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Professor Arun Sharma
Deputy Vice-Chancellor

FIAC Secretariat
Forestry Branch
Department of Agriculture
GPO Box 858
Canberra ACT 2601

5 June 2015

Dear FIAC Secretariat,

Re: Response to 'Meeting Future Market Demands: Australia's Forest Products and Forest Industry - A Strategic Directions Issues Paper' (Issues Paper)

QUT supports and encourages the Forest Industry Advisory Council (FIAC) in the preparation of a discussion paper on the future of the national wood and forestry products industries, and is excited by the opportunity to contribute to this process by responding to the Issues Paper. We recognise and acknowledge the Issues Paper as signalling significant collaborative intent and we commend the government on the investment in long term strategy for this key rural industry. The Australian agricultural innovation sector is in need of such leadership to drive productive collaboration that enables positive industry outcomes.

QUT is 'a university for the real world' and combines technological focus and interdisciplinary culture with a commitment to working in partnership with industry. QUT has a history of successful collaborations with industry to achieve outcomes, two recent examples of which include:

- A consortium consisting of Forestry and Wood Products Australia, Sugar Research Australia, Cotton Research and Development Corporation, Australian Pork Limited, an oil refinery, and animal feed producer to develop 'A profitable future for Australian agriculture: biorefineries for higher-value animal feed, chemicals and fuels' funded by the Rural R&D for Profit scheme;
- Improving the profitability of the Australian sugar industry through numerous research projects with both Sugar Research Australia and directly with sugar mill consortia;

QUT acknowledges that there are a number of highly relevant stakeholders likely to provide significant and meaningful contribution to this process. QUT has strengths and capability in a number of areas relevant to the Issues Paper and we have targeted our response to areas that we believe align best with the intent to inform the direction of the forest and wood products sector.

Relevant to the Issues Paper, QUT's key research strengths include:

- Agricultural bioprocessing and biorefining;
- Robotics, computer vision, and autonomous systems;
- Data science, computational modelling, and simulation science;
- Environmental monitoring and optimisation of soil health and nutrition;
- Biosecurity and forest protection;
- Materials science and engineering;
- Business innovation; and
- Work-integrated learning and new technology for delivery of virtual learning and industry-specific content.

QUT thanks FIAC for the opportunity to provide input into the strategic direction of the forest products sector. We would be happy to elaborate on this response and look forward to further significant collaborations with the industry in areas of mutual strategic alignment.

Yours sincerely

personal contact details
personal contact details

Professor Gordon Wyeth

A/Deputy Vice-Chancellor

(Research and Commercialisation)

Questions for consideration

Vision and objectives

1. What should the vision be for the forest products sector in the coming decades?

A profitable, sustainable, and responsive Australian forest industry that exploits significant regional and international competitive advantages through leadership in research, development, and education.

2. What specific objectives should underpin this vision?

The Australian forest products industry has access to a stable, productive, and world-class higher education sector focused on commercial and environmental outcomes for industry. Closer alignment of the Australian higher education sector with the needs of the forestry industry will enable the sector to achieve its long-term goals of profitability, sustainability, and responsiveness, as well as meet the demands of future markets.

The key objective to underpin this vision is investment in research, development, and education that increases profitability and market access by:

- developing new revenue streams from integrated biorefineries;
 - developing and manufacturing of new and improved timber, paper, and composite materials;
 - improving productivity through the use of robotics and autonomous systems;
 - improving forest management using remote sensing and data analysis tools;
 - improving product development and production processes through modelling and simulation;
 - adapting and improving management practices to address the challenges of climate variability, biosecurity and crop protection, and meet market demand for sustainable, certified forestry products; and
 - increasing workforce skill levels and improving workforce retention via tailored, innovative delivery and content of training and education, and work-integrated learning.
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Issue 1: Market trends and pressures

3. What forest products does Australia have a local and/or international competitive advantage in producing?

The geographical range of Australian forestry supports both softwood and tropical hardwood plantations.

4. What is the potential demand for forest products in the coming decades?

N/A

5. How can Australia best position itself for this demand, both nationally and internationally?

N/A

6. What are the other drivers or disruptions that will potentially affect supply and/or demand?

Environmental constraints and climate change will have a significant impact on forest productivity, susceptibility to pests and diseases, frequency and intensity of fire, and post-harvest regeneration of desirable species in native forests. Water availability will become an increasingly critical issue, particularly during plantation establishment. Further, the demand for certified 'sustainable' products and international constraints on the use of native forests will increase. Finally, the sector can expect an increase in the demand for new, sustainable, high-value materials, and bioproducts.

Submission in response to *Meeting future market demand: Australia's forest products and forest industry* — a strategic directions issues paper

Issue 2: Emerging uses and markets

7. Which emerging forest products have the greatest potential for Australia?

QUT has made extensive strategic investments to support the delivery of technology solutions that will enable the Australian forest products sector to capture maximum value from emerging forest products by:

- identifying and purifying secondary metabolites unique to softwood and hardwood with application as high-value speciality chemicals, agrochemicals, fragrances, nutraceuticals, and pharmaceuticals;
 - transform lignocellulosic forestry waste into fermentable sugars, fuels, resins, coatings, paints, animal feed, and high-quality fibre in integrated biorefineries; and
 - developing structurally-efficient and innovative building products, for example using improved timber sections together with appropriate steel and/or concrete components.
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8. What are some of the barriers to the development and/or uptake of these emerging forest products in Australia?

The key barriers to the development and/or uptake of these technologies are:

- recognition that ‘transdisciplinary’ research, development, and engineering teams capable of the full spectrum of activity from applied research to demonstration-scale implementation are needed to develop the forest industry products of the future;
 - sufficient investment in transdisciplinary research, development, and engineering teams with sufficient ‘critical mass’ to achieve genuine outcomes for industry;
 - deeper understanding of the performance of hybrid-timber products and systems under relevant design actions; and
 - existing design rules that restrict the development and/or use of such hybrid products in buildings.
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9. What opportunities exist to better utilise wood resources?

Novel approaches to generate forestry products more rapidly and cost-effectively, including modelling, simulation, analysis, and experimental validation, are available but are currently underutilised. These approaches have been successfully used by QUT in the development of new timber products and processes, such as boards, and kiln and vacuum dried woods.

Concerns over fire safety and limitations on structural capacity of timber in comparison with steel and concrete structures have limited its use in construction to low-rise buildings. However, timber as a building material has significant benefits to offer occupants, designers, and the community in general. Development of structurally-efficient and innovative composite building products that incorporate timber and timber products will lead to increased use of timber in mid- to high-rise buildings, and in the broader construction context.

Efficient, decentralised cogeneration of power from forestry residues, chips, and sawdust is an opportunity for the forest products sector to add value to existing waste streams, improve waste stream management practices, enhance the environmental ‘credentials’ of the industry, and reduce energy costs for the sector. QUT is a world leader in the design and implementation of energy efficiency measures for the sugar industry and in cogeneration of electricity from sugarcane bagasse.

Issue 3: Forest resources

10. What is required to ensure the plantation estate is able to meet future demand for forest products?

The future viability of existing commercial plantations will depend upon meeting the challenges and opportunities posed by:

Submission in response to *Meeting future market demand: Australia’s forest products and forest industry – a strategic directions issues paper*

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- competition from alternative uses for forestry land, including agriculture, housing, and conservation;
 - increasing restrictions and costs associated with water used to establish and maintain young trees;
 - the negative effect of plantations on catchment hydrology;
 - the need to demonstrate the economic and environmental benefits of planting shelter belts, contour lines, *etc.* to encourage investment by farmers;
 - recognition of the carbon value under the carbon farming initiative (CFI) and emission reduction fund (ERF) may encourage long-rotation (>25 years) native plantings on-farm if information on species suitable for timber harvest is available;
 - the use of robotics and automation to increase productivity;
 - Threats to forest protection and biosecurity incursions are increasing through international movement of materials and people, climate change, and global distribution of native Australian plantation species. Nationally, capacity in forest protection is declining and State Government services to industry are being reduced. Industry plans should include further optimisation and planning for incursion management, and new strategies for integrated and sustainable pest management. Technology and training should be developed to increase linkage between industry staff and the smaller expert base to increase industry capacity to respond; decline in provision of state government technical and research skills;
 - decline in provision of state government technical and research skills; and
 - lack of specialist training and the requirement for specialist training building on broad university and VET in forest management and protection.

The future viability of Australian rural industries, including forestry, relies upon a well-trained workforce with well-defined succession planning in key areas. QUT is not alone in recognising the decline in forest-specific expertise, training, and research, and is uniquely placed to develop these areas in partnership with the forest products sector (see Issue 8 for further comment).

11. What is required to ensure the native forest estate is able to meet future demand for forest products?

In order to ensure the native forest estate is able to meet future demands for forest products, the following should be considered:

- Consumers of high quality native forest timbers will increasingly demand the sustainable production from these resources. Early investment in assessment of resource use and emissions associated with native forest products and communication of life cycle analysis will assist in positioning the industry for this market;
 - The benefits of forests for carbon storage, if properly estimated and communicated, will help to ensure access to sustainable harvest in native forest areas;
 - Climate change projections predict an increased risk of wildfire and spread of disease that must be evaluated and integrated into long-term forest management plans. Climate change will also affect regeneration of preferred species following harvest;
 - Impacts of climate change on site/species suitability and decline in forest health will be important factors for management of post-harvest regeneration for long-term sustainability and production of high value species in changing landscapes; and
 - Native forest estates can benefit from robotics, sensing and spatially and temporally explicit information to help managers address issues specifically related to multi-use land, such as conservation of biological diversity, feral animal detection, forest habitat fragmentation, and forest composition.
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12. What opportunities are there to increase wood supply from farm forestry, private native forestry and Indigenous owned and managed lands?

Opportunities for increasing wood harvest from farm forestry in the longer term will require education on appropriate species and access to cost-effective harvest and milling.

There is potential to link with ERF projects for long-rotation agroforestry species where the total farm area planted to trees can be maintained through replanting following harvest or where prices are sufficient to make plantings viable on less-productive (for crops or livestock) sections of the farm.

Issue 4: Innovation, research and development

13. What are the future research and development needs for Australia's forest products sector, and which of these needs are specific to strengths and opportunities in the Australian context?

Future research needs are closely aligned with the key opportunities to realise the vision of an innovative, sustainable, and responsive Australian forest industry and include:

- developing new revenue streams from integrated biorefineries;
- developing and manufacturing of new and improved timber, paper, and composite materials;
- improving product development and production processes through modelling and simulation;
- improving forest management using robotics, sensing and data analysis tools;
- responding to biosecurity threats, improving crop protection practices and rebuilding capacity in forest protection; and
- adapting and improving management practices to address the challenges of climate variability and meet market demand for sustainable, certified forestry products.

Developing new revenue streams from integrated biorefineries

The development of technologies, knowledge, and capacity to increase revenue from existing forest products and by-products with rapid paths to market will deliver increased productivity and profitability. The specific objectives to underpin this vision are as follows:

Development of a detailed understanding of the characteristics of the feedstocks, value chains associated with products from plantation to market, and organisational capacity of the sector to adapt to these new opportunities. This requires a detailed understanding of resource availability, composition and quality, harvesting and transport options, and competing uses for the feedstocks. Development of business models and value chains appropriate for new bioproduct industries in Australia will enable additional flow through of value creation to primary producers and manufacturers. QUT is currently partnering with Forestry and Wood Products Australia to deliver these outcomes.

A comprehensive assessment of the technology and product opportunities that can add value to the Australian forest products sector. New technologies to add value to forestry products and by-products are developing rapidly. However, it is not clear which technologies offer the best opportunities for Australia, particularly given challenges such as transport, infrastructure, geographic isolation, and the desire for economies of scale. The assessment will provide policy makers and the industry with a science-based assessment of the most promising biomass to product value chains. QUT has successfully delivered equivalent high-level assessments for the Australian sugar industry.

Development of the technologies needed to convert forestry feedstocks into new value-added animal feeds, bulk chemicals, fine chemicals, pharmaceutical, nutraceuticals, and liquid fuels. Using the technology and product assessment as a guide, strategic investment in key product and technology development is needed. Particular emphasis needs to be placed on ensuring that the benefits of new technology to the Australian

forest products sector are maximised and transfer of technology to lower-cost centres is minimised.

Developing and manufacturing of new and improved timber, paper, and composite materials. Improving product development and production processes through modelling and simulation.

New approaches to production processes for rapid and cost-effective development include modelling, simulation, analytical characterisation, and experimental validation. These approaches have been used by QUT to develop new timber products and processes such as boards, and kiln and vacuum dried woods. Concerns over adequate fire safety and limited structural capacity in comparison to steel and concrete structures have limited the use of timber in construction to low-rise buildings. However, timber as a building material has significant benefits to offer occupants, designers and the community in general. Development of structurally-efficient and innovative composite building products will lead to increased use of timber in mid- to high rise buildings, and in building applications in general.

Improving forest management using robotics, remote sensing and data analysis tools.

Agricultural robotics can provide forest managers with unprecedented levels of spatial and temporal information about soil and stand conditions, including pest and disease outbreaks, erosion rates, growth stages and rates, and biomass. This will allow managers to more precisely target management practices and potentially reduce herbicide use and overall management costs. Intelli-sensing is the integrated collection of tools and techniques (from robots, unmanned aerial vehicles (UAVs), and sensor networks to sophisticated mathematical models and algorithms) that can help forest managers make sense of large amounts of data (agronomic, environmental, and economic) and make risk-informed decisions as they run their operations. QUT is a recognised leader in these fields, and is currently developing robotics, sensing, and data integration technology for agriculture and forestry.

Like plantation forests, native forest estates can benefit from automation, sensing and data integration to increase productivity. Information about pest outbreaks, growth stages and rates, and biomass will be important in native forest estates. Spatially and temporally explicit information will also help managers address issues specifically related to multi-use land, such as conservation of biological diversity, feral animal detection, forest habitat fragmentation, and forest composition. The ability to improve and demonstrate sustainable production will allow the forest industry to tell a positive environmental story and ensure that timber production continues in multi-use, native forest estates in the future.

The Australian Research Centre for Aerospace Automation (ARCAA) uses UAVs and UAV based technologies for plant pest and feral animal detection, and applied them to aerial surveys for insect and pathogen outbreaks, and detection of plant nutrient deficiency. The three year project 'Optimising Surveillance Protocols Using Unmanned Aerial System' has and is developing advanced software for existing high-tech imaging equipment (hyperspectral and multispectral) that can pinpoint pests such as Stripe Rust found in wheat and Myrtle Rust currently threatening horticulture, as well as native plants such as tea tree and bottle brush.

The use of robots in forestry will not only require the development of robotic platforms and novel sensors and manipulators, but also developments in areas of agricultural informatics, mathematical and statistical modelling, analysis of big-data, and decision support systems. Some of these developments will require not only technology, but also the input of scientists with expertise in:

- Pest and weed modelling and management;
- Agricultural biotechnology;
- Soil health, climate, and gas emissions;
- Stakeholder engagement;
- Economics of precision agriculture;
- Asset management; and
- Innovation and technology uptake.

QUT also hosts a node of the ARC Centre for Excellence in Mathematics and Statistics (ACEMS): Big Data

Analytics, Big Models, New Insights. The ACEMS group is made up of quantitative researchers with the expertise to model large volumes of spatially and temporally explicit data, in order to provide useful information for management of forest resources.

Responding to biosecurity threats, improving crop protection practices and rebuilding capacity in forest protection

Threats to forest protection and incursions are increasing with international movement of materials and people, climate change, and global distribution of native Australian plantation species. Nationally, capacity in forest protection is declining and State Government services to industry are being reduced. Withdrawal of conventional chemical controls and increased demands for reduction in chemical usage are limiting options available to forest managers and increasing the threat of resistance.

Universities can meet some of these challenges through research and education in collaboration with industry. Work-integrated learning and industry sponsored, work-integrated research in partnership with universities can add to both increased workforce capacity and to staff retention and career progression. Existing technology can be used and adapted to increase linkage between industry staff and the smaller expert base. Industry capacity to respond could be increased through industry-specific, modular, and virtual 'hands on' training (see Issue 8).

In addition to remote sensing, QUT is engaged in modelling of pest and disease incursions and in optimising responses and actions through the CRC for Plant Biosecurity. QUT is a national leader in the development of new approaches to pest management, including the development of integrated pest management and resistance management strategies, research into plant/pest biology, and commercial development and application of biopesticides, which are widely used in forestry internationally as alternatives to conventional chemistry. We have international research and extension capacity in forest entomology, protection, silviculture, and management for high-value hardwood timbers and tropical forest plantations. This expertise can be used to build capacity and improve responses and management strategies in partnership with industry.

Adapting and improving management practices to address the challenges of climate variability and meet market demand for sustainable, certified forestry products.

Australia has a highly variable climate and projections are that the future climate will be hotter and more extreme. For long-lived 'crops' like trees, research is essential into the impacts of climate on: (1) tree survival and yield; (2) wood quality; (3) risks of fire and extreme weather events such as heat waves and floods; (4) spread of diseases and pests (above and below ground); and (5) regeneration of native forests post-harvest and impact of climate change on recovery of valuable species.

Quantifying environmental impacts and reporting life cycle assessment has the potential to: (1) provide some (though likely small) additional income through carbon credits recognising that credited carbon will be discounted for harvest; (2) encourage additional private farm forestry investment; (3) meet market/consumer expectation of demonstrated efficiency of resource use and minimised emissions, including GHG emissions (reduced emissions and maximised sequestration); and (4) maximising use of all harvested material through innovative use for timber, biofuel, heating, *etc.*

Changing climate may provide opportunities that include longer growing seasons in southern Australia and options for integrating production of new species. However, in some areas where current species are marginal, timely identification of stresses will be needed to position the industry for the future. Climate change will have significant impact on regeneration of desirable species and flow-on effects on management of native forest resources. QUT has demonstrated research, development and education in the adaptation of rural industries to climate change, sustainable natural resource management, soil and water and whole systems analysis, including economic and social perspectives.

14. What are the current inhibitors to private sector investment in research, development and extension and what role, if any, does the Australian Government potentially have in addressing these?

Short term investment goals and lack of immediate cost-benefit for research hinder the development of longer term, strategic research and development programs. The risk in supporting such longer-term but (ultimately) essential programs can be offset by the development of cost-benefit models that appropriately capture the long-term benefits of research to improve transparency for industry stakeholders and investors.

15. How can the framework for coordinating Australian forestry research and development be strengthened?

Increased and active engagement with university research and development providers will provide access to innovation and facilitate knowledge transfer and increased workforce capacity as well as support R&D. Participation in joint workshops and development of training will enhance access to innovation and networks.

Investment in R&D is typically short term. A strategic and industry-led investment program is required, supporting proof of concept funding for short term projects and longer-term investments, with increased cost-benefit analysis to encourage longer-term investment to support fundamental research through to adoption.

Issue 5: Consumer and community engagement

16. How can domestic and international consumers be better engaged on the environmental, economic and social credentials of Australian forest products?

Quantification of environmental credentials using tools such as life cycle assessment is needed to ensure social licence to operate.

Improved communication of investment in sustainability, traceability, and provenance for suppliers and consumers interested in ethical purchasing of timber products will help to create a continuing demand.

17. How important are consumer awareness programs to the future prosperity of the sector?

There is an increasing consumer expectation that products are produced sustainably and that contribution to climate change is minimised. Apart from high-quality products such as furniture, consumers will likely rely on the retailers to ensure the environmental credentials of products (*e.g.*, for housing, panel, and paper).

18. Can forest certification be better leveraged to achieve stronger demand and better prices for Australian forest products and, if so, how?

As noted in Question 17, certification or labelling provides assurance of ethical production but it should be built on defensible science-based calculations such as LCA. There is potential for certification to become a requirement in some sectors of the market in future. Without certification being essential for market access it may still help ensure market share against alternative products or imported timber.

Issue 6: Strengthened regional approaches

19. How could forestry hubs better utilise resources and promote greater efficiencies and innovation?

If focus shifts to native forests in more remote areas away from current centres of population, including on indigenous lands, forest hubs may be needed to ensure sufficient yield for investment in harvest and transport to be viable.

20. What have been the barriers to the establishment and efficient operation of forestry hubs to date, and what might be the role of the Australian Government in addressing these?

A lack of research, development, and engineering into establishment of regional pilot-scale facilities for integrated forestry processing and biorefineries. Virtually all agricultural industries practice biorefining to a lesser or greater extent. Pilot-scale assessment of new technologies is a key step in the transition from laboratory innovation to commercial production. The lack of capacity to rapidly trial new forestry technologies at the pilot-scale impacts upon (ultimately) the ability to attract commercial investment. The establishment of such facilities will reduce the risk of new technology uptake by the industry and provide key information for comprehensive techno-economic assessment of technology implementation for both softwoods and hardwoods. QUT has successfully developed industry-integrated, pilot-scale infrastructure for deployment of new technologies into the Australian sugar industry (Mackay Renewable Biocommodities Pilot Plant). Where possible, such test facilities could be co-located or used across multiple industries supplying feedstocks. QUT has recently partnered with Forestry and Wood Products Australia to apply these technologies to forestry products.

21. If additional forestry hubs are to be established, where would they best be located?

The location of future successful bioprocessing and biorefinery hubs will depend on numerous factors including, but not restricted to, the following:

- Proximity to forestry resources;
 - Access to transport infrastructure, energy, and labour;
 - Input costs
 - Proximity to markets for both traditional forestry outputs and new value-added products; and
 - Proximity to or co-location with other plant biomass producing industries, particularly where there are opportunities to achieve significant economies of scale in cogeneration and/or value-adding.
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Issue 7: Infrastructure

22. What infrastructure will be required to respond to future demand for Australian forest products?

A future increase in either harvest of native forests or area under plantation will require significant investment in transport and energy infrastructure. Improved integration of forestry with existing or future crop and animal production (particularly in northern Australia in light of recent federal government support for infrastructure development in that region) will be advantageous.

23. What can be done to ensure better recognition and understanding of the sector's infrastructure needs?

N/A

Issue 8: Industry skills and training

24. What are the skills and training needs of the sector over the coming decades, and where are the current gaps?

The Strategic Directions Issues Paper identifies several key challenges, particularly the reduction in local and regional VET and declining student numbers. Increasingly, staff recruited into the industry will come with broad training (sometimes to a tertiary level) in, for example, biological sciences, engineering, or environmental science, but not necessarily specific training in forest production or processing. This will combine with increased staff turnover and competition from other industries, leading to an increasing need for immediate and industry-specific training. Staff career progression will require ongoing professional development through work-integrated learning, which in turn will assist with staff retention through increased motivation and a clear route to self-advancement. As a result, there will be an increasing need for specific, local and 'in-house' training, and for flexible, work-integrated training and education delivered across a widely dispersed and highly mobile workforce.

25. Are Vocational Education and Training and university training providers well-positioned to meet the future skills and training needs of the sector?

Universities are well placed to deliver the future skills and training needs of the sector and are increasingly providing specific and tailored content through work integrated learning, the internet, and simulated learning platforms, as well as developing new approaches to training. QUT, for example, works with the sugar industry to develop and deliver specialist modular training content in a variety of forms (*e.g.*, video) for processing plant operators and transport staff. This online content can be used by in-house and local VET for a range of employees, from modules designed, for example, to familiarise administrative staff as part of an induction to working in a processing plant, or university graduates new to the workforce, to more advanced modules for existing staff wishing to advance from operational to supervisory roles.

Universities are also developing new approaches to deliver more effective workplace teaching and learning. QUT, for example, is developing engaging and cost-effective game-based simulation software that incorporates personalised, hands-on learning into workplace training by simulating a wide range of realistic scenarios and problems. Users 'learn by doing' and receive constant feedback on their progress. This has been applied in areas such as quarantine inspection, plant health diagnostics, and ophthalmic testing. These "serious games" have widespread applications across industries as an adjunct to in-house training and will be a valuable resource for local VET providers.

Opportunities for more advanced professional development and increased retention of experienced and qualified staff could be delivered through industry-sponsored, work-integrated research and higher degrees.

26. What improvements are required at an enterprise level to support the recruitment, development and retention of the sector's current and future workforce?

Training and staff development offer recruits opportunities for career progression and advancement (*e.g.*, the transition from an operational to a supervisory role), increased staff retention, as well as enhancing the overall skill level of the forestry workforce. Enterprises can support recruitment, development, and retention by promoting and sponsoring participation in locally-delivered and in-house work-integrated learning using modular and tailored content provided by universities, and through industry-sponsored, work-integrated research and higher degrees.

General Comments

In formulating the Discussion Paper, the Forest Industry Advisory Council could consider the environmental constraints on production, increasing cost of infrastructure and market driven shifts in demand and pricing, into a long-term game plan.
