	37%	
Highest cost project	$4,293,950	$4,200,000	$3,899,700	
Average cost project	$403,401	$370,533	$295,723	
Lowest cost project	$15,000	$10,000	$1,680	

2.2 Step 1: Sampling

The CRRDCC Guidelines for Evaluations describe the methodology for assessing the impact of R&D programs funded by the Research and Development Corporations (RDCs). The two most critical elements of the CRRDCC's guidelines are the need to create a representative sample of independent investments[1] and for this sample to be random.

The Guidelines specify that the population of sub-programs[2] from which a random sample is drawn should be based on a population that conforms to the following characteristics:

- *A series of 'clusters' of projects commissioned to contribute to a particular defined area of investigation that was established to produce a particular product, service or other outcome. These may be sub-programs or simply related projects leading to a specific outcome.*
- *The sampling process should be random, that is all defined sub-programs or their equivalent should be put into the population from which the pooled samples will be drawn.*
- *The 'sub-program' or cluster of projects must have reached (but not necessarily achieved) a significant milestone within the last 2-5 years.*
- *The time frame for the population from which the sample will be drawn should be long enough for some confidence in the technology to be built (usually indicated by early adoption rates) and for sufficient data to be available (such as ABS or ABARE survey reports).*
- *The pool of CBAs proposed will be based on a three year cycle. This means that the pool of sampled projects will initially be built up over three years once the process has been implemented. Once the pool has been established, each subsequent year will be added and a year dropped off. This will provide a three year moving average with results published each year.*
- *The program can have either an off-farm or on-farm orientation (supply or demand focus).*

Based on this guidance, and through our discussions with the FWPA, URS has developed the following methodology for an evaluation that is consistent with these two overarching requirements.

2.2.1 Sampling process

A fixed sampling rate for each of the three investment categories (growing, processing and marketing) was used. Six projects were randomly selected from each category which were then shortlisted to three projects for each category. For each of these categories, the sample projects were selected to represent high, low and average cost projects. Overall, nine projects were selected for evaluation.

The short-list was discussed with FWPA to help refine the selection. Some projects were rejected on the grounds that they related to the delivery of workshops. Other projects were combined, where they represented sequential research effort for a particular project outcome[3]. The Wood Quality Initiative (PN04.2004) was included at FWPA's suggestion, as a representative large-scale processing project .

2.3 Step 2: Benefit cost analysis

Following the selection of the sample, the BCA was undertaken using the following key steps:

- Specification of the objectives of the projects to be evaluated;
- Defining the base case;

[1] Note that, in the current context, an 'independent investment' is assumed to refer to a stand alone research project.
[2] Note that, from FWPA's perspective, 'sub-programs' are considered equivalent to research projects.
[3] For example the Treatment correction factors for capacitance meters with radiata pine and slash pine (PN04.2002) and the Moisture meter corrections for ACQ treated pine projects (PN07.2045).

2 Methodology

- Identifying project impacts relative to the base case;
- Assessing project impacts (quantitatively, where possible);
- Undertaking the BCA at the project level
- Aggregating results to the program level; and
- Performing sensitivity testing of key parameters

These steps are elaborated in the following sections.

Specifying the objectives of the proposed projects to be evaluated

The objectives of the projects were determined based on the detailed project proposals, final reports and discussion with project leaders.

Defining the base case (or counterfactual)

The base case is also known as the 'counterfactual' or 'business-as-usual' scenario and was defined using input from both project staff and industry contacts. Industry contacts included:

- Representatives from hardwood and softwood plantation companies;
- Technical and business development managers and CEOs from softwood processing companies;
- Representatives from industry associations;
- Principal research scientists and managers from research organisations;
- Plant breeding managers from plantation companies;
- Industry consultants;
- Engineers from industry manufacturing companies; and
- Representatives from wood preservation companies.

The base case provides the point of reference for the assessments, and each project was assessed relative to the base case over an appropriate time period. The CRRDCC Guidelines for Evaluations recommend, as a minimum, 5, 10 and 20 year assessment horizons and all projects were assessed over these horizons. Projects were also assessed over a 50 year horizon in recognition of, for example, "growing" projects, where the benefits often accrue only after trees are grown and harvested.

It is important to recognise that the base case is not the current situation, but rather the expected future in the absence of any change from continuation of the business-as-usual scenario. For example, the industry may receive benefits from private sector investment in processing technology, regardless of whether FWPA makes an investment in this area. Therefore the base case should incorporate these benefits to the extent possible.

In defining the base case, it was also necessary to recognise that the reference year for calculating the benefit cost ratio (BCR) of each project differed. Accordingly, a CPI adjustment factor was used to ensure that projects with different reference years were compared on a consistent basis. All costs and benefits in this evaluation are based on 2009 dollars.

2 Methodology

Identifying project impacts

A qualitative understanding of the likely impacts of implementing each of the projects, relative to the base case, was next obtained.

The project impacts were identified through the project proposals and final reports and were confirmed in discussions with project leaders and industry contacts.

The following approaches were taken to assessing the benefits:

- For projects that could result in increased forest productivity (e.g. genetics, fertiliser trials), benefits were estimated according to the potential increase in gross value resulting from increases in log volume at the stumpage level.
- For projects that could result in increases in final product value (e.g. improved timber quality), benefits were estimated according to the potential increase in gross value of the products ex-primary processing mill.
- For projects that could result in efficiency gains (e.g. improved processing tools and technologies), benefits were estimate according to the potential reduction in operating costs.
- For projects that could result in an increase in the volume of timber products sold in Australia (e.g. improved perceptions of wood products), benefits were estimated by the cost savings to consumers that purchase these products.[4]

There is a very important qualification relating to any benefits that may accrue as a result of timber product quality or reduced processing costs. Structural timber is considered to be a commodity product and the ability of any single enterprise to differentiate their products and gain a competitive advantage in terms of price or profits will be limited to early movers. These benefits are only likely to accrue for a short period of time before the rest of the market is selling a similar quality product, or has made similar reductions to costs that result in reductions in the product price.

Care was taken to avoid double-counting of benefits and costs. For example, if the benefits of an investment resulted in an increase in the value of wood production (primary market) it was not counted a second time in relation to an increase in employment (secondary market) that this may have caused.

Assessing project impacts

Following the confirmation of the impacts in physical or qualitative terms, the magnitude of costs and benefits was estimated. The most convenient metric for analysis is to measure costs and benefits in monetary terms (i.e. 2009 dollars). This is most straightforward where the project resulted in changes to the quantity or value of goods and services that are traded in markets, and hence have an associated market price. For example, the benefit of a project that results in increased forestry production can be measured by the increase in revenue arising from that project. Similarly, reductions in operating costs are a monetary measure of the benefits of a given project.

Some project impacts produced a benefit or conferred a cost to society that was not reflected in market transactions of goods and services. For example, environmental improvements are widely

[4]There is a conflict between the methodology for assessing the benefits in this analysis and the charter guiding FWPA's R&D investment in research into market access issues. While the FWPA will fund projects to maximise the value of returns to the timber industry at the expense of other competitive industries (e.g. steel), the BCA assesses the benefits to society as a whole. As such, any increase in the market share of timber is valued in terms of the net cost saving to society, not the increase in revenue to the timber industry.

recognised as a benefit to society. However, due to inherent difficulties in assigning property rights to these benefits, markets do not exist for the goods and services provided by the environmental resource. As a result, no market price exists to value these benefits.

Such values are often measured using techniques that attempt to reveal the price that people would be willing-to-pay to receive these benefits, known as non-market valuation (NMV) techniques. These include techniques such as the travel cost method, hedonic pricing, choice modelling, and contingent valuation. An alternative to these techniques is Benefit Transfer, which relies on secondary research to estimate NMV. However, the application of these techniques is usually a costly and time-consuming process.

Where possible, the environmental and social impacts of the R&D projects were estimated using existing literature that had been completed in relevant areas. Where this was not possible, a qualitative description of the impacts is provided.

Undertaking the BCA

Once the impacts associated with the projects were quantified (as far as possible), the stream of costs and benefits were converted into a single measurement at a point in time by using discounting. An MS Excel spreadsheet model was developed for this purpose.

Discounting is a common approach to accounting for costs, benefits or outputs that occur over different time periods. The process of discounting enables the direct comparison of an amount of money that accrues in different time periods. Discounting gives greater weight to initial benefits and costs and less weight to those in the distant future. The CRRDCC guidelines specify a real discount rate of five percent, which was used for the analyses.

The difference between the discounted sum of the costs and benefits associated with the project is known as the net present value (NPV). The NPV provided the basis for a number of different decision criteria, including:

- Benefit-cost ratio (BCR) – comparing benefits as a proportion of costs;
- Internal rate of return (IRR) - the discount rate at which the costs of the investment are equal to the benefits of the investment (i.e. NPV = 0).

Consistent with the CRRDCC guidelines, all three decision criteria are reported.

Aggregation of project evaluation

The project-level BCR's were 'scaled-up' based on the total expenditure in each of the three investment categories to provide a program-level evaluation for these categories.

Sensitivity analysis

Sensitivity analyses were undertaken on the parameter values of key costs and benefits to determine the relative significance of these variables in the overall evaluation. These analyses were undertaken for each project.

Results

The following section contains a summary of the BCA results for the three broad investment categories. Further detail relating to these results, including sensitivity testing, are contained in Appendices A - I.

The project-level results are followed by the program-level results.

3.1 Project results

Table 3-1 contains the summary results for the projects. For each project, results are evaluated through to 50 years after the project was completed, using a five percent discount rate. A 50 year timeframe was considered appropriate for forestry projects where the benefits often accrue only after trees are grown and harvested. Monetary values are reported in 2009 dollars. It was not possible to estimate the benefits of the medium value growing and processing projects and the high value marketing project in quantitative terms. Further details about the assessment of these projects are contained in Appendices A - I.

Table 3-1 Results for growing, processing and marketing investment projects

	Project value		
Project	**Low**	**Medium**	**High**
Growing			
BCR	1.4	NA	15.4
IRR	3%	NA	21%
Processing			
NPV ($ 000)	$346	NA	$14,717
BCR	3.1	NA	5.5
IRR	16%	NA	26%
Marketing			
NPV ($ 000)	$702	$821	NA
BCR	4.9	6.4	NA
IRR	42%	48%	NA

Note that all BCRs are evaluated over 50 years, using a 5% discount rate. Values are reported in 2009 dollars.
Source: URS estimates.

3.1.1 Summary

All projects for which the benefits were quantified provided a positive NPV. There is significant variation in the NPVs associated with the projects, with the BCR's ranging from 1.4 to 15.

3.2 Program results

The results obtained for each category have not been aggregated to obtain a measure of the overall benefits achieved from FWPA's entire investment portfolio. This was based on the assessment that such aggregation would not be reflective of the potential benefits. Rather, aggregation has been undertaken at the category level (i.e. growing, marketing, and processing). Table 3-2 contains the aggregated results for the growing, processing and marketing category projects.

Table 3-2 Growing, processing and marketing categories aggregation

	Number	Total value invested ($ 000)	Value of sample projects ($ 000)	Sample projects as % of total	Weighted average BCR	Estimated benefits from total investment ($ 000)
Growing category	33	$16,694	$2,626	16%	14.8	$247,894
Processing category	58	$35,150	$3,004	9%	5.4	$189,550
Marketing category	47	$18,924	$594	3%	2.4	$45,061

Note that all BCRs are evaluated over 50 years, using a 5% discount rate. Values are reported in 2009 dollars.
Source: URS estimates.

3.2.1 Summary

The BCRs across the categories are all positive, ranging from 2.4 to 14.8, with the growing category projects providing higher weighted average BCRs than processing or marketing projects Applying these BCRs to the total value invested provides an indication of the benefits that may be expected in each category. However, the aggregation required to calculate these potential benefits means that the estimates should be treated with a significant degree of circumspection. Not every project within these categories can be expected to achieve the estimated BCR.

3.3 Sensitivity analysis

Table 3-3 contains the results from the sensitivity analysis, reflecting both high and low estimates. The results continue to be positive for all but the low-value growing project. Further information about the assumptions that underpin the sensitivity analyses are contained in the relevant appendices.

Table 3-3 Sensitivity analysis - project results

	Benefit Cost Ratio*	
Project	Low estimate	High estimate
Growing - low	0.7	4.8
Growing - high	6.8	32.8
Processing - low	2.0	7.1
Processing - high	4.4	7.3
Marketing - low	2.8	15.2
Marketing - medium	2.9	12.2

* Note that all BCRs are evaluated over 50 years, using a 5% discount rate.
Source: URS estimates.

Discussion

BCA is widely used and is considered the most appropriate methodology to evaluate R&D investments. In this review, the BCA framework has been used to estimate the benefits and costs associated with the projects from society's perspective; however, for some projects, for example PNC053-0708, PN04.3003 and PN03.1213[5], the methodology was not as applicable.

For these projects, the research results enabled hypotheses to be disproved, but did not lead to a quantifiable market impact. Such results do not mean that the research should not have been funded. Rather, the benefits from such projects are generally more difficult to quantify and take the form of avoided future research effort or the maintenance of research capability, both of which are difficult to quantify in monetary terms. Another reason that such projects are not well-served by BCA is the difficulty associated with identifying a counterfactual scenario had the research not gone ahead. Hence it is not possible to develop two streams of costs and benefits for the 'with' and 'without' research projects scenarios to assess within the BCA framework.

Another concern with the BCA methodology is the need to quantify impacts in a common unit of assessment; namely the monetary value of the impacts. This is relatively straightforward for projects that result in, for example, changes in the volume or value of timber produced; however, for projects that incorporate environmental benefits, the estimation of value is more difficult. In this review, only a handful of projects are thought to have (or will result in) significant environmental benefits. These have been quantified where possible and where this is not the case, such benefits have been described qualitatively.

Environmental and social impacts

Environmental and social impacts were considered for all projects; however, environmental benefits could be estimated quantitatively for only one of the projects. This was the 'Assessing the ability of a large-scale fire test to predict the performance of wood poles exposed to bushfires and the ability of fire protective formulations to reduce loss of wood poles exposed to severe bushfires' project (PNA014-0708), which was assumed to result in the substitution of wooden poles for steel or concrete equivalents. In this case there was technical information available to assess the differences in embodied energy between the alternative products and some early signals on carbon prices (although this market has not yet been established). For other projects, the environmental and social impacts of the research (relative to the base case) could not be accurately quantified. There are a number of reasons for this:

- Of the projects selected for evaluation, many were considered to have no, or very limited, direct environmental or social impacts.
- For some projects that could potentially have environmental or social impacts, quantifying the impacts with any confidence was not possible because of the lack of technical or market price information.
- For other projects, many of the environmental and social benefits are already captured in the benefits derived from improved efficiency. In these cases, estimating the environmental and social benefits would result in double-counting of the project benefits.

[5] PNC053-0708 (Standing tree measurement of acoustic velocity as a predictor of kraft pulp yield in *E. nitens* across two sites); PN04.3003 (Genetic variation in wood properties of *E. dunnii* relevant to solid wood products); and PN03.1213 (A risk based approach to enhancing the perception of timber as a suitable construction material in termite prone areas).

Although direct environmental and social impacts have not been identified or estimated for a number of the projects, it is important to recognise that there may be secondary environmental and social benefits associated with projects that result in productivity improvements. Through such improvement, fewer resources are required to produce the same volume of output, potentially resulting in a smaller ecological footprint and, hence, in environmental benefits. Society also benefits through the improved living standards that result from productivity improvements.

It is also important to recognise that there is a broader benefit to society from maintaining research capacity that is capable of tackling future research needs. Research capacity, particularly in terms of scientists, engineers and technicians, cannot be established quickly. Reduction in research capacity could mean that potential productivity improvements are foregone and that Australia becomes increasingly reliant on the international research effort. Both outcomes could reduce the competitiveness and performance of Australia's Forest and Wood Products sector.

4.1 Results

The results suggest that the “growing” research provides the greatest return on investment, despite the long time horizons before some benefits are accrued. The primary reason for this is that projects resulting in genetic gains will increase yields from a given area of land without any substantial change in the costs of managing that land during the rotation. Benefits are therefore transferred straight to the bottom line of growers at the time of harvesting. This contrasts to the processing projects where the potential to increase revenue from quality improvements is limited by the commodity nature of the product and volume based costs associated with production.

The research projects associated with the growing sector also produced information with the potential to be readily applied across both the softwood and hardwood plantation industries. In addition, adoption of research outcomes in the growing sector is expected to be rapid as the beneficiaries of the research are a relatively small group.

The marketing research appears to provide the lowest estimated return on investment. However, this does not necessarily mean that this area of research is not worthwhile for the forest industry. Rather, it is likely that this result reflects a conflict between the methodology for assessing the benefits in this analysis and the charter guiding FWPA's research investment in market access issues. of the FWPA in funding marketing projects. While the FWPA will fund projects to maximise the value of returns to the timber industry at the expense of other competitive industries (e.g. steel), the BCA assesses the benefits to society as a whole. As such, any increase in the market share of timber is valued in terms of the net cost saving to society, not the increase in revenue to the timber industry. In marketing projects the ‘technology’ transfer (i.e. extension and marketing activity) also needs to be directed at a much broader audience than for the other research categories, which makes it particularly difficult to maximise the impact of a given marketing project.

4.2 Limitations of the analysis

Project level results

There are a number of qualifications associated with the results:

- Estimates of costs and benefits are contingent on a number of assumptions. The assumptions underpinning our estimates have been based on discussions with project leaders, industry contacts and professional judgement; however they are nonetheless subjective and should be considered indicative of the order of magnitude rather than the actual value of research.

- For many of the projects that were reviewed, identifying the counterfactual (or base case) was not always clear and it is possible that the project benefits will be either under- or over-estimated.
- Even where the assumptions about the costs and benefits have been estimated with relative certainty, the extent to which the research results are adopted by industry will have a significant bearing on the projects' overall impact. In the short term (e.g. in the five years after a project is completed), it is generally easier to consider the adoption rate, because market conditions are more certain. In the longer term, adoption is more difficult to assess as there are likely to be a number of unforeseen factors that may affect adoption. Long term adoption rates also depend on assumptions regarding whether or not industry participants would have undertaken their own research and reached similar conclusions in the absence of FWPA investment.
- Generally speaking, research results are but one factor influencing the market for timber products and the competitiveness and profitability of businesses operating in the forest and wood products industry. Movements in the exchange rate, the price of alternative products, and residential housing starts are all factors that have a significant influence on the timber products market. It is often difficult to distinguish the effects of research from these other influences.

Program level results

The selection of the projects for evaluation was undertaken to comply with the RDCC requirements of representativeness and randomness. Taken literally, these two objectives are mutually exclusive as representativeness cannot be achieved if the selection process is strictly random. The approach taken in this review was to select projects from each of FWPA's broad investment categories and within these, to randomly select projects to represent high, medium and low value investments.

Because of the inherent variability in the projects selected for assessment, a weighted average BCR was not derived for the entire R&D program funded by FWPA. Rather, a weighted average BCR was used to estimate the overall benefits for each broad investment category.

These estimated benefits should not be considered reflective of the actual benefits associated with the investment that has been made in each of these categories, because of the variability in BCRs that is evident at the project level. Rather, the results could best be considered as a tool for guiding the investment between and within the three broad categories.

4.3 Implications for future evaluations

The reliance on assumptions such as those that have been made during this evaluation could be reduced by gathering some of the relevant information at project commencement. In particular, it would be useful for project proponents to consider and report their views on the base case at the time of requesting funding. At this time the alternative routes for development of technology or information are usually much clearer than they are after the project has been completed.

It would also be helpful if project proponents were able to undertake the following steps:

- When undertaking the benefit cost analysis as part of the project proposal, clearly articulate the reasons for assumptions. In some cases the data presented for projects reviewed in this study were based on hypothetical outcomes, rather than detailed analysis; and

4 Discussion

- At the end of the project, and as part of the deliverable, project leaders could specify the expected impacts of the project and how the information required to measure the impacts could be gathered and analysed.

It is important to recognise that project proponents are not independent of the analysis and obviously have an interest in inflating the predicted benefits. In addition, the project proponents are not always the best qualified to asses the impacts. For example, a geneticist does not necessarily have an appreciation of the factors that drive timber prices. Some form of independent review will still be necessary and project proponents should draw on industry assistance for information about impacts and adoption.

Generally speaking, there is a need for improved industry statistics throughout the value chain. The coordinated collection and reporting of such statistics would benefit the whole of industry and would assist project proponents (and independent project evaluators) to determine the value of project impacts.

References

ABARE (2009) *Australian forest and wood products statistics*, March and June quarters 2009, Canberra.

Blakemore, P., Morrow A., Liew, L., Muruganathan, M. and Luff R. (2005) *Species and treatment corrections for hand-held moisture meters with radiata and slash pine* (Final Report). Client Report No. 1521.

Bureau of Rural Sciences (2006) Australia's Plantations 2006. Canberra. Department of Agriculture, Fisheries and Forestry.

Burns, K., Sledge, P. and Wicks, S. (2009a) *ABARE 2007 sawmill survey report*, ABARE report to the Australian Government Department of Agriculture, Fisheries and Forestry and Forest and Wood Products Australia, Canberra.

CSIRO Forestry and Forest Products (no date (a)) *Wagner capacitance meters with radiata pine and slash pine* (Detailed Research Proposal).

CSIRO Forestry and Forest Products (no date (b)) *Genetic variation in wood properties of Eucalyptus dunnii relevant to solid-wood products. (Detailed Research Proposal).*

CSIRO Forestry and Forest Products (no date) *Genetic variation in wood properties of Eucalyptus dunnii relevant to solid-wood products*. (Detailed Research Proposal).

Downes, G., Ebdon, N., Meder, R., Joyce, K., and French, J. (2007) *Standing tree measurement of accoustic velocity as a predictor of kraft pulp yield in E. nitens across 2 sites* (Final Report). Project number PN07.3025.

DPI&F (2006) *Australian timber pole resources for energy networks, A review*. Prepared by Lesley Francis and Jack Norton Innovative Forest Products, Horticulture and Forestry Science Department of Primary Industries & Fisheries, Queensland, for the Department of Primary Industries & Fisheries and Energy Networks Association.

Dunn, A. and Forsythe, P. (2009) *Strategy for large span second storey timber and wood products*. (Final Report). Project number PNA020-0809.

Ensis (no date (a)) *Standing tree measurement of acoustic velocity as a predictor of kraft pulp yield in E. nitens across 2 sites*. (Detailed Research Proposal).

Ensis (no date (b)) *Moisture meter corrections for ACQ treated pine*. (Detailed Research Proposal).

Ensis Forests and Environment (2007) *Fertiliser usage in forestry: current status and prospects for its efficiency and profitability*. (Detailed Research Proposal).

Erlandsson, M., Ödeen, K., and Edlund, M. (1992) *Environmental consequences of various materials in utility poles – A life cycle analysis*. Paper prepared for the 23rd Annual Meeting of the International Research Group on Wood Preservation.

Forest and Wood Products Research and Development Corporation (no date) *Termite risk management. A step-by-step guide for the building industry*.

Gardner, W. D. and White Jr., J. A., (2008) *Assessing the ability of a large-scale fire test to predict the performance of wood poles exposed to severe bushfires and the ability of fire retardant treatments to reduce the loss of wood poles exposed to severe bushfires.* (Final Report). Project number PNA014-0708.

5 References

Harwood, C., Bandara, K., Washusen, R., Northway, R., Henson, M., and Boyton, S. (no date) *Variation in wood properties of plantation-grown Eucalyptus dunnii relevant to solid-wood products.* (Final Report). Project number PN04.3003.

Kerr, R. J. Dutkowski, G. W. McRae, T. A. Pilbeam,D. J. Powell, M. B., Cameron, A. I. Hunter, Breidahl, S. R. Potts B. M. and Jones, R. (2008) *Genetic gain optimisation in tree breeding (MATEPLAN) and deployment (SEEDPLAN).* (Final Report). Project number PN07.4025.

May, B., Smethurst, P., Carlyle, C., Mendham, D., Bruce, J. and Baillie, C. (2009) *Review of fertiliser use in Australian forestry*. (Final Report). Project number PR07.4029

McRae, T. A., Li, L., Tier, B., Powell, M. B., Pilbeam, D. J., Dutkowski, G. W. Kerr, R. J. (2007) *An advanced genetic evaluation system for forest tree improvement (TREEPLAN)*. (Final Report). Project number PN03.1915.

Southern Cross University (no date) *Improving dimensional stability in plantation-grown E. pilularis and E. dunnii.* (Detailed Research Proposal).

Southern Tree Breeding Association Inc (no date) *An advanced genetic evaluation system for forest tree improvement.* (Detailed Research Proposal).

Southern Tree Breeding Association Inc (no date) *Genetic gain optimisation in tree breeding (MATEPLAN) and deployment (SEEDPLAN)*. (Detailed Research Proposal).

Timber Development Association (NSW) Ltd (no date) *A risk based approach to enhancing the perception of timber, as a suitable construction material in termite prone areas.* (Detailed Research Proposal).

Timber Development Association NSW Ltd (2007) *Strategy for large span second storey timber and wood products*. (Detailed Research Proposal).

Raymond, C. A., Henson, M., Pelletier, M.-C., Boyton, S., Joe, B., Thomas, D., Smith, H., and Vanclay, J. (2008) *Improving dimensional stability in plantation-grown Eucalyptus pilularis and E. dunnii*. (Final Report) Project Number PN06.3017.

Samuelson P.A. (1976). *Economics of forestry in an evolving society*. Economic Inquiry, vol XIV, Dec. 1976.

Ximenes, F., Robinson, M., and Wright, B. (2008) *Forests, wood and Australia's carbon balance*. Report for Forest and Wood Products Association.

Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Forest and Wood Products Australia and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 01/04/2010.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between 01/04/10 and 29/06/10 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Appendix A Fertiliser usage in forestry: current status and prospects for increasing its efficiency and profitability (PRC072-0708)

A.1 Project objective

There were five primary objectives of the project:

- To summarise the existing information on fertiliser use;
- To review the environmental impacts of fertiliser use;
- To undertake a financial analysis of different fertiliser regimes in softwood and hardwood plantations;
- To compare fertiliser use in forestry with agricultural pursuits; and
- To identify and prioritise knowledge gaps.

A.2 Project need

Prior to the project being undertaken there were no similar summaries available on fertiliser use in Australian forestry. Research into fertiliser use had also declined within some state forest management agencies.

In addition, there were perceptions regarding fertiliser use that were being used by some groups to argue against expansion of the plantation industry. It had been claimed that the industry was using more chemicals (including fertiliser) than alternative land uses and that there were negative impacts on water quality and greenhouse gas (GHG) emissions as a result. Prior to the report being published there was no authoritative comparison of the potential impacts of fertiliser use on water quality or GHG emissions from forestry compared with agricultural land uses that could be used to counter these claims.

A.3 Project costs

Research costs

The project costs are summarised in Table A-1.

Table A-1 Project costs

Project number	Operating	Capital	In-kind	Total
PRC072-0708	$64,500	–	$34,000	$98,500

Source: Project proposal documentation.

Implementation costs

For the project results to be adopted, it is assumed that further extension and communication of the results will be required and that the costs of this extension could be $10,000/annum over a two year period.

Appendix A

A.4 Project benefits

Economic

From a financial perspective, the output of the project that had most significance was a finding that mid-rotation fertiliser yields a superior economic return than fertiliser at establishment. However, the financial analysis was limited in that it did not evaluate some of the other benefits of fertiliser use at establishment, such as improved survival and early canopy closure (therefore less weed control).

Industry contacts from the hardwood sector considered that the conceptual outcome was sound, but questioned some of the assumptions used to quantify the impact of fertiliser. They also considered that the extent of any benefit and the rate of adoption would vary quite considerably between companies and regions. In the softwood sector, there was more agreement surrounding the basis for assumptions used, but also considerable variation in regional benefits and base case rates of adoption.

The project found that fertiliser use in forestry was generally less than other agricultural pursuits. However, data from the agricultural sector that was used for benchmarking was limited by the fact that some of the land uses provided as a comparison covered a very wide spectrum. For example, data for the grazing sector included rangelands as well as more intensive grazing in higher rainfall areas. The project also did not evaluate which alternative uses should be used as a comparison in particular regions. As such the report provided some of the background information necessary to compare fertiliser use in particular regions, but it does not provide any definitive conclusions at a regional level.

The report identified knowledge gaps including a lack of data on response to mid-rotation fertiliser of hardwood plantations and thinned softwood plantations, emissions and leaching losses associated with different fertiliser types, and analysis of the economic benefits.

Environmental and social

While the project identified the scope for fertiliser use to be reduced in plantation management, it also found that the environmental impacts of fertiliser used in plantation management are very low if codes of practice are followed. Consequently, because the potential benefits were likely to be small, no environmental benefits associated with the project were estimated as part of the analysis.

The project may improve the viability of some forestry operations and, by doing so, increase the size of the operations, hence employment in the industry. However, because data are not available about the impact on viability, these potential employment impacts have not been estimated.

A.5 Base case

In the absence of the project, it is assumed that financially sub-optimal fertiliser regimes used by some private companies and state forest management agencies would continue. However, other organisations had already adopted the practices recommended by the project. This previous adoption was the result of prior work by the project leader that was privately commissioned by plantation managers in the Green Triangle, as well as other in-house research conducted by Australian plantation managers.

For those companies that could benefit from the research it is assumed that they would have otherwise come under pressure to review fertiliser use as a part of sound business practices over the next five years. Movement of foresters between companies would also result in extension of the research previously implemented by other companies within a reasonably short period of time.

A.6 Adoption relative to base case

Some parts of the softwood industry have picked up on the financial benefits of delaying fertiliser application and made changes to silvicultural regimes as a result of the study. For others in the industry there has not yet been sufficient extension of the findings to encourage and there appears to be less willingness to change established regimes (particularly within some government agencies).

The hardwood plantation industry has been under financial pressure and the cost of inputs such as fertiliser has been reduced for reasons other than optimal silviculture. Those hardwood plantation companies that have been actively managing plantations over the last two years had some difficulty applying the results to their own situations because of the specific species, sites and soil types that they were trying to manage. However, the concepts used to evaluate the financial benefits of fertiliser use were found to be useful and could be applied to research undertaken by specific companies.

The different rates of adoption between the softwood and hardwood industries may also be because data used to evaluate fertiliser responses is considered more robust for softwood plantations than for hardwoods. This reflects the maturity of the softwood industry, which has the benefit of several decades of research. In comparison the hardwood plantation industry has rapidly increased in scale over the last decade and lacks the research on fertiliser responses on which to base the analysis in many of the regions.

At an industry level the results of the research are expected to be adopted by 5% of the softwood plantation industry within five years of completing the research. In order to achieve this adoption rate it is assumed that further extension and communication of the results will be required and that the costs of this extension will be $10,000/annum over a ten year period. The rate of adoption as a direct result of FWPA funding will decrease to 0% within ten years as the key findings were already known to a large segment of the industry and it could reasonably be expected that financial imperatives would have driven other organisations to the same conclusions over time.

A.7 Summary

Table A-2 contains a summary of the main project impacts (benefits and costs) relative to the base case and indicates whether the impact has been estimated quantitatively.

Appendix A

Table A-2 Summary of project impacts and adoption

Impact component	Estimated (yes/no)	Parameter value (net)	Adoption relative to base case		
			Year 5	Year 10	Year 20
Benefits					
Improved timing of fertiliser application	Yes	$200/ha of establishment fertiliser costs delayed for average of 4 years	5% of softwood establishment	0%*	0%*
Environmental benefit	No				
Costs					
Project costs	Yes	See Table A-1			
Extension costs	Yes	$10,000/annum for 2 years			

* Note that, it is assumed that the project benefits have dissipated at this time.
Source: URS estimates, derived from primary and secondary sources.

A.8 Evaluation

Table A-3 contains the evaluation results, including estimates of Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) over a fifty year period using a five percent discount rate.

Table A-3 Evaluation results

Evaluation measure	5 years	10 years	20 years	50 years
NPV ($ 000)*	$469	$141	$42	$42
BCR	5.3	2.3	1.4	1.4
IRR	55%	-2%	3%	3%

*Assumes 5% real discount rate. Values are 2009 dollars.
Source: URS estimates.

A.8.1 Sensitivity analysis

High scenario

Table A-4 contains the results from a sensitivity analysis, that assumes the project benefits extend to include the hardwood industry. Adoption in the hardwood industry is assumed to peak in year 5 at 5% of the plantation area before declining to 0% in year 10. All other assumptions are unchanged.

Appendix A

Table A-4 Sensitivity analysis – high estimate

Evaluation measure	5 years	10 years	20 years	50 years
NPV ($ 000)*	$1,894	$758	$418	$418
BCR	18.2	7.9	4.8	4.8
IRR	112%	-4%	1%	1%

Source: URS estimates.

Low scenario

Table A-5 contains the results from a sensitivity analysis that assumes no further extension occurs and that adoption within the softwood industry peaks at 2% of the area of softwood plantation in year 5 and then declines to 0% by year 10. All other assumptions remain unchanged from the original analysis.

Table A-5 Sensitivity analysis – low estimate

Evaluation measure	5 years	10 years	20 years	50 years
NPV ($ 000)*	$118	$90	($25)	($25)
BCR	2.3	2.0	0.7	0.7
IRR	23%	22%	NA	NA

Source: URS estimates.

Appendix B Genetic variation and improvement of *E. dunnii* and *E. pilularis* (PN04.3003 and PN06.3017)

This evaluation comprises two separate, but related projects:

- Genetic Variation in Wood Properties of Eucalyptus *E. dunnii* Relevant to Solid Wood Products (PN04.3003); and
- Improving dimensional stability in plantation-grown *E. pilularis* and *E. dunnii* (PN06.3017)

B.1 Project need

Plantations of *E. dunnii* and *E. pilularis* have been established in northern NSW and southern Queensland over the last decade. Most of this resource has been established for pulpwood production, but there is also a significant area that has been established for solid wood production. For various reasons the plantation estates that have focussed on pulpwood production have not reached sufficient scale for a pulpwood industry to be sustained in the long term and hence sawn timber production is a possible means of utilising this largely unallocated resource.

The two projects were concerned with investigating cost-effective non-destructive methodologies for assessing wood quality for plantation grown *E. dunnii* and *E. pilularis.* Such methodologies could have three primary benefits:

- They provide information on wood quality to the processor prior to harvest so that sawing techniques and kiln drying regimes can be optimised;
- They provide feedback mechanisms to breeding programs about wood quality that is not dependent on waiting until the end of the rotation; and
- As non-destructive methodologies, they enable tree breeders to utilise the seed from the standing tree. An option that is obviously not available after harvest.

B.2 Project objective

The project objectives can be summarised as follows:

- Evaluate possible low-cost methods of assessing solid wood value of plantation grown *E. dunnii* and *E. pilularis* to assess wood properties;
- Relate core properties to wood properties;
- Provide information on potential kiln-drying regimes for *E. dunnii*;
- Assess the quality of kiln-dried sawn boards of plantation grown *E. dunnii;*
- Develop a toolkit for wood quality examination;
- Understand the role of wood chemistry in the control of wood behaviour, quality, drying and sawnwood characteristics; and
- Understand the extent to which wood properties can be managed through genetics.

Appendix B

B.3 Project costs

Research costs

The project costs are summarised in Table B-1.

Table B-1 Project costs

Project number	Operating	Capital	In-kind	Total
PN04.3003	$70,000	–	$71, 891	$141,891
PN06.3017	$183,895	–	$613, 281	$797,176
Total	**$253,895**	**–**	**$685,172**	**$939,067**

Source: Project proposal documentation.

B.4 Project benefits

Economic

The projects established that properties of wood cores do not appear to be reliable predictors of economically important sawn timber characteristics in the species that were studied. However, the project research methodology (i.e. the use of increment cores to predict wood properties) has been used and adapted in subsequent research. The method is low-cost and may, in part, reduce reliance on more expensive technologies such as Silvascan. The method has also been used to investigate the wood properties of other species, such as *E. globulus* and *E. nitens*. However, it should be noted that the technology has not been developed to a point where widespread adoption would be feasible.

In both projects there was useful information gathered regarding the sawn timber properties of *E. dunnii,* which was previously considered to be a relatively low quality sawn timber species when established in plantations. The trials undertaken in this research showed that there are still significant challenges associated with processing young plantation grown eucalypts for solid wood production because of the low dimensional stability. However, the sawing qualities of *E. dunnii* were not materially different from other plantation grown hardwoods, such *E. pilularis*.

It should also be noted that the work on improving dimensional stability also provided information on pulp yield of *E. dunnii* that showed it had very favourable pulping properties. However, the lead researcher has indicated that these properties are dependent on site, with higher quality sites providing better pulp yields. The sites sampled were on good quality sites, while the majority of the sites established have been in more marginal areas.

As a result of the project *E. dunnii* families were able to be ranked for wood properties and this information has been used by Forests NSW to establish a clonal seed orchard. This orchard has recently begun yielding high quantities of seed, with around 10kg of seed harvested last year and similar levels expected this year. If this amount of seed is planted, it would represent approximately 1,000 ha of establishment.

Environmental and social

There are no direct environmental or social benefits identified in relation to the project outcomes.

B.5 Adoption relative to base case

The project has not resulted in increased rates of establishment of *E. dunnii* for solid wood production or improvements in breeding. This is partly the result of the fact that further work is required before the tools necessary to predict sawn timber quality with confidence are developed, but also due to changes in the plantation industry as a result of the financial collapse of some MIS companies.

B.6 Evaluation

The projects identified that the techniques trialled had some limitations and refocused the means by which further research into the development of non-destructive options for assessing wood quality could be undertaken. However, positive quantification of the project results is not possible in this case.

Appendix C TREEPLAN, MATEPLAN AND SEEDPLAN genetic programs (PN03.1915 and PN07.4025)

This evaluation comprises two separate, but related projects:

- An advanced genetic evaluation system for forest tree improvement (TREEPLAN) (PN03.1915)
- Genetic gain optimisation in tree breeding (MATEPLAN) and deployment (SEEDPLAN) (PN07.4025)

C.1 Project need

At a national level, tree breeding has been characterised by a number of separate programs that have been run by different organisations. It has not been feasible to capture the cumulative benefits of these programs and a need was identified to make the most of existing knowledge by creating efficient ways of accessing and processing data.

The most immediate need for this work is to reduce the amount of inbreeding that could otherwise occur in seed orchard programs. As breeding programs develop, the level of inter-relatedness between different populations used in seed orchards also increases exponentially. In designing seed orchards it is therefore essential that relatedness is considered, so that inbreeding is minimised and gains from breeding are maximised.

TREEPLAN has consolidated the large amount of data from several independent programs and has enabled the degree of relatedness between individual trees of populations to be quantified. MATEPLAN and SEEDPLAN interpret data for end-users and allow greater efficiency in selecting crosses, designing seed orchards, and planning plantation establishment programs.

C.2 Project objective

The combined objective of the two projects was to develop three interrelated software programs:

- TREEPLAN is software that enables the evaluation of breeding values using multi-variate analysis across generations, years, sites and trials. Southern Tree Breeders Association (STBA) members and other breeders all contribute data.
- MATEPLAN is a tool for breeders aimed at assisting optimal selection and crossing in the breeding program. The aim is to limit increases in co-ancestory, which can increase exponentially if not controlled.
- SEEDPLAN is a collection of tools for selecting genotypes for a seed orchard, creating deployment values for seedlots, and optimally matching seedlots to environment. It also assists with designing seed orchards so that inbreeding is minimised. Where male parents are not known, it can be used to estimate the probability of a particular parent given, for example, flowering, timing, and abundance.

Appendix C

C.3 Project costs

Research costs

The project costs are summarised in Table C-1.

Table C-1 Project costs

Project number	Operating	Capital	In-kind	Total
PN03.1915	$1,062,141	$65,000	$302,920	$1,430,061
PN07.4025	$202,000	$6,000	$257,926	$465,926
Total	**$1,264,141**	**$71,000**	**$560,846**	**$1,895,987**

Source: Project proposal documentation.

Implementation costs

In addition to these costs, on-going maintenance costs for project-related software and hardware will need to be incurred. These have been estimated at approximately $60-100k per year. However, this will be offset to some extent because various independent breeding programs will have lower costs as a result of this centralised approach.

The estimated future costs of program development over approximately the next five years are around $1.6 million. This would bring the MATEPLAN and SEEDPLAN software to a point of greater useability and would enable its application across the Australian industry. It would also help to integrate the three programs, providing further operational efficiency. A proposal to undertake this work has been submitted to FWPA for consideration.

C.4 Project benefits

Economic

Prior to investment from FWPA, TREEPLAN was in a relatively early stage of development with limited useability for the forest industry. The FWPA grant funded development of a second version of the software that has contributed to its wider application. The subsequent investment from FWPA enabled further development of MATEPLAN and SEEDPLAN to improve efficiency of breeding processes and their deployment.

Beneficiaries of the projects, to date, include:

- Members of the Southern Tree Breeders Association (STBA), who can access the model outputs (genetic values of individual trees or populations), as well as improved plant material that has been developed using the programs.
- Non-members of the STBA, who can access improved plant material and contract the STBA to analyse their own data. The project leaders commented that it is encouraging wider use of the software by non-members.
- Researchers, who use the software for various applications and can add additional information to the databases, which contributes to its ongoing improvement.

Through improved orchard design, the projects have helped to reduce inbreeding. This increases output by avoiding productivity losses as well as through productivity gains. It is estimated that better-informed genetic selection decisions and associated plantation planning has resulted in improvements to yields and quality.

The project leaders and end users have suggested the projects could result in a 10% improvement in the volume of wood produced at the time of harvest and a 5-10% percent improvement in the quality (value) of selected commercial products (structural timber and hardwood pulpwood) when plantations are harvested that have been established using these tools.

In URS opinion, the financial benefits associated with the project are likely to be restricted to those that result from increased yield and these benefits will accrue at the stumpage level. At this point in the supply chain, increases in yield will result in an increase in revenue without any change in costs. Beyond this point costs are incurred per unit of volume harvested or processed and any change in net value is minimal. Increases in value associated with improved product quality are unlikely to result in an increase in the price for commodity products that otherwise meet specifications for a particular grade.

In the case of projects that improve the genetic sources used to establish forest plantations, the benefits of research will not be obtained until the trees are harvested. These harvest periods are assumed to be:

- 30 years in the case of softwood sawlog;
- 25 years for hardwood sawlogs; and
- 10 years for hardwood pulpwood.

Environmental and social

The environmental benefits associated with the project are linked to the anticipated productivity improvements. By using the same resource inputs to achieve a greater output, there is an implicit environmental benefit. However, because this benefit is encapsulated in the value of the productivity improvement, estimating this value separately would involve double counting.

There are no direct social benefits anticipated with the adoption of the project results.

C.5 Base case

Under the base case it is assumed that the projects would not have developed as quickly as they did with assistance from the FWPA. However, the potential benefits of the project are compelling enough that the plantation industry (and particularly STBA members) is likely to have undertaken the same work within five years.

C.6 Adoption relative to base case

The programs have been used to run national-scale analysis of breeding programs for *Pinus radiata*, *Eucalyptus globulus* and *E. nitens*. These species represent a large proportion of the national hardwood plantation estate. Preliminary work has been undertaken with other species which should drive wider adoption.

The project leaders believe that 80% of Australian tree breeders will adopt the technology within 10 years, resulting in improvements in plantations harvested from stock developed over this time. However, if it is assumed the work would have been undertaken through other funding sources within five years, the rate of adoption associated with FWPA funding is likely to peak at 40% and then decline as net benefits reduce compared to the base case where similar technology will become available to adoptees.

C.7 Summary

Table C-2 contains a summary of the main project impacts (benefits and costs) relative to the base case and indicates whether the impact has been estimated quantitatively.

Table C-2 Summary of project impacts and adoption

Impact component	Estimated (yes/no)	Parameter value (net)	Adoption relative to base case		
			Year 5	Year 10	Year 20
Benefits					
Improved yield	Yes	$10% increase in yield by volume over the rotation	40% of plantation establishment	0%*	0%*
Better-quality end-product	No				
Costs					
Project costs	Yes	See Table C-1			
Implementation costs	No				

* Note that, it is assumed that the project benefits have dissipated at this time.
Source: URS estimates, derived from primary and secondary sources.

C.8 Evaluation

Table C-3 contains the evaluation results, including estimates of Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) over a fifty year period using a five percent discount rate.

Table C-3 Evaluation results

Evaluation measure	5 years	10 years	20 years	50 years
NPV ($ 000)*	($2,514)	($3,036)	$27,813	$47,092
BCR	0.0	0.0	9.9	15.4
IRR	NA	NA	21%	21%

*Assumes 5% real discount rate. Values are 2009 dollars.
Source: URS estimates.

C.8.1 Sensitivity analysis

High scenario

Table C-4 contains the results from a sensitivity analysis that assumes the research is not undertaken independently by industry as part of the base case until 10 years after project completion. Therefore the benefits from adoption are assumed to peak at 80% in year 10, before declining to zero by year 15. All other assumptions remain unchanged from the original analysis.

Table C-4 Sensitivity analysis – high estimate

Evaluation measure	5 years	10 years	20 years	50 years
NPV ($ 000)*	($2,514)	($3,036)	$62,136	$104,198
BCR	0.0	0.0	21	32.8
IRR	NA	NA	25%	25%

*Assumes 5% real discount rate. Values are 2009 dollars.
Source: URS estimates.

Low Scenario

Table C-5 contains the results from a sensitivity analysis that assumes that follow-up funding is not obtained and the adoption rate slows to 25% by year 5, before declining to 0% in year 10. All other assumptions remain unchanged from the original analysis.

Table C-5 Sensitivity analysis – low estimate

Evaluation measure	5 years	10 years	20 years	50 years
NPV ($ 000)*	($2,047)	($2,123)	$12,980	$21,536
BCR	0.0	0.0	6.8	10.1
IRR	NA	NA	18%	18%

*Assumes 5% real discount rate. Values are 2009 dollars.
Source: URS estimates.

Appendix D Moisture correction factors (PN04.2002 and PN07.2045)

This evaluation comprises two separate, but related projects:

- Species and CCA (chromium copper arsenic) treatment corrections for hand-held moisture meters with radiata pine and slash pine (PN04.2002)
- Moisture meter corrections for ACQ (alkaline copper quaternary), treated pine (PN07.2045)

D.1 Project need

Drying sawn timber to the desired moisture content is one of the most important steps in processing, and drying accounts for a significant component of processing costs.

Hand-held capacitance meters are used by mill operators at various stages of softwood processing. Typically, the moisture meters are used in the late stages of drying before machining. As confidence in the accuracy of the meters has been low, mills have typically developed their own correction factors, resulting in an inconsistent approach across the industry. This is likely to have resulted in timber entering the market that is at varying moisture contents, which could adversely impact of timber in some applications, giving rise to costs that could be avoided.

Accurately measured moisture content is critical for ensuring the stability of the end-product and to optimising the drying process, thereby improving efficiency.

D.2 Project objective

Hand-held moisture meters, in particular the Wagner (capacitance-type) moisture meters, are used extensively throughout the exotic softwood processing industry in Australia. While their use is widely accepted, uncertainty relating to accuracy and precision remains relating to their use on Australia's two most commercially important exotic softwood species: *Pinus radiata and Pinus elliottii*. There is also uncertainty when such species are treated with either CCA or ACQ.

The key objective of these projects was to reduce and/or remove the uncertainties associated with the use of Wagner Meters in the softwood processing industry and by doing so, provide the ability to better manage moisture content before machining into products.

D.3 Project costs

Research costs

The project costs are summarised in Table D-1.

Table D-1 Project costs

Project number	Operating	Capital	In-kind	Total
PN04.2002	$98,532	–	$10,000	$108,532
PN07.2045	$60,000	–	–	$60,000
Total	**$158,532**	**–**	**–**	**$168,532**

Source: Project proposal documentation.

Appendix D

Implementation costs

The costs involved with implementing the project findings are considered to be minimal, requiring a once-off adjustment of the moisture correction factors currently utilised by mill operators. This cost is considered insignificant relative to the overall operational costs of the mill and have not been estimated.

With the project, it is assumed that the time spent attending to returned products and mis-performing products for a full time staff member is 1%. The value of this time is estimated to be $1,000 per annum for a medium-sized mill.

D.4 Project benefits

Economic

The project has provided robust independent data, which has enabled moisture correction factors to be derived that can be applied across the industry.

The project benefits may be summarised as follows:

- More efficient drying processes – by applying the correction factors, mill staff have more accurate information and therefore greater understanding of the moisture content of the timber and can therefore make better-informed decisions about how to operate their drying equipment. It should be noted that kilns would only be operated more efficiently if, because of the project, the volume of wood that is over-dried is reduced.
- Better quality end-product – by enabling greater quality control at the mill, the incidence of under-dried or over-dried timber entering the market should be reduced and greater certainty could be obtained that the end-product will meet the claimed standards.
- Reduced product returns – with better-quality products entering the market there is likely to be a reduction in the incidence of products under-performing in application and hence fewer products being returned to the mill.
- Independent authority – research undertaken by an independent third-party is considered by industry to be valuable, should timber performance be contested.

Consensus on the size and nature of the project benefits was not obtained through interviews with industry contacts. Those contacted could not estimate the impact associated with the moisture correction factor in terms of tangible benefits such as reduced operating costs or improvement in product quality, because timber moisture is just one element of overall production costs and product quality. Based on these comments, the quantifiable benefit of the project is assumed to be reflected in lower costs of responding to customer complaints regarding under-performing products. Although better-quality end products are anticipated, the commodity nature of the structural timber market is such that it is not thought that the potential quality improvements would be reflected in a higher price.

Environmental and social

The main environmental benefits associated with the project are likely to be captured in the potential to operate kilns in a more efficient manner, hence avoiding over-drying, and thereby achieving a reduction the energy consumed in the drying process. Conversely, for those mills that are not sufficiently drying their timber they may need to run their kilns for longer to meet the new standards. Consequently, this benefit has not been estimated.

The social benefit associated with the project may be reflected in the greater consumer satisfaction obtained from the higher quality timber entering the market. However, because this benefit is encapsulated in reduced time spent in negotiations, estimating this value separately would involve double counting.

D.5 Base case

A number of mill operators advised that they had independently developed and were using moisture meter correction factors prior to the commencement of the project. In the absence of the project, these mills are likely to have continued to use their own meter correction factors. However, in the event of a challenge to the validity of the correction factors, these operators would not have had the benefit of independently determined correction factors that the project produced and, hence, it is assumed that time would be spent negotiating settlements for timber that under-performs in application.

For mill operators that did not have in-house capacity to develop their own moisture meter correction factors prior to the project, it is likely that they would have continued to rely on the default settings within Wagner meters and also borne the costs associated with negotiating with customers.

It is possible that the moisture correction factors could have been developed by another independent source at a later date; however, funding from FWPA allowed the project results to be made public earlier than they would have been and for the results to be implemented by all mills.

The costs associated with the base case relate to inefficient drying processes and mis-specified products that leave the sawmill and which could be returned, or require negotiations around under-performance. It is assumed that a full time member of sales staff could spend 5% of their time attending to returned products and customer negotiations around underperforming products. The value of this time is estimated to be $5,000 per annum for an average sized softwood sawmill. These costs are expected to reduce to $1,000 per annum for an average sized mill as a result of adopting the project outcomes.

While it is likely that sales staff at large enterprises spend more time than this on credit claims, underperformance due to moisture content variations is only one of the factors that is likely to impact on performance of timber products.

D.6 Adoption relative to base case

It is assumed that the project results are potentially applicable to the total volume of dry coniferous sawn timber produced annually in Australia, or approximately 80% of total coniferous sawn timber produced.

However, adoption of the research outcomes has been limited to date. Industry interviews have raised several possible reasons for this. One reason that was nominated, particularly in relation to ACQ treated timber, was that moisture content variability is a relatively small contributor to overall product variability. Even with more accurate moisture correction factors, some mill operators have not been able to achieve the desired level of control over timber quality.

A further reason suggested is that the correction factors have not been incorporated into a revision of the AS/NZS 1080.1 (1997) standard (Timber-Methods of Test. Method 1: Moisture Content). If the requirement for moisture testing was incorporated in the standard, this would become a reference point for best practice, which could be expected to result in an increase in adoption.

Given these factors, it is assumed that the adoption rate, as reflected in the number of plantation log sawmills using the technology, is limited in the short term. It is assumed that adoption starts at 5% in the third year after the project was completed and remains this way until year 5, as individual mills adopt the technology. After this time the adoption rate is assumed to grow quickly over time if the relevant standard is amended, reaching 80% of the mills by year 10. By year 15, adoption relating to this project will have declined to 0% as it is assumed that alternative equivalent research would have occurred, effectively reducing the adoption that is associated with the project, and therefore leading to a reduction in the project-related benefits.

D.7 Summary

Table D-2 contains a summary of the main project impacts (benefits and costs) relative to the base case and indicates whether the impact has been estimated quantitatively. It also contains the assumed adoption profile.

Table D-2 Summary of project impacts and adoption

Impact component	Estimated (yes/no)	Parameter value (net)	Adoption relative to base case		
			Year 5	Year 10	Year 20
Benefits					
Efficient drying processes	No				
Better-quality end-product	No				
Reduced product returns and customer and time on negotiations	Yes	$4,000 pa	5% (of mills)	80% (of mills)	0%* (of mills)
Environmental benefit	No				
Costs					
Project costs	Yes	See Table D-1			
Implementation costs	No				

* Note that, it is assumed that the project benefits have dissipated at this time.

Source: URS estimates, derived from primary and secondary sources.

D.8 Evaluation

Table D-3 contains the evaluation results, including estimates of Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) over a fifty year period using a 5% discount rate and an adoption rate of 5% of mills at year 5.

Table D-3 Evaluation results

Evaluation measure	5 years	10 years	20 years	50 years
NPV ($ 000)*	($134)	$179	$346	$346
BCR	0.2	2.1	3.1	3.1
IRR	9%	13%	16%	16%

*Assumes 5% real discount rate. Values are 2009 dollars.
Source: URS estimates.

D.8.1 Sensitivity analysis

High scenario

Table D-4 contains the results from a sensitivity analysis that assumes the net benefit to mills from credit claims is higher, nominally $9,000 per mill. All other assumptions remain unchanged from the original analysis.

Table D-4 Sensitivity analysis – high estimate

Evaluation measure	5 years	10 years	20 years	50 years
NPV ($ 000)*	($98)	$605	$980	$980
BCR	0.4	4.7	7.1	7.1
IRR	18%	22%	24%	24%

*Assumes 5% real discount rate. Values are 2009 dollars.
Source: URS estimates.

Low scenario

Table D-5 contains the results from a sensitivity analysis that assumes the Standard is not revised and hence the net project benefits peak at only 25% of mills at year 5 and declines to 0% by year 10. All other assumptions remain unchanged from the original analysis.

Table D-5 Sensitivity analysis – low estimate

Evaluation measure	5 years	10 years	20 years	50 years
NPV ($ 000)*	($18)	$165	$165	$165
BCR	0.9	2.0	2.0	2.0
IRR	14%	14%	14%	14%

*Assumes 5% real discount rate. Values are 2009 dollars.
Source: URS estimates.

Appendix E Acoustic wave velocity and kraft pulp yield (PNC053-0708)

E.1 Project need

Kraft pulp yield (KPY) is the most important factor by which wood chip traders determine the price they are willing to pay for various species. A higher pulp yield is typically reflected in a higher price in the market. However, these differentials are generally not reflected at the stumpage (plantation) level because of the complexities associated with sampling in field.

A rapid, non-destructive test that enables wood chip processors to perform resource assessments of stands would allow improved sampling and improved pricing structures that reward growers of higher-yielding stands. Chip exporters could also better manage the quality of stockpiles and the information obtained could be used to target higher yielding seed sources in breeding programs.

Previous studies have shown that acoustic measurements from standing trees and felled logs may potentially provide predictions of KPY, however some doubts remained regarding the robustness of the relationship, particularly across sites.

Industry considered there was a need to conduct independent research to better understand the uncertainty and develop a more reliable test.

E.2 Project objective

The key objective was to unequivocally validate or discard the use of standing tree and/or log acoustics as a tool for predicting KPY.

E.3 Project costs

Research costs

The project costs are summarised in Table E-1.

Table E-1 Project costs

Project number	Operating	Capital	In-kind*	Total
PNC053-0708	$31,589	–	$72,431	$104,020

* Note that the project proposal estimated in-kind contributions from Gunns of $227,175; however only approximately 20 percent of this value is estimated to be directly attributable to the project.
Source: Project proposal documentation and discussions with Gunns representatives.

E.4 Project benefits

Economic

The project found that standing tree acoustic measurements explain more variance in KPY than for measurements from felled stems. However, the low level of variance explained by such measurements was unlikely to provide any major commercial incentive to acoustically screen sites or genotypes for KPY.

The project successfully achieved its objective in that it was able to provide the evidence required to discard the use of standing tree acoustics as a predictive tool for KPY. Although this finding does not result in any market benefits for industry, it has allowed future research efforts to be directed to more prospective forms of non-destructive testing such as Near Infra Red Spectroscopy (NIR). It has also prompted industry to research other techniques for improving KPY, such as through molecular genetics.

Environmental and social

There are no direct environmental or social benefits identified in relation to the project outcomes.

E.5 Base case

A number of hardwood plantation managers indicated that the research would not have been undertaken in-house because of the technical expertise that was required.

E.6 Adoption relative to base case

Based on discussions with industry contacts, it appears that industry is aware of the findings and has subsequently focussed its research investment on other means for predicting KPY.

E.7 Evaluation

Discussions with industry contacts indicate that there was a need to clarify the role of acoustic wave velocity in predicting KPY in standing trees. By confirming that acoustic wave velocity is not a reliable predictor KPY for individual trees, research effort has been directed elsewhere, particularly into NIR. However, no quantifiable benefit has been allocated to the project.

Appendix F Wood quality initiative (PN04.2004)

The Wood Quality Initiative (WQI) was a New Zealand-based consortium established to undertake industry-facing research on the wood quality of radiata pine[6]. The WQI was a major multi-year program with a broad funding base, including New Zealand public and private sector funding coupled with contributions from FWPA and CSIRO.

A broad range of projects were undertaken in the six years over which WQI operated. These fell into five key themes – appearance, resource characterisation, stability, structural, and integration. URS has not evaluated the individual projects within these themes. Rather, a high-level assessment has been undertaken based on the potential benefits of Australia's investment in this initiative.

F.1 Project need

The project need was driven by industry concern about radiata pine's declining market share in appearance and structural applications, particularly in New Zealand. For Australia, the initiative came at a time of declining research into the softwood sector of the industry and is seen by some within the industry as having been critical to maintaining research capacity.

Given the Australian market for softwood timber is dominated by structural applications, the evaluation for this review has focussed on the benefits to this segment of the industry.

F.2 Project objective

The WQI was established with two major objectives:

- To improve understanding of the factors affecting wood quality and thereby grow better wood; and
- To develop tools to enable the existing resource to be monitored and segregated into wood quality classes and matched to the most appropriate processing option and market, thereby improving resource allocation within the market.

F.3 Project costs

Research costs

Table F-1 contains the project costs that were contributed by FWPA and CSIRO, representing approximately 19% of the total cost of the WQI.

Table F-1 Project costs

Source	Operating	Capital	In-kind	Total
FWPA	$1,271,109	–	–	$1,271,109
CSIRO	$1,280,539	–	–	$1,280,539
Total	**$2,551,648**	**–**	**–**	**$2,551,648**

Source: FWPA and WQI data.

Implementation costs

The costs involved with implementing the majority of project outputs are considered to be minimal, requiring, for example, the integration of existing information within software packages or tools that are

[6] The WQI ran between 2003 and 2008 however another research program called the Solid Wood Innovation grew out of the WQI program. This evaluation focuses only on the research undertaken as part of WQI.

already commonly used. The information is free to FWPA members, but may require a small labour cost to apply the information in an operational setting. This cost is likely to be a once-off cost and is estimated to be the labour costs associated with one full time equivalent employee for one week. This costs is estimated to be in the order of $2,000.

A major output from the WQI was the negotiation of an exclusive license for warp prediction technology. To access the warp prediction technology mill owners would need to pay a one-off licensing fee, which is estimated to cost $100,000. It should be noted that to utilise the warp prediction technology, scanning equipment must also be installed in the mill. Discussions with industry contacts suggest that such equipment is already beginning to be installed in some of the larger mills, independent of the warp prediction technology. URS has therefore not included the cost of such equipment in the implementation of the warp prediction technology.

F.4 Project benefits

Economic

WQI's research outputs were intended to benefit the Australian softwood timber industry primarily through research into factors affecting the structural performance of timber products. Research outputs resulted in:

- The ability to forecast wood quality (e.g. density) and yield estimates, which allows better targeting of timber to end-users.
- Standing tree acoustic velocity tools to rank stands for stiffness. This is done to help smooth out the flow of log quality into a sawmill during the year, and can also be utilised when tendering to purchase stands.
- Algorithms for use in GF19 and GF14 material, which can be integrated into forest management support systems (YTGen and Atlas).
- Warp prediction technology. This technology was developed by Weyerhauser US, but WQI negotiated exclusive license access in Australasia for WQI shareholders.

Notwithstanding the warp prediction technology, a number of Industry contacts had difficulty identifying specific outcomes from the WQI; however this was largely attributed to the range of different outcomes associated with the project. Given this, it was difficult for industry contacts to identify the impacts in terms of tangible benefits such as reduced operating costs, or an improvement in product quality. Discussion with these contacts was more general and focussed on the benefits of specialised research for the softwood processing sector.

Based on these comments and our understanding of the project objectives, URS considers there is potential, over time, for these outputs to lead to an improvement in the quality of Australian radiata pine timber produced for structural applications.

Two benefit streams were estimated; one for the overall WQI results; and another that focused specifically on the potential benefits of the warp prediction technology.

The warp prediction technology has been adopted in the United States, providing 'performance-guaranteed' products that, anecdotally, have been attracting higher prices because of the improved stability provided by these products. Industry views about the potential benefits of this technology, if it were to be adopted in the Australian market, are mixed. Some consider that a 15% increase in price could be obtained for 20% of the total volume of structural products, through the increased end-user certainty regarding stability that such technology could provide. Others consider the Australian market to be significantly different from the US market, indicating that the Australian standards for structural performance are more rigorous, meaning that products such as MGP 10 and MGP 12 are already providing a high degree of certainty for consumers. As such, the additional benefits from producing a 'performance-guaranteed' product are not considered to be significant, by some industry contacts. Others in the industry suggested that consumers would be unwilling to pay higher prices for a quality assured product, therefore any additional production costs would have to be absorbed entirely by producers.

In URS's view there are likely to be benefits from adopting outcomes of the research and for the early adopters of these technologies to differentiate their products based on quality. This product differentiation may result in either improved prices or a reduced need to discount prices when stock levels increase. As structural timber is a commodity product, any benefits are only likely to accrue for a short period of time before the rest of the market is selling a similar quality product, or has made similar reductions to costs that result in reductions in the product price.

Environmental and social

The environmental benefits associated with the project are linked to the anticipated improvements in processing efficiency. However, because this benefit is encapsulated in the value of the efficiency gain, estimating this value separately would involve double counting.

The social benefit associated with the project may be reflected in the greater consumer satisfaction obtained from the higher quality timber entering the market. However, because this benefit is encapsulated in the estimated value of improved quality, estimating the social value separately would involve double counting.

F.5 Base case

In the absence of the project, it is assumed that some research would occur in-house, by the larger softwood mills, but the nature of this research is likely to have been fragmented and specific to a particular company's operations and location rather than being integrated and communicated across the industry. Ultimately the benefits of this research are likely to have reached the rest of the industry.

F.6 Adoption relative to base case

It is assumed that the project results are potentially applicable to the total volume of dry coniferous sawn timber produced annually in Australia, or approximately 80% of total coniferous sawn timber produced.

Estimating adoption is particularly challenging for this project as it has produced many tools and technologies, some of which are more relevant to the Australian market than others, and some of which are more likely to result in a quality improvement than others. Of these, some are likely to have a more direct affect on structural softwood sawn timber quality than others.

For the general quality improvements, URS has assumed that five years after the project ended (2011-12), adoption of the project outcomes has increased to 5% of total volume produced and a higher price for dry structural softwood sawn timber is achieved. The price improvement is assumed to be 0.5% higher than under the base case and is available to those companies that have adopted the technology. As the entry cost associated with access to these improvements is low, adoption is assumed to increase to 50% of the total volume produced in 2014-15. At this time, it is assumed that the premium diminishes to zero by 2017-18, as the rest of the industry responds to competitive pressures and adopts the research outputs (i.e. the benefit of adoption is assumed to be 0% at this time, irrespective of how many mills have adopted the technology).

In the case of the warp-prediction technology, it appears that there is minimal interest in adopting the technology at present, due largely to the absence of market demand for 'performance-guaranteed' products with greater performance compared with products that are manufactured according to Australian standards. Other industry interviewees suggested that the licensing fee is a significant barrier to adoption, especially when new generation scanning technology is also required to access the technology. Discussions with industry interviewees suggested that adoption would be much greater if the Australian market faced competition from 'performance-guaranteed' imports.

For the quality improvements associated with the warp prediction technology, URS has assumed that five years after the end of the project (2011-12), the technology will begin to be adopted by one of the biggest mills, representing 5% of the total volume of coniferous sawn timber produced. It is assumed that, as the 'first adopter', this mill is able to achieve a quality-based increase in price of 1% relative to the base case. It is assumed that the benefits of being the 'first adopter' are short-lived as other mills quickly enter the market in response to competitive pressures. However, the rate of adoption will be slightly slower than for the general quality improvements because of the capital investment necessary to access the improvements. By 2016-17 it is assumed that adoption has increased to 50% of the total volume produced. However, after this point it is assumed that the quality improvements have been become standard throughout the industry, and as such the ability for any one mill to achieve a higher price will be diminished; essentially meaning that the project benefits are no longer represented by a higher price by 2020-21.

F.7 Summary

Table F-2 and F-3 contains a summary of the main project impacts (benefits and costs) relative to the base case and indicates whether the impact has been estimated quantitatively.

Table F-2 Summary of project impacts and adoption (general quality improvements)

Impact component	Estimated (yes/no)	Parameter value (net)	Adoption relative to base case		
			Year 5	Year 10	Year 20
Benefits					
Improved product quality	Yes	Marginal increase in value with project - $5/m^3$	30*%	10%	0%***
Improved processing efficiency	Yes				
Costs					
Project costs	Yes	See Table F-1			
Implementation costs (general quality improvements)	Yes	$2,000 (once-off)			

*30% of adoptees benefit from adoption.
** Note that adoption is assumed to peak in year 8 at 50%
***Note that it is assumed that the project benefits no longer result in improved prices at this point.
Source: URS estimates.

Table F-3 Summary of project impacts and adoption (warp prediction improvements)

Impact component	Estimated (yes/no)	Parameter value (net)	Adoption relative to base case		
			Year 5	Year 10	Year 20
Benefits					
Improved product quality	Yes	Marginal increase in value with project - $\$2/m^3$	5%	50%	0%*
Improved processing efficiency	Yes				
Costs					
Project costs	Yes	See Table F-1			
Implementation costs (general quality improvements)	Yes		5%	80%	0%*
Implementation costs (warp technology)	Yes	$100,000 (once–off)			

* Note that it is assumed that the project benefits no longer result in improved prices at this point.
Source: URS estimates

F.8 Evaluation

Table F-4 contains the evaluation results, including estimates of Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) over a fifty year period using a5 % discount rate and an adoption rate of 5% at year 5.

Table F-4 Evaluation results

Evaluation measure	5 years	10 years	20 years	50 years
NPV ($ 000)*	($2,102)	$11,073	$14,717	$14,717
BCR	0.2	4.4	5.5	5.5
IRR	22%	24%	26%	26%

*Assumes 5% real discount rate. Values are 2009 dollars.
Source: URS estimates.

F.8.1 Sensitivity analysis

High scenario

Table F-5 contains the results from a sensitivity analysis that assumes the benefits from the warp prediction technology peak at 80% in year 10. All other assumptions are unchanged from the original analysis.

Table F-5 Sensitivity analysis – high estimate

Evaluation measure	5 years	10 years	20 years	50 years
NPV ($ 000)*	($2,102)	$17,239	$23,456	$23,456
BCR	0.2	5.7	7.3	7.3
IRR	26%	29%	31%	31%

*Assumes 5% real discount rate. Values are 2009 dollars.
Source: URS estimates.

Appendix F

Low scenario

Table F-6 contains the results from a sensitivity analysis that assumes the benefits from the warp prediction technology peak at 30% in year 10, reflecting the fact that some mills may find the license fee a barrier to entry. All other assumptions are unchanged from the original analysis.

Table F-6 Sensitivity analysis – low estimate

Evaluation measure	5 years	10 years	20 years	50 years
NPV ($ 000)*	($2,102)	$8,394	$10,216	$10,216
BCR	0.2	3.8	4.4	4.4
IRR	NA	22%	23%	23%

*Assumes 5% real discount rate. Values are 2009 dollars.
Source: URS estimates.

Appendix G Assessing the performance of wood poles exposed to bushfires (PNA014-0708)

G.1 Project need

The electricity distribution grid has approximately five million wood poles. Loss of poles through bushfires is becoming an increasing problem for distribution grid operators. It results in increased costs to replace poles, increased costs if other materials (e.g. concrete) are used instead of wood poles, and can also lead to loss of revenue, or demands for compensation, when power supplies are interrupted.

Grid operators have responded by using alternative pole materials, such as concrete and steel and, hence, there has been a decline in the volume of wood poles used in this application.

One solution to reduce the loss of poles in bushfires would be to apply a fire retardant to the poles. However, there was no appropriate test data available to demonstrate that treating CCA-poles with fire retardants would provide adequate protection should they be exposed to severe bushfire.

G.2 Project objective

The project objectives are summarised as:

- To develop a large-scale test method that would predict the real-life outcomes for CCA-treated hardwood poles and creosote-treated hardwood poles exposed to severe bushfires;
- To assess the fire performance of CCA-treated radiata pine pole specimens; and
- To assess the efficacy of three fire retardant formulations applied as coatings and one fire retardant formulation applied by vacuum/pressure treatment to CCA-treated hardwood and softwood pole specimens.

The ultimate objective was to increase the use of treated wood power poles in use in Australia.

Two Australian Standard tests for bushfire exposure were published at the time the project testing began. As a consequence, the project aims were expanded to include testing all specimen types to one of the abovementioned methods.

G.3 Project costs

Research costs

The project costs are summarised in Table G-1.

Table G-1 Project costs

Project number	Operating	Capital	In-kind	Total
PNA014-0708	$136,000	–	$23,500	$159,500

Source: Project proposal documentation.

Implementation costs

The costs associated with using treated wood poles are the material costs of such poles and the associated costs of CO_2 emissions. Fire retardant poles are estimated to cost $825/pole, while equivalent concrete poles are estimated to cost $1,000/pole. And the cost of purchasing CO_2 permits, is estimated to be $20/permit.

G.4 Project benefits

Economic

The project identified pole products and treatments that are susceptible to bushfire, and those which are not. In particular:

- CCA-treated hardwood poles, which are the main wood pole products currently used, are easily destroyed in wildfire due to the afterglow effect caused by CCA.
- Creosote-treated hardwood poles do not ignite. However, these poles are not used widely at present as there are some concerns about the OH&S of the product.
- Fire retardant impregnated softwood poles performed very well in the fire tests. Softwood poles are not currently used by grid operators and the project findings suggest that there is potential for softwood poles to be used more often in the future.

The project has allowed grid operators to identify poles that are currently in operation within the electricity supply network which need to be managed to avoid fire damage. For example, it has allowed grid operators to prioritise the management of their stock of CCA-treated hardwood poles.

Another significant benefit of the project is the development of an accurate bushfire test, which can be used by grid operators to test new products.

Industry interviewees indicated that, as a result of the project, treated wood poles can be more confidently used in the distribution of electricity. The distributors now also have a better understanding of how to prioritise the management of its existing stock of wood poles. As a result, it is assumed that the project will contribute to the increased use of treated wood poles in the electricity distribution network, relative to concrete or untreated wooden poles. However, industry contacts could not identify the number of poles that had the potential to be replaced in fire-prone areas as a result of the project outcomes.

Environmental and social

Another benefit of utilising wood poles is the estimated avoided CO_2 emissions associated with wood relative to concrete. The life-cycle assessment (representing raw material, processing and operation and service phases) of carbon dioxide emitted in the production of a 45kV, 12m concrete electricity pole is estimated to be 257kg/pole, while for CCA treated wood poles it is estimated to be 76kg/pole (Erlandsson, Ödeen, and Edlund 1992). It should be noted that the life-cycle assessment, upon which these estimates are based, was undertaken using Swedish material input parameters. The relativities may be different in the Australian context. Fire retardant poles are estimated to cost $825/pole, while equivalent concrete poles are estimated to cost $1,000/pole.

Society is also likely to benefit from the anticipated reduction in the incidence of distribution poles burning during fires and the disruption and potential danger this causes. However, it has not been possible to quantify this benefit.

G.5 Base case

Without the project it is assumed that there would be a gradual decline in the number of wood poles (both treated and untreated) used in electricity distribution grids within areas where there is a risk of bushfires (for replacement purposes and for new grids), and an increase in poles made from concrete.

It is assumed that similar research would have been undertaken by the timber pole industry. However, this is assumed to have occurred more slowly and in a more fragmented way, than under the case with the project.

G.6 Adoption relative to base case

Industry interviews suggest that adoption of the research findings has been limited to date. Two main reasons were provided regarding the lack of adoption. The first is that the fire retardant-impregnated poles are not yet available in commercial quantities, which means that distributors are still dependent on alternatives such as concrete or steel. The second reason is that some of the fire retardants are difficult to apply, and as a consequence, cost more. Although creosote-treated poles are relatively easy and inexpensive to produce, OH&S concerns have limited the up-take of these poles in the Australian market.

It is estimated that the annual demand for poles is around 100,000 (DPI&F 2006) and comprises poles for replacement and for expansion of the electricity grid. It is assumed that five percent of these poles (5,000 poles per annum) will be used in areas where there is a risk of bushfires. Five years after the project was completed (2013-14), it is assumed that the adoption rate (i.e. the number of wood poles treated with fire retardant) is in the order of 30% of the annual demand for poles in bushfire areas. After this time, it is assumed that the benefits of alternative research undertaken as part of the base case would have influenced behaviour and the demand for fire retardant wood poles is assumed to decline significantly by year 10.

G.7 Summary

Table G-2 contains a summary of the main project impacts (benefits and costs) relative to the base case and indicates whether the impact has been estimated quantitatively.

Table G-2 Summary of project impacts

Impact component	Estimated (yes/no)	Parameter value (net)	Adoption relative to base case		
			Year 5	Year 10	Year 20
Benefits					
Reduced material costs	Yes	$175/pole	30% of demand for poles in bushfire areas	0%	0%*
Reduced CO_2 emissions	Yes	$3.62/pole			
Social (reduced disruptions from burnt poles)	No				
Costs					
Project costs	Yes	See Table G-1			

* Note that it is assumed that the project benefit no longer result accrues at this point.
Source: URS estimates.

G.8 Evaluation

Table G-3 contains the evaluation results, including estimates of Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) over a fifty year period.

Appendix G

Table G-3 Evaluation results

Evaluation measure	5 years	10 years	20 years	50 years
NPV ($ 000)*	$464	$821	$821	$821
BCR	4.1	6.4	6.4	6.4
IRR	42%	48%	48%	48%

*Assumes 5% real discount rate. Values are 2009 dollars.
Source: URS estimates.

G.8.1 Sensitivity analysis

High scenario

Table G-5 contains the results from a sensitivity analysis that assumes alternative research does not occur and adoption peaks in year 10 at 55% of the demand for poles in bushfire prone areas. All other assumptions are unchanged from the original analysis.

Table G-5 Sensitivity analysis – high estimate

Evaluation measure	5 years	10 years	20 years	50 years
NPV ($ 000)*	$464	$1,629	$2,143	$2,143
BCR	4.1	11.8	15.2	15.2
IRR	42%	53%	53%	53%

*Assumes 5% real discount rate. Values are 2009 dollars.
Source: URS estimates.

Low scenario

Table G-6 contains the results from a sensitivity analysis that assumes that the producers of concrete poles respond by lowering the costs of concrete poles, effectively lowering the net project benefits to $125/pole. All other assumptions are unchanged from the original analysis.

Table G-6 Sensitivity analysis – low estimate

Evaluation measure	5 years	10 years	20 years	50 years
NPV ($ 000)*	$120	$277	$277	$277
BCR	1.8	2.8	2.8	2.8
IRR	19%	26%	26%	26%

*Assumes 5% real discount rate. Values are 2009 dollars.
Source: URS estimates.

Appendix H Strategy for large span second storey timber and wood products (PNA020-0809)

H.1 Project need

Steel beams are commonly used in large span structural applications. However, in this application, steel beams can be labour-intensive to install and they can also have OH&S risks owing to the machinery that is required during installation. Large span timber products can be a lower-cost alternative material, which require a lower level of skill during installation and fewer OH&S requirements.

The project need arose when it became apparent that there was little awareness of the alternatives to steel beams, despite the benefits that timber products offer.

H.2 Project objective

The project objective was to raise awareness that there are other solutions available for long-span beams, including box beams and other wood based products and thereby increase the use of such beams in the residential building market.

H.3 Project costs

Research costs

The project costs are summarised in Table H-1.

Table H-1 Project costs

Project number	Base case	Capital	In-kind	Total
PNA020-0809	$31,589	–	$72,431	$104,020

Source: Project proposal documentation.

H.4 Project benefits

Industry interviewees commented that the project's main outputs have been:

- Raising awareness within the building industry that wood beam options and solutions exist. This has been achieved by creating a link to wood beam manufacturers through the Timber Development Association (TDA) website.
- Designing span tables for box beams that have assisted in the utilisation of the product.

The benefits of using engineered timber beams relative to steel include lower material costs for equivalently-performing materials. Based on information available to URS, the potential saving associated with using timber beams depends on the application and could range from between $0 and $250/m^3. For the purpose of this analysis, URS has assumed a cost saving of $125/m^3.

Discussion with industry interviewees indicates there is mixed opinion as to whether timber beams result in lower installation costs and lower health and safety risks. One industry interviewee commented that, if the timber beam weighs more than 20kg (e.g. an 8 m length of LVL beam), then a crane would be required to be compliant with OH&S requirements.

There is demand for the project information on the TDA website; for example, it is estimated that six percent of key word searches on the TDA website are for beams/EWP. There are also 500 unique visitors to the website per day.

Industry interviewees considered the project to have made a contribution to growth in demand for wood products; however, they commented that the value of this contribution could not be readily determined because of the many other factors influencing demand for large span wood products. One industry interviewee commented that there has been growth in demand for ‘split hanger’ products, which is indicative of growth in demand for wood beams, but this could not be readily estimated. Industry contacts also found it difficult to estimate the number of buildings that were being built with wood beams and how many of these could be attributed to the project. ABS data on the materials used in outer walls of buildings was located; however equivalent data on beam material is not available.

Environmental and social

Current research suggests that predominantly timber-based houses contribute fewer greenhouse gas emissions than predominantly brick or steel (see, for example Ximenes, Robinson and Wright 2008). Given this, it is assumed that the project could result in environmental benefits in the form of reduced greenhouse gas emissions; however, these benefits have not been quantified as the information available to quantify embodied energy on a like-for-like basis is very limited. While a product such as steel may have more embodied energy per unit of volume than wood, a greater volume of wood may be required to meet the same purpose.

By reducing the OH&S risks associated with building, society is likely to benefit from fewer accidents and the consequential reduced stress and trauma for immediate family, work colleagues and associated communities. However, because industry interviewees had mixed opinions about the project’s contribution to improved OH&S, this value has not been estimated.

H.5 Adoption relative to base case

URS estimates that EWP have the potential to directly compete with 116,000 m^3 pa of steel that is currently used in residential construction, including alterations and additions. A further 16,000 m^3 pa could be substituted into the non-residential construction sector. In total, the potential market volume for which steel and EWP beams could be considered substitutes is estimated to be 132,000 m^3 pa.

The extent to which timber beams is likely to substitute for steel is estimated to be in the order of 30% of the total market in which EWP could compete with steel - approximately 39,600m^3 pa. However, in the longer term, it is assumed that most of the growth in the use of EWP is likely to result form the positive experience of builders using the products rather than the project itself. Therefore, URS has assumed that one year after the project commenced, the adoption rate (in terms of the likely volume of EWP that will substitute for steel) is 1%. By year 5, this is assumed to increase to 6%; however by year 11, it is assumed that the project benefits have been dissipated as a result of alternative research and technology transfer.

In considering these adoption rates, it is noted that wide-scale dissemination of the project information was not possible within the project budget, and one industry interviewee considered this to be a barrier to further adoption.

H.6 Summary

Table H-2 contains a summary of the main project impacts (benefits and costs) relative to the base case and indicates whether the impact has been estimated quantitatively.

Table H-2 Summary of project impacts

Impact component	Estimated (yes/no)	Parameter value (net)	Adoption relative to base case		
			Year 5	Year 10	Year 20
Benefits					
Reduced material costs	Yes	$125/m^3 of EWP used	6% of likely substitution between EWPs and steel beams	1% of likely substitution between EWPs and steel beams	0%*
Reduced installation costs (potential)	No				
Reduced OH&S risks (potential)	No				
Environmental benefits	No				
Social benefits	No				
Costs					
Project costs	Yes	See Table H-1			

* Note that it is assumed that the project benefit no longer result accrues at this point.

Source: URS estimates.

H.7 Evaluation

Table H-3 contains the evaluation results, including estimates of Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) over a fifty year period.

Table H-3 Evaluation results

Evaluation measure	5 years	10 years	20 years	50 years
NPV ($ 000)*	$207	$702	$702	$702
BCR	2.1	4.9	4.9	4.9
IRR	28%	42%	42%	42%

*Assumes 5% real discount rate. Values are 2009 dollars.
Source: URS estimates.

H.7.1 Sensitivity analysis

High scenario

Table H-4 contains the results from a sensitivity analysis that assumes the benefits from alternative technology transfer do not occur as quickly and hence adoption peaks in year 10 at 10%. All other assumptions are unchanged from the original analysis.

Appendix H

Table H-4 Sensitivity analysis – high estimate

Evaluation measure	5 years	10 years	20 years	50 years
NPV ($ 000)*	$243	$1,507	$2,033	$2,033
BCR	2.3	9.3	12.2	12.2
IRR	30%	51%	52%	52%

*Assumes 5% real discount rate. Values are 2009 dollars.
Source: URS estimates.

Low scenario

Table H-5 contains the results from a sensitivity analysis that assumes that the manufacturers of steel beams respond by lowering their costs, effectively lowering the net project benefits to $75/m^3. All other assumptions are unchanged from the original analysis.

Table H-5 Sensitivity analysis – low estimate

Evaluation measure	5 years	10 years	20 years	50 years
NPV ($ 000)*	$51	$348	$348	$348
BCR	1.3	2.9	2.9	2.9
IRR	12%	28%	28%	28%

*Assumes 5% real discount rate. Values are 2009 dollars.
Source: URS estimates.

Appendix I Enhancing the perception of timber as a suitable construction material in termite prone areas (PN03.1213)

I.1 Project need

In the construction industry, timber competes with a number of alternative building materials, particularly steel. In the late 1990s and early 2000s, timber was losing market share to non-timber building products, in part because there was a perception that timber was inferior because of its susceptibility to termite attack.

During this time, the timber industry was in the process of developing new termite treatments for wood. However, until these products became available in the market, it was considered necessary to invest in a marketing campaign that was designed to address consumers' concerns about using timber in termite-prone areas.

I.2 Project objective

The project's objectives can be summarised as:

- To provide reassurance and improve the understanding of builders and home owners about the real risks of termite damage to timber; and
- To provide information on termite risk assessment and management options.

The project was primarily aimed at reducing the perception of risk, and actual damage from termite attack, and therefore maintaining the use of softwood timber in structural applications (e.g. framing) within the residential building market.

I.3 Project costs

Research costs

The project costs are summarised in Table I-1.

Table I-1 Project costs

Project number	Operating	Capital	In-kind	Total
PN03.1213	$174,720	-	$174,720	$349,440

Source: Project proposal documentation.

I.4 Project benefits

Economic

The project enabled the potential risks of termite attack to be validated, as well as the development of management options which could be used by builders, pest managers and consumers to minimise the likelihood of an attack, and hence damage to buildings. The Timber Development Association has also used the information produced through the project to develop a training course for builders.

As there is no tangible evidence that the issue of termite resistance was impacting on timber sales prior to the project being initiated, the value of any benefit has not been estimated. The project was largely a 'stop-gap' measure, designed to provide confidence within the market until the new termite-resistant products became available.

Appendix I

Environmental and social

There are no direct environmental benefits identified in relation to the project outcomes.

The social benefit associated with the project may be reflected in the availability of information about termite risks and management strategies and the associated reduced level of stress experienced by people who were unnecessarily concerned; however it has not been possible to evaluate this benefit.

I.5 Adoption relative to base case

The information and online course that was produced by the project were adopted almost immediately and are still being accessed today by consumers, builders and pest managers. However, no data are available on the extent to which the information gained through the project has been adopted; there is also some concern about the dissemination of the project information. URS understands that the large-scale dissemination of the project results was not included in the budget.

The project was largely a ‘stop-gap’ measure, designed to provide confidence within the market until the new termite-resistant products became available. As such the adoption of the project information and potential benefits were envisaged to be relatively short-lived.

I.6 Evaluation

While project benefits have not been quantified, discussions with industry contacts indicate that there was a desire by industry to improve the availability of information about termite risk. The project provided the means by which information about termite risk management could be disseminated, while more fundamental research into ways of improving the termite-resistance of timber products was undertaken.

URS Australia Pty Ltd
Level 6, 1 Southbank Boulevard
Southbank VIC 3006
Australia
T: 61 3 8699 7500
F: 61 3 8699 7550

www.ap.urscorp.com