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Report

Forest Residues Solution Study

AUSTRALIA

Stage 1 - Residue Options Identification and Analysis

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EXECUTIVE SUMMARY

The Department of State Growth (DSG) has engaged URS Australia Pty Ltd (URS), in conjunction with Enecon Pty Ltd (Enecon), to investigate economically viable and environmentally sustainable solutions for the use of timber residues generated in Tasmania. In a two stage review, this initial stage considers the widest range of options through an evidence-based analysis with the aim of identifying solutions worthy of more detailed investigation as part of the second stage.

A substantial volume of residues are available from Tasmanian forests. The results from a multi criteria analysis of 23 potential residue utilisation options identified six key opportunities for further consideration as part of the Stage 2 assessment:

- Plywood
- Glulam/Cross Laminated Timber
- Stand-alone power
- Industrial cogeneration
- Biomass based hydrocarbons
- Torrefaction of wood pellets

Estimates of residue availability

Tasmania has a long history of forest utilisation for timber production. Historically timber for domestic construction was sourced from native forests and supply from these forests remains an important part of the Tasmanian forest and wood products sector.

The state's plantation softwood estate has developed since the 1920's and has reached a point where these forests provide a stable supply of softwood products.

The earliest commercial scale hardwood plantations were established in Tasmania through the 1990's but expanded rapidly between 2000 and 2010. Much of this expansion was undertaken by private investors in various Managed Investment Schemes (MIS). With the collapse of the companies responsible for managing these schemes, a transfer of ownership to the private investment sector is currently in progress. Most hardwood plantations were established for the production of pulpwood. The oldest of these plantations are mature and fibre availability is expected to increase rapidly over the next decade.

Residues is a generic term for material generated through the harvesting and processing of forests. This includes: harvested wood not taken for sawlog, veneer or peeler billets (including pulp logs, crowns, roots and offcuts from harvested logs and thinnings); and processing residues (including woodchips, shavings, sawdust and dockings). For this study, it is considered that residues could arise from native forests and plantations.

Potential residue availability from public and private forests as well as from the state's processing sector was modelled by Forestry Tasmania (FT) and Private Forests Tasmania (PFT). Residues from public forests are based on the volume required for FT to meet its contract sawlog and veneer log commitments. As a consequence residues are an arising from the harvesting process, rather than a driver of the decision to harvest. The PFT assessment includes supply from privately owned plantations as well as native forests.

Two types of forest residues are identified in the modelling:

- **Pulpwood** - logs of any size not suitable for solidwood processing to a small end diameter of 8 centimetres (cm); and
- **Other Stemwood** - non-merchantable stemwood, including the stump that is usually left in the forest but excludes limbs, foliage and roots.

Pulpwood is generally recovered during harvesting operations, where it is commercially feasible to do so. Other Stemwood is not currently recovered from harvesting operations. Therefore the viability of collecting Other Stemwood will depend on a combination of the economics of recovery, its suitability for end markets and the environmental impacts associated with its removal from the forest.

Residue flows are presented at a regional level and aggregated into three lustrums over a 30 year timeframe. These periods correspond with various milestones including FT's contract supply commitments as well as key dates set out in the Tasmanian Forest Agreement.

URS notes that:

- FT's wood flow models are driven by its log supply commitments. It is not based on a market outlook or the economics associated with the delivery of logs to various end markets; and
- Yield predictions for the long rotation eucalypt plantations can only be realised if there is continued investment in thinning and pruning.

Residue flows from private native forests were estimated using a 'sustainable yield' model developed by PFT in 2012.

The bulk of the state's hardwood and softwood plantations are managed on behalf of private investors. Softwood harvest volumes are reasonably predictable as the estate is in a mature phase where harvesting is balanced with re-establishment.

As at August 2014, future ownership of the majority of the private hardwood plantation estates is subject to a number of liquidation processes of the previous owners. As the long-term management intention of the new owners of these plantations is not known, the PFT analysis represents its best estimate of future fibre availability.

Two scenarios are presented in the forecast of harvest volumes from the hardwood plantation estate. One scenario assumes full replanting of harvest areas. The second scenario assumes no company managed plantations are replanted on leased land. The decision to replant will be driven by many factors. However, the assumption of a decrease in hardwood plantation area is not unreasonable as land scarcity during the latter stages of the period of plantation expansion meant some lease costs were higher than what could be justified for a forestry investment. In addition some plantations have not performed as anticipated and are unlikely to be replanted.

Processing residues are identified from their forest source rather than at the mill. This will need to be revised for any detailed analysis as processing residues should be identified from where they are created (i.e. at the mill). A 2013 survey of the Tasmanian timber processing sector indicates woodchips are the most common mill residue with most of this material sold to chip exporters. Sawdust and shavings are sold to a range of domestic customers for a diverse range of end uses. Collectively these three products account for 90% of total mill residues.

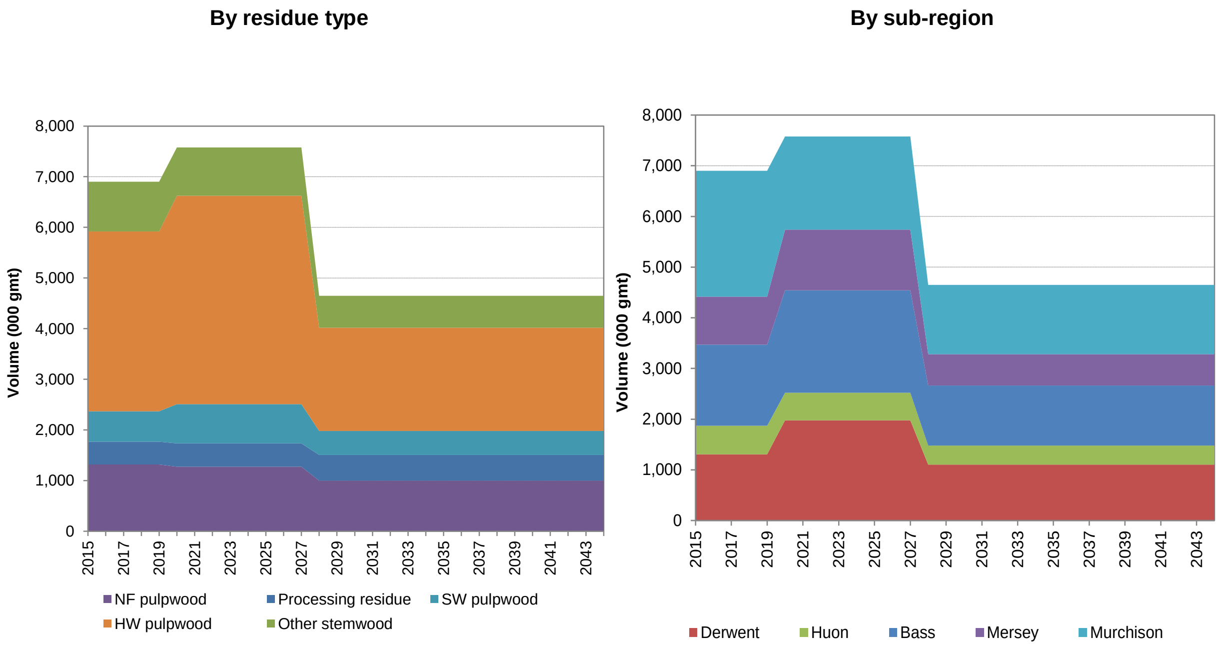
Figure ES 1 shows the distribution of residues by type (LHS) and sub region (RHS). Hardwood plantations account for approximately half of the available residue volume and are modelled to decline substantially due to an assumed land use change following harvesting. Native forest residues are the next most common source of supply and are also expected to decline over time. Subject to confirmation of feasibility, Other Stemwood has the potential to supply a significant quantity of residues. Processing residues make up a relatively small component of total residue availability. Despite this relatively small volume, having reliable end markets for residues is important to the overall viability of processing sector.

The results from the partial replanting scenario, which is used as the base case for the analysis, presents a significant decrease from the estimated residues available from the hardwood plantation estate. This is a hypothetical outcome and while there may be some decline in the size of the estate, it may not be as large as indicated by the scenario analysis.

Forest and processing residues are spread right across the state. Residues from the Bass, Murchison, Mersey and northern parts of the Derwent region have ready access to port facilities so woodchip exports represent a potential market.

Forest and processing residues from the southern parts of the Derwent region and the Huon region have no ready access to residue markets. As a consequence mills and forest growers in this region are experiencing difficulty in selling residues due to the distance required to transport this material to export ports. These regions account for approximately 30-35% of total estimated residue availability.

Figure ES 1 Forecast residue availability



Following our review of the residue forecasts URS notes:

- The volume over the first five year period and 2014/15 in particular is significantly higher than current levels of production. Trade data for 2012/13 indicates the total volume of logs and woodchips exported from Tasmania was slightly more than one million tonnes. Should residue production remain at similar levels in the short-term, this would lead to an increase in available supply at a later stage;
- Harvest volumes are at the upper end of our expectations for the capacity of the existing market to absorb additional hardwood chip supply. While this is not material for the purposes of assessing residue availability, the profile would be different if hardwood chip export capacity were to be considered; and
- Other Stemwood accounts for around 950-980,000 tonnes/year over the first 15 years and 630,000 tonnes/year from 2027. Previous operational trials suggest the economic recovery of this material is marginal. URS considers it reasonable to identify this material as a potential source of fibre, but the capacity to utilize Other Stemwood will need to be determined on a case-by-case basis.

Key tasks for assessing residue availability during Stage 2 include:

- Identify processing residue availability by residue type and mill location.
- Consideration of the likelihood of replanting plantation hardwoods within the supply catchments of the preferred options.
- A high level assessment of the delivered cost for the various residue types to locations identified for most prospective opportunities for residue utilisation.

Analysis and findings

This section describes URS' evaluation methodology and presents the results of the analysis for a range of potential residue markets.

Evaluation methodology

The residue processing options considered for the analysis were classified into a number of themes. Within each theme a range of different market options were assessed. The options considered include existing forest products as well as new and emerging technologies that may be commercialised over the 30 year timeframe considered in this study. As the scope required consideration of the broadest range of options, some products were included even though they may not be ideally suited to the types of residues expected to be available from Tasmania.

Table ES 1shows the nine key themes and the product options considered within each theme. Additional detail about each of the product options is provided later in this section. A total of 23 different product options were considered.

To provide some context as to the quantum of residues each option could potentially consume, a guide of potential feedstock requirements is also included. This provides broad guidance but does not preclude the development of smaller units that may be more suited to a Tasmanian setting.

Table ES 1 Residue processing options considered

OPTION	RESIDUE THEME	PRODUCT	EXPECTED SCALE (GMT RESIDUES/ YEAR)
1a	Pulp	Kraft	> 1 million
1b		Sulphite	500 - 1 million
1c		Mechanical	500 - 1 million
2a	Panels	Particleboard	100 - 500
2b		MDF	100 - 500
2c		OSB	100 - 500
3	Sawn timber	Sawn timber	100 - 500
4a	Engineered Wood Products	Plywood	100 - 500
4b		LVL	100 - 500
4c		OSL	100 - 500
4d		Glulam/CLT	50 -100
5a	Electricity	Stand-alone power	100 - 500
5b		Export pellet/chip	500 - 1 million
6a	Cogeneration	Industrial	100 - 500
6b		Domestic/commercial	50 -100
7a	Biofuels	Hydrocarbons	> 1 million
7b		Ethanol	50 -100
8a	Other	Wood composites	50 -100
8b		Charcoal	100 - 500
8c		Activated Carbon	50 -100
9a	Emerging technology	Torrefaction	> 1 million
9b		Biorefining	100 - 500
9c		Nanotechnology	50 -100

For the evaluation of each option URS applied a multi criteria analysis (MCA) approach. A MCA provides a flexible methodology that allows for a meaningful comparison of quantitative and qualitative information. One of the main benefits of a MCA is it provides a standardised methodology that is transparent and simple to follow. The principles and criteria used for the analysis are presented in Table ES 2.

The assessment scored each indicator between -2 (highly incompatible) to + 2 (highly aligned). The scores for each criterion were aggregated and an assessment made on how these might change over time. Following discussions with the Advisory Group for this project no weighting was applied to the assessment. This means an equal weighting was applied to each criterion.

The MCA assessment for each criterion is supported by a qualitative analysis. A summary of the MCA assessments and the qualitative analysis is presented in Section 4.

Table ES 2 Key principles and criteria used for the multi criteria analysis

EVALUATION PRINCIPLE	CRITERION
Impact on residue volumes (time periods 5,15 and 30 yrs)	Residue volume required and timescales: • Likely volumes • Potential timing of uptake • Utilisation rate and species suitability
Technical feasibility	Status of manufacturing: • Current commercial use • Research and development phase • Requirements needed for commercialisation
Market potential	Market preparedness: • Product definitions • Price data Market dynamic: • Market size • Market evolutionary position • Status of competitor products
Economic viability	Business case viability: • Capital requirements • Direct economic impacts • Indirect economic impacts
Social factors	Social factors: • Existing operations displaying community acceptance • Effects noted by stakeholders • Employment impact
Environmental sustainability	Environmental requirements: • Regulatory framework • Infrastructure needs • Supply attributes
Financing requirements	Financial aspects: • Enterprise financing • Government financing
Feasibility timeframes	Feasibility assessment: • Timeframes • Approval requirements

Results and discussion

Figure ES 2 shows the overall score based on the 5, 15 and 30 year timeframes. The total for each option is calculated as the sum of the scores for each of the eight criteria shown in Table ES 2 and can be positive or negative. Key findings include:

- Subject to identification of sites that offer synergies for transmission and/or cogeneration, bioenergy options represent some of the best short term opportunities to utilize residues either for stand-alone power generation or through industrial supply of heat and/or power;
- Plywood and secondary sawn timber products such as Glulam or Cross Laminated Timber (CLT) represent the most prospective wood product options;
- Over a 15 year period, hydrocarbon biofuels made from wood fibre (that can substitute seamlessly for Tasmania's current petrol and diesel use) provide the greatest potential based on current development technologies; and
- Over a 30 year period, the emergence of new products such as torrified wood pellets may represent a significant new industry, subject to major growth in international markets.

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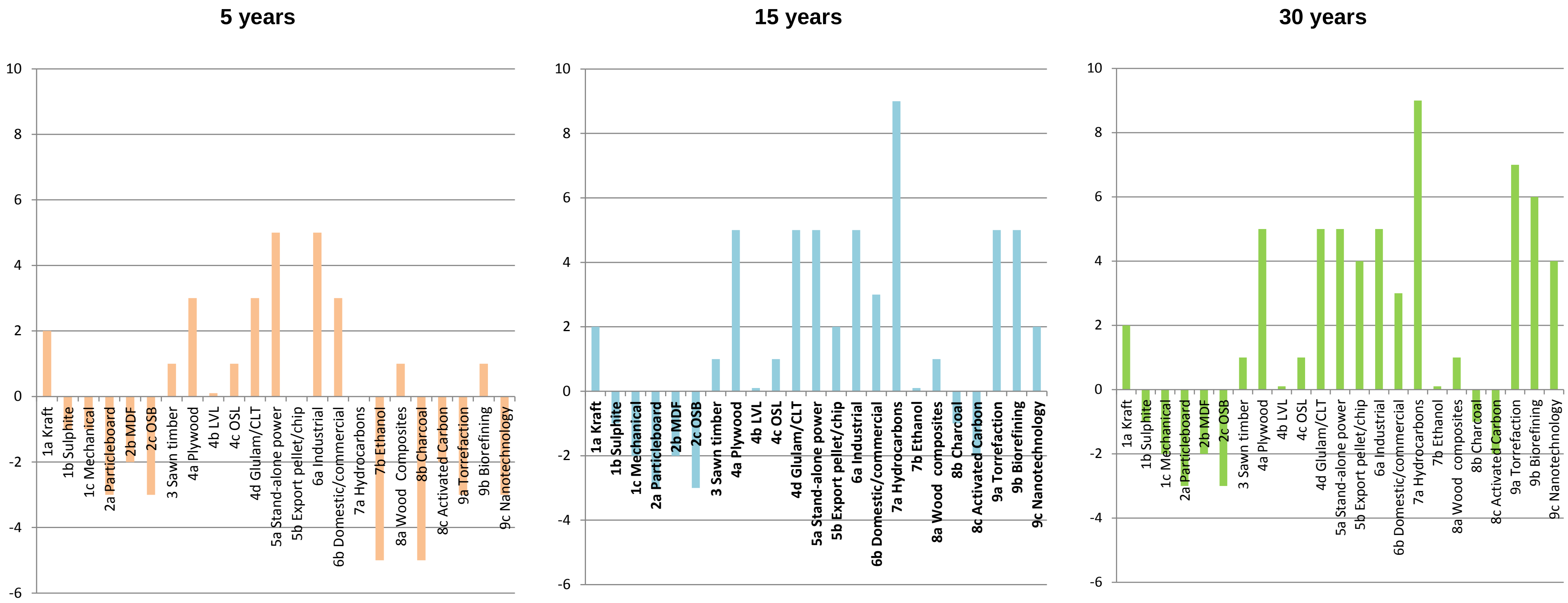
Figure ES 2 Summary of results from a multi criteria analysis of residue processing options



The following section summarises the analysis of the market opportunity for each of the nine product themes. For options with limited opportunities or identified as having significant barriers to viability, only a summary of the analysis is presented.

Pulp

Three different types of pulp were considered: kraft pulp, dissolving pulp and mechanical pulp. Each has the capacity to utilise significant volumes across the range of residues arising from Tasmanian forests. Norske Skog is the only existing producer of pulp and paper in Tasmania. Feedstock to Norske's Boyer mill comprises entirely of radiata pine, which is predominantly sourced from its own plantations.

There is significant international trade in each of the pulp markets considered, with Australia being a net importer of pulp. Global production of kraft and dissolving pulp has expanded in recent years with kraft pulp increasingly exported to China to supply its expanding paper production capacity. Dissolving pulp is primarily used to produce sanitary products and as a textile. Its use is interchangeable with cotton and dissolving pulp prices are highly correlated to cotton prices. A spike in the price of cotton in 2011 led to a rapid expansion in the production of dissolving pulp. As a consequence the market is in a state of over-supply with cotton inventories also at record highs. With a global decline in newsprint consumption, mechanical pulp has experienced a number of years of structural decline. A similar trend has occurred in Australia, with newsprint demand declining steeply over the past three years.

Any new pulp mill development in Tasmania would require an export focus. Given the structural adjustment occurring in mechanical pulp markets, the prospects for a new mill supplying this market appear limited. The expansion of dissolving pulp has largely occurred through brownfield conversions of existing pulp mills considered marginally viable for alternative pulp markets. Given the investments already made in this sector there appears to be limited opportunity for a new entrant for the foreseeable future.

There is currently potential for the construction of a new kraft mill in Tasmania as the permits for the mill are in place and sufficient forest resources are available within Tasmania to supply the mill. The nature of the rights currently being offered to the market would allow a proponent to commence construction immediately.

The process for the acquisition of the rights to the pulp mill have been made more complicated with the sale of Gunns plantation and chip processing assets. To establish an adequate long term supply, the operator of a pulp mill would have to enter into a long-term contract with major hardwood plantation owners for the supply of plantation fibre. While long-term supply agreements are not uncommon in Australia, pricing would most likely be on an export parity basis, which would introduce a degree of volatility to feedstock prices for the pulp producer.

As the rights to the pulp mill are currently being offered to the market, URS does not propose including kraft pulp as part of the Stage 2 analysis. Vendor due diligence on the acquisition of the rights to construct the mill would be comprehensive, with the ultimate sale underpinning the potential viability of the project. We note that a pulp mill would require a significant proportion of the residues available in Tasmania.

Panels

Panel products are manufactured by combining fragmented wood fibres with a synthetic resin or binding agent before being pressed into panels that can be used for a range of internal construction applications. The feedstock typically includes sawmill residues such as wood chips or sawdust as well as pulp logs. The assessment considered three types of panel product: particle board, medium density fibre board (MDF) and oriented strand board (OSB).

Particle board and MDF are both manufactured on the Australian mainland and primarily supply the domestic market. Supply and demand are largely in balance and consumption has been relatively flat in the past few years, reflecting the Australian housing market. Very little Australian product is exported. In the middle of the past decade, Australia exported around 40% of its MDF production, however the industry has since retreated from these markets. Particleboard is not traded in significant volumes globally. OSB is produced primarily in the northern hemisphere where its high thermal insulation properties make it suitable for internal cladding, which is required in building design in these markets.

Panel products are not considered a potential prospect for utilising Tasmanian residues because:

- The manufacture of particle board and MDF in Australia is predominantly based on radiata pine as a feedstock. Research trials indicate that while various eucalypt species can be used to manufacture panel products, their performance is inferior to radiata pine; and
- A greenfields mill constructed in Tasmania would rely substantially on export markets, which also have a preference for softwood panels.

The best prospect for panel production would be for the utilisation of softwood residues sourced from plantations and softwood mills in northern Tasmania. Even using radiata pine as the preferred feedstock, there would be limited competitive advantage in establishing a processing operation in Tasmania, compared to other plantation regions such as the Green Triangle where there is currently a significant surplus of softwood processing residues and pulpwood available, and greater access to domestic markets.

Sawn timber

Hardwood sawn timber is already widely produced in Tasmania. This option relates to the extension of the log specifications to include smaller diameter (<30 cm) straight logs. There is some overlap with this log type and the peeling billets already supplied to Ta Ann which have a minimum small end diameter of 20 cm.

This overlap means there is limited scope for expanding sawlog supply from native forests as small diameter logs are most likely already supplied as peeler logs which can utilise shorter length logs. The best prospect for sawn timber is for the processing of straight small diameter sawlogs from hardwood plantations that would otherwise be sold as pulpwood.

Studies indicate that sawing these small diameter logs is technically feasible and URS understands some processors in Tasmania have successfully produced a range of timber products from hardwood plantation material and sold this into domestic markets. However, the potential to do so at a commercial scale is not proven and the lack of markets for low value timber grades is currently a barrier to further development. One potential pathway to market for this material would be to integrate a sawmilling operation with secondary value-adding operations such as a glulam line and/or a CLT plant, if these markets were to be developed further in Australia.

Engineered wood products – plywood, LVL and OSL

Engineered Wood Products (EWPs) are constructed by gluing together veneer sheets or small timber sections to form larger dimension products. EWP's are utilised for construction requiring high strength or load bearing properties. The analysis considered a range of products including: plywood, laminated veneer lumber (LVL) and oriented stand lumber (OSL).

Plywood is a large volume market in Australia and is used extensively in residential construction and for industrial formwork. LVL is also used by the residential construction market. It has the advantage over other heavy structural materials such as solid timber or steel of being lightweight and easy to handle. Both markets rely on imports produced predominantly from softwood species, which provides the balance of strength and light weight for handling purposes.

Tasmania currently has two international scale veneer operations owned by Malaysian company Ta Ann. Collectively the sites have the capacity to process up to 157,000 m^3 pa of peeler billets (short round logs). The veneer sheets are currently exported to Malaysia for plywood production. There is limited production of hardwood plywood in Australia. What is produced domestically is primarily used for industrial and commercial formwork where its durability and re-usability is valued. LVL is also produced in Australia in limited quantities.

LVL is generally produced using softwood species, although there are commercial examples of hardwood LVL in North America. Forestry Tasmania has also developed a hardwood LVL product called 'Hardlam'. Small quantities of Hardlam are currently being produced as part of the market development process. Hardlam has a key point of difference from softwood LVL in that it is targeting appearance as well as structural markets. Potential appearance end markets for Hardlam include flooring, staircases, panelling and visible internal beams.

OSL is not produced in Australia but is used extensively in North American markets. It has the benefit over plywood and LVL of being able to accept a much lower quality log as a feedstock. There has been some interest for a number of years in producing OSL in Australia using hardwood species. The successful development of this product would require the displacement of established building products such as solid timber, other EWP's, steel and concrete.

The MCA suggests plywood has the greatest potential to add value to wood residues. Positives for the development of a plywood facility include:

- The presence of an existing manufacturer in Tasmania who is familiar with handling the product and understands the plywood supply chain internationally and within Australia;
- Increased availability of hardwood plantation logs over time. The presence of a plywood market would allow logs that are not suitable as sawlogs to be peeled, improving overall value recovery from the plantations; and
- Development of a plywood mill in Tasmania would have a low environmental impact as much of the infrastructure required is already in place. The end product, which would utilize regrowth logs, would also have the capacity to displace imported plywood made from tropical hardwoods.

Downsides to this option were mainly market related as production from Tasmania would have to compete with suppliers from the Australian mainland or international export markets. The market for hardwood plywood in Australia is relatively small and specialised.

The LVL assessment did not score as well as plywood because:

- A large scale hardwood LVL product in Tasmania is unlikely to be able to compete directly with softwood LVL currently being imported into mainland structural markets;
- While the development of a LVL product for appearance markets is innovative, market acceptance of Hardlam is yet to be proven; and
- The manufacturing process for Hardlam is still at a pre-commercial phase.

However, both products show enough potential to be considered for further analysis, with Hardlam showing promise as a niche market opportunity. While not likely to utilise significant additional residue volumes, these products have the potential to expand Tasmania's manufacturing base compared to undifferentiated woodchip exports. The scale of operations could potentially be expanded through the development of secondary wood products which are discussed below.

Engineered wood products – Glulam and CLT

Glulam and cross laminated timber (CLT) are structural engineered wood products manufactured from sawn timber or potentially other EWP's. CLT is not produced in Australia but manufacturing is expanding outside of Europe. A CLT facility was recently established in New Zealand with the aim of developing a market presence during the Christchurch reconstruction programme. A number of CLT buildings have been constructed in Australia using imported material.

Glulam is produced in Australia by Australian Sustainable Hardwoods at its Heyfield mill in Victoria. The feedstock to the mill is based on the same ash species utilised in Tasmania.

Factors in favour of this option include:

- A low capital cost relative to other options;
- An expected increase in demand as construction methods using these materials becomes more common. In some countries this is being promoted through government policies specifying timber construction. Demand could also arise due to savings in construction time, and in consumer preferencing for the feel of timber buildings;
- The low environmental impact associated with the manufacturing process and its capacity to displace carbon intensive products such as concrete and steel; and
- Its acceptance as a building product in the market as evidenced by the expansion in production capacity in Australia (Glulam), North America and New Zealand (CLT).

Downside impacts include: the relatively small volumes that would be involved, the current limited commercial application of these products and the financial viability of the product over the long-term.

The short-term potential of these products is limited as the market is currently in the early stages of development. However, there has been sufficient growth in recent years to consider these products as having upside potential over a 15-30 year timeframe.

Bioenergy

In this review bioenergy includes heat and power, with end markets either in Tasmania or overseas. The three main bioenergy categories considered are:

- Electricity generation in Tasmania;
- Cogeneration in Tasmania; and
- Export of pellets or torrefied wood for power generation overseas.

Biomass power generation uses mature technology and is widely practised in most parts of the world. Its use in Australia is minimal however due to the low cost of alternative sources of electricity (particularly coal) and the lack of financial incentives for renewable electricity created from forest based biomass. Stand-alone biomass power in Tasmania is currently uneconomic; however there may be an opportunity for commercially viable power generation in specific circumstances such as if it can be used to avoid upgrades to transmission infrastructure and the funds for those upgrades can instead be directed to biomass power plants.

Cogeneration potentially offers better commercial viability because revenues come from both heat and power. Individual opportunities need to be assessed to determine whether a biomass cogeneration system will be more cost-effective than current sources of energy, which include coal, gas, LPG and electricity. Potential opportunities include: large industrial sites, or smaller sites such as dairy farms and municipal buildings.

The export of wood pellets or torrefied wood could be a major potential use for Tasmania's residues. While only very small local markets for these products, the global market for wood pellets is already large and is growing rapidly. This growth is based entirely on government mandates for renewable power generation. The European market is well established with substantial domestic supply as well as imports arising from eastern North American suppliers.

South Korea and Japan are emerging as potential large future markets with increasing government support for bioenergy.

At present these markets use wood pellets for co-firing in coal-fired power stations. If demand increases to the point where wood pellets reach their maximum blending capacity within existing power plant infrastructure, a parallel market for torrefied wood may develop. Torrefied wood has similar handling properties to coal and has the potential to replace large volumes of coal in existing power plants without the need for major capital investment to convert to a biomass based feedstock.

The world wood pellet market is currently met almost completely by producers in Europe and North America. These companies utilise large volumes of low value processing residues. Tasmania's current competitive position is considered to be weak due to the cost of its own residues and its location relative to the European market. This may change in future if the demand for biomass co-firing moves past the available supply of low cost residues overseas and demand from Asian markets increases.

Biofuel

The manufacture of transport biofuels can be considered in two main categories:

- Biofuels that must be blended with existing fossil fuels to meet consumer expectations – this refers to ethanol in blends with petrol; and
- Biofuels that are hydrocarbons and are essentially interchangeable with petrol and diesel made from crude oil.

There are many different process pathways to make these biofuels. Most biofuel technologies are either at an early commercial or a pre-commercial phase based on funding by major international fuel development groups. While technology development in Australia is at a relatively early stage, a number of groups overseas are now either building or operating prototype commercial scale plants that make biofuels from a range of biomass feedstock.

The review focused on the domestic Tasmanian market for transport fuels, which is currently approximately 800 million litres/year with petrol and diesel each accounting for approximately 50% of total demand. With high profit margins for biofuel exports extremely unlikely, its use in Tasmania as a substitute for imported fuels was seen as a more attractive option.

- The Tasmanian market for ethanol is very limited. An E10 blend for all of Tasmania would provide a maximum domestic market for some 40 million litres/year of ethanol. However the current market penetration for ethanol on the mainland is only a small fraction of total consumption, indicating that a realistic ethanol market in Tasmania is less than 10 million litres/year, which is too small for even a single commercial plant.
- Compared with ethanol, the relative benefit of "drop in" hydrocarbon biofuels comes from their ability to be used seamlessly alongside or instead of petrol and diesel. By manufacturing to accepted petrol and diesel specifications, and avoiding the requirement for blending, hydrocarbon biofuels are potentially able to access the entire Tasmanian market for transport fuels. This would create a long term opportunity for use of all of Tasmania's residues to make renewable fuel for local consumption in an established and relatively stable market. While such plants cannot be built immediately this option represents a major opportunity for Tasmania in the future.

Other products

A number of other products can be manufactured from wood residues with existing technology for a range of international markets.

Wood plastic composites (WPC) have an established market in the United States and a growing market in China. Demand from both markets are largely met by domestic production. The regional market in Australia and South East Asia is quite small by comparison. A new plant to satisfy the market growth in these regions may only require a few thousand tonnes of wood residues per year, and there is no competitive advantage to building such a plant in Tasmania.

Charcoal can be made from wood residues by a variety of technologies but there are no current industrial-scale markets for charcoal in Tasmania. It is also not cost –effective to transport due to its low bulk density and handling difficulty. The Tasmanian market could change if a major user such as a silicon smelter is built; but there appear to be no plans for such a project at this point in time.

Charcoal can be further processed to make activated carbon, a product with physical attributes and sufficient value to allow for distribution to international markets. Potential barriers to such a plant in Tasmania are the need for initial product feasibility and market studies, access to technology and marketing networks and feedstock costs.

Emerging technologies

Two other areas of development that receive considerable research focus worldwide are biorefineries and nanocellulose production.

The logic that underpins biorefineries is to use a single processing facility to make multiple products. This diversifies revenue sources and markets and enhances the viability of wood processing. Crude oil refineries currently make a wide range of products this way, and it is expected that biorefineries will mimic this approach by focusing initially on fuels and then on plastics and other higher value chemicals. A number of the companies currently building prototype commercial biofuels plants are also researching the concurrent manufacture of higher value chemical products.

Two commercial scale bioplastics plants have been built in the United States in the past ten years, using corn starch as a feedstock. These plants have not yet been replicated anywhere in the world, suggesting that the markets for bioplastics will take some time to reach the point that plants could be built in Australia. So instead of developing dedicated commercial plants in the short term, large scale biorefineries for Tasmania are seen as being a natural extension of a biofuels industry over the long-term.

Nanocellulose products are made by modifying cellulose and as such they appear to be well suited to be additions to existing cellulose producing facilities such as pulp mills. The largest nanocellulose plant in the world currently makes just one tonne per day of product, and this emerging technology is expected to take some years to commercialise.

Prospective Stage 2 opportunities

Table ES 3 provides a summary of the rating for the options considered to have the best prospects for increasing the utilisation of forest and processing residues in Tasmania. The rankings are based on the outcome from the MCA analysis presented in Figure ES 2. The preferred feedstock for each of the options is also identified, in descending order of preference. The Stage 2 will complete further analysis of prospects and key elements of these various processes.

Table ES 3 Prospects for further analysis as part of Stage 2

OPTION	PROCESS DESCRIPTION	PRODUCT	PREFERRED FEEDSTOCK	EXPECTED SCALE (GMT RESIDUES/ YEAR)	MCA 5YEARS	MCA 15 YEARS	MCA 30 YEARS
4a	EWPs	Plywood	NF, H	100 - 500	2✓	4✓	4✓
4d	EWPs	Glulam/CLT	S, P*, H	50 -100	3✓	5✓	5✓
5a	Electricity	Stand-alone power	All	100 - 500	4✓	4✓	4✓
6a	Cogeneration	Industrial	All	100 - 500	3✓	4 ✓	4 ✓
7a	Biofuels	Hydrocarbons	All	> 1 million	Neutral	9✓	9✓
9a	Emerging	Torrefaction	All	> 1 million	3 ✗	5✓	7✓

Key – P- processing, NF – native forest, S – plantation softwood, H – plantation hardwood, All – any forest and processing residues.
P* - not all types of processing residue would be suited to this option.

1 INTRODUCTION

1.1 Background

Tasmania has a long history of forest utilisation for timber production. Historically timber production has relied on supply from native forests and it remains an important part of the Tasmanian forest sector. The sawmilling industry in Tasmania has specialised in processing hardwood logs for appearance and structural timber markets. The harvesting and processing of native forests generates a significant volume of material (referred to as residues) that is not suited to timber production. Historically this residue material has been chipped and exported to Japan for the production of a range of pulp and paper products. More recently, investment in processing technology has allowed some of this material to be peeled and converted into plywood.

The first plantation activity in Tasmania occurred around 1908 with the first commercial softwood plantations established in the 1920's. The softwood estate has subsequently expanded significantly to around 75,000 hectares (ha) and now provides a stable supply of softwood products. A range of hardwood species were also trialled over this period and Forestry Tasmania (FT) has maintained an active programme of expanding its hardwood plantation estate primarily for the production of sawlogs as an alternative to the high quality sawlog resource available from native forests. Between 2000 and 2010 private investment in hardwood plantation development resulted in a rapid expansion of the hardwood estate in Tasmania. Large parts of this private estate were established for the production of pulpwood and are expected to mature over the next 5-10 years.

The Tasmanian Government has engaged URS Australia Pty Ltd (URS) to undertake a study of potential residue markets, including the economic viability and environmental outcomes of different options. The aim of the study is to identify and provide a detailed assessment of options to minimise, process, value add and/or otherwise utilise forest and processing residues in Tasmania. The project is overseen by an Advisory Group who represent a range of stakeholders and provide input to the study.

The terms of reference for the study require consideration of the widest range of options through an evidence-based analysis which includes an assessment of the capacity of each option to:

- provide an environmentally sustainable, commercial down-stream utilisation of residues within Tasmania in the next 5, 15 and 30 years;
- improve the economic viability and environmental sustainability of timber production in Tasmania; and
- reduce the volume of residues delivered for export as undifferentiated wood products such as woodchips.

The study is intended to support the development of a strategy to implement options to better utilise residues. It will also provide essential input to forestry policy and planning required for the long-term viability of the Tasmanian forest industry.

The analysis in this report is based on the volume of timber estimated by FT and Private Forests Tasmania (PFT) as being available from the Permanent Timber Production Zone land, public plantations, private native forests, private plantations and wood processing residues. The study does not consider supply from Future Potential Production Forest land.

1.2 Project overview

URS applied a two stage approach to the assessment of options for further processing of residues. Stage 1 involves:

- An assessment of resource availability and projected forest and processing residue fibre flows prepared by FT and PFT. This analysis is presented in Section 2 of the report;
- Section 3 provides an overview of the market opportunities considered for each residue processing option;
- The potential for each option was considered using a multi criteria analysis framework. This approach provides a flexible methodology that allows for a meaningful comparison of quantitative and qualitative information. The results from the multi criteria analysis are summarized in Section 4; and
- Section 5 provides a summary of the preferred options based on the results of the multi criteria analysis and the steps required to consider these options in more detail as part of Stage 2 of this project.

Stage 1 consultation

The Advisory Group for this project provides a representative cross section of people with a stake in the future Tasmanian forest industry. As part of Stage 1 URS presented the multi criteria analysis framework to the Advisory Group and provided an open forum for the participants to express their views on the various options being considered.

In addition to direct engagement with the Advisory Group, Stage 1 also involved consultation with a cross section of forest industry representatives. The purpose of this initial consultation was to better understand: the existing utilisation of residues by industry; supply chain issues; prospects for expanding residue utilisation and perceived barriers to investment. Consultation feedback has been taken into account in the assessment of selected options and, where appropriate, is referenced in the report.

2 RESOURCE AVAILABILITY AND RESIDUE FLOWS

Key messages:

A substantial volume of forest residues are available over the next 30 years, primarily sourced from the hardwood plantation estate

The volume of residues available is expected to increase as the hardwood plantation estate matures, then decline as not all areas originally established are confirmed to be replanted – a hypothetical example of the decline is presented. The actual volume available will depend on a range of factors

Residue forecasts incorporate non-log residues of approximately one million tonnes that may not be economic to recover

Processing residues make up a relatively small proportion of total residue availability but markets for these residues are important to support mill viability

Approximately one third of the residues arise from south east Tasmania. Residue sales from this region are currently difficult due to the need to transport the residues to northern ports

2.1 Forest resources

This section provides an overview of Australia's forest resources and the regional balance for the utilisation of harvesting and processing residues. The analysis considers estimates of forest and processing residue availability from Tasmania over a thirty year period. These estimates were prepared by FT and PFT.

Part of the scope for this project is a requirement to consider options that minimise residue production. This is largely a production related issue that is beyond the scope of the Stage 1 analysis and will be addressed as part of the consultation phase during Stage 2.

2.1.1 Australian overview

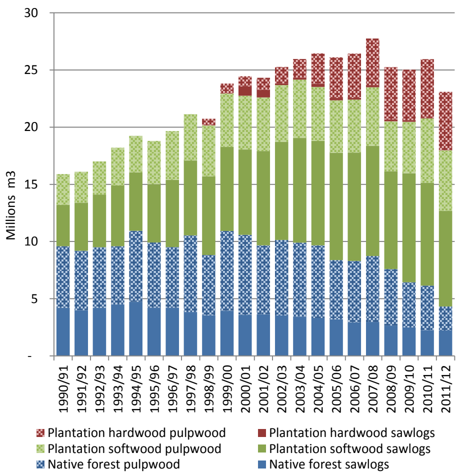
Australia's native forests and plantations produce a diverse range of wood products. Timber harvesting in Australia's native forests occurs primarily in publicly owned, multiple-use forests. In recent decades there has been a nation-wide reduction in the area of native forest available for timber production as land has been progressively incorporated into the conservation estate.

Figure 2-1 shows roundwood removals from native forests and plantations in Australia over the 22 year period to 2011/12. The decrease in supply from native forests reflects the transition of forest areas from timber production zones into the conservation estate. Australia's native hardwood sawlog and pulp log production has declined by 5% p.a. and 7% per annum respectively since peak levels in 1994/95. Figure 2-2 shows the bulk of the reduction in harvest volume from native forests has occurred in Tasmania.

Sawlogs from native forests and softwood plantations are largely processed domestically for the local construction and housing sector. While large volumes of softwood pulpwood are also processed domestically, a significant volume is exported as softwood chip. The bulk of the native forest residues and supply from the hardwood plantations are chipped and exported to Asia for the production of a range of pulp and paper products.

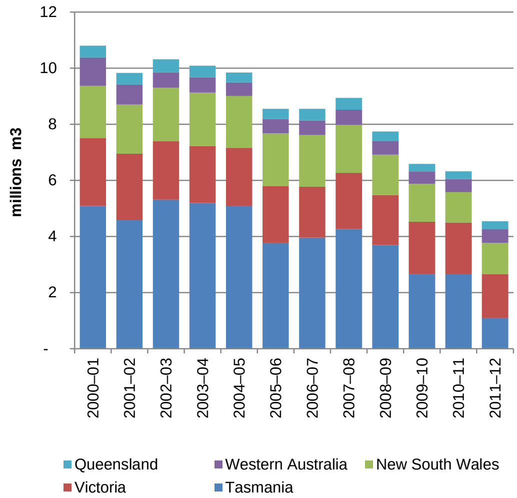
While the volume of timber sourced from native forests has been decreasing, harvest volumes from Australia's plantation resource has been increasing. The increase in softwood plantation sawlog volume over the past 20 years has impacted on native forest timber supply with softwood now dominating structural timber markets. Sawlog production from hardwood plantations remains a minor component within Australia's plantation estate with the majority of plantation investment to date focused on pulp log production.

Figure 2-1 Australian roundwood removals



Source: ABARES 2013

Figure 2-2 Roundwood removals from Australia's native forests



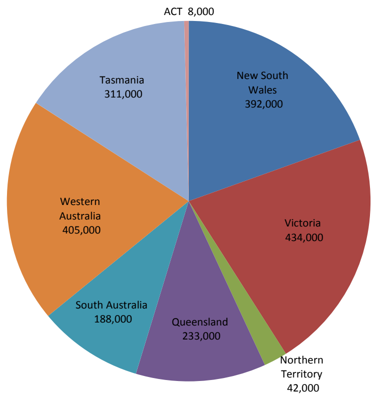
Source: ABARES 2013

Australia's total plantation area is approximately two million ha with hardwood and softwood plantations each accounting for approximately 50% of the total resource. *Eucalyptus globulus* is the dominant hardwood species *(56%)* followed by *Eucalyptus nitens (24%)* with the balance a diverse range of species classified as Other Hardwoods *(20%.)* *Pinus radiata* is the dominant softwood species accounting for *76%* of all softwood plantations with the balance being Other Softwoods *(24%)* Other Softwoods are predominantly sub-tropical pine species grown in northern New South Wales and Queensland and *Pinus pinaster* which is grown in Western Australia.

Figure 2-3 shows the distribution of Australia's plantation resources by State. Western Australia, Victoria and New South Wales account for around 60% of plantation estate with each containing approximately 20% of the national plantation resource. Tasmanian plantations comprise 15% of the national total.

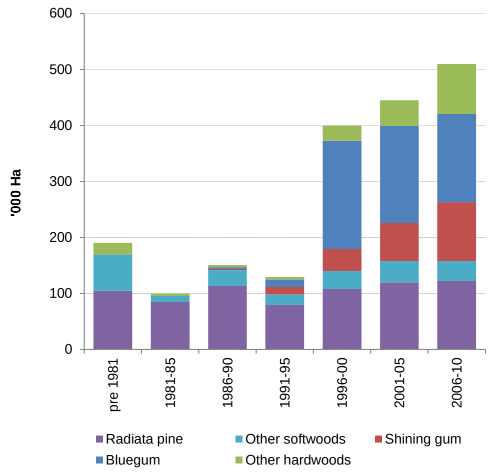
Figure 2-4 shows Australia's hardwood plantation area expanded rapidly between 1995 and 2011 increasing from 0.2 million ha to 0.98 million ha. The majority of these hardwood plantations were established on cleared agricultural land for the production of pulpwood. In contrast, the softwood estate has a relatively even age-class distribution.

Figure 2-3 Distribution of Australian plantation forest resources



Source: Gavran, M., 2013

Figure 2-4 Australian plantations by establishment year and species



Gavran M., & Parsons, M., 2011

2.1.2 Tasmanian forest resources

Tasmania has extensive native forest and plantation resources under both public and private ownership. Tasmania's public native forest resource is managed by FT and comprises around 1.4 million ha. A further 860,000 ha of native forest is under private ownership.

Tasmania's plantations are concentrated in the north of the State and in the south east, inland from Hobart. In 2011/12 the Tasmanian estate comprised 236,000 ha of hardwood plantations and 75,000 ha of softwood plantations. The majority of plantations are either privately owned or leased from the State via long-term cutting rights.

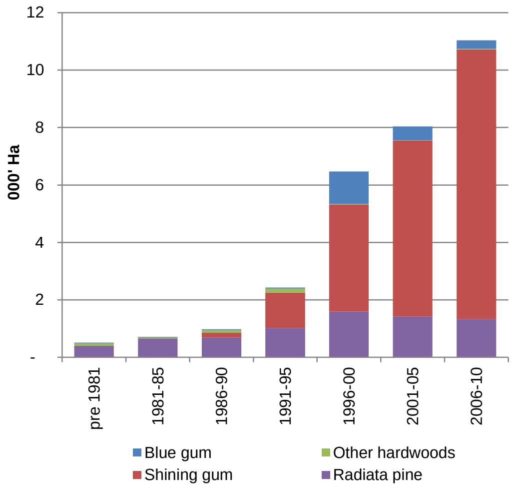
As with other regions in Australia, the expansion of the hardwood plantation resource in Tasmania began in the early 1990's then accelerated rapidly from 2000 to 2010 (Figure 2-5). *E. nitens* is the preferred plantation species in Tasmania accounting for around 85% of the total hardwood estate. It is more suited to Tasmania's cooler climate compared to *E. globulus* which is the preferred hardwood species established on the Australian mainland.

In addition to establishing hardwood plantations for pulpwood production, FT manages a proportion of its hardwood estate for sawlog and/or peeler log production. Some of the earliest of these hardwood plantations are currently being harvested with trials being conducted on the suitability of these logs for sawn timber and veneer production.

The softwood plantation estate has remained relatively steady over the long term, although, there has been a slowing of activity over the last 10 – 15 years as establishment of hardwood plantations has taken precedence within the plantation industry.

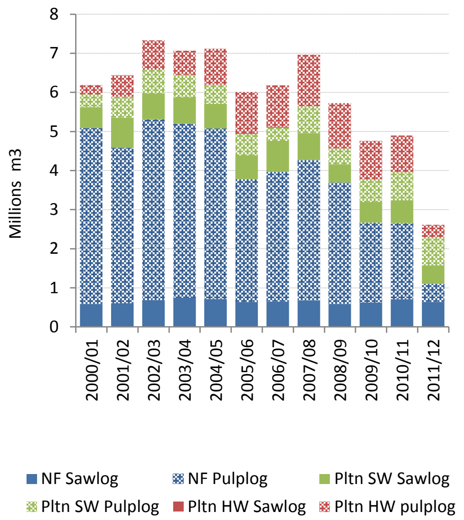
Figure 2-6 shows the historic trends in Tasmanian roundwood removals. In 1990 around 80% of Tasmania's log volume was derived from native forests. By 2012, native forest production had significantly reduced and the planation resource supplied around 58% of the State's total log production.

Figure 2-5 Distribution of Tasmanian plantations by age class and species



Source: Garvan, M. *et.al*, 2013

Figure 2-6 Historic Tasmanian roundwood removals



Source: ABARES, 2013

The reduction in supply from native forests reflects a combination of:

- A strategic decision by sawmiller and woodchip processor Gunns to exit the native forest product sector, particularly hardwood chip exports as part of its proposed plan to establish a pulp mill in Tasmania. As a consequence pulpwood harvests from native forests declined significantly;
- An increase in the availability of plantation fibre from mainland Australia (particularly *E. globulus* which has a superior pulp yield to fibre sourced from native forests); and
- A reduction in the competitiveness in Australian fibre in export markets due to the strengthening of the Australian dollar and the emergence of new low cost suppliers from South East Asia, particularly Vietnam.

Another contributor to the reduction in pulpwood supply has been the closure of the Triabunna chip facility in 2009. The mill was the primary destination for forest and processing chip residues in south east Tasmania with annual production of around 875,000 green metric tonnes between 2005 and 2009. The mill assets were acquired in 2012 with the new owners seeking an alternative use for the facility. As a consequence forest growers and processors in the south east have sought alternative routes to market pulpwood from the region.

2.1.3 Review of forest residue availability in Tasmania

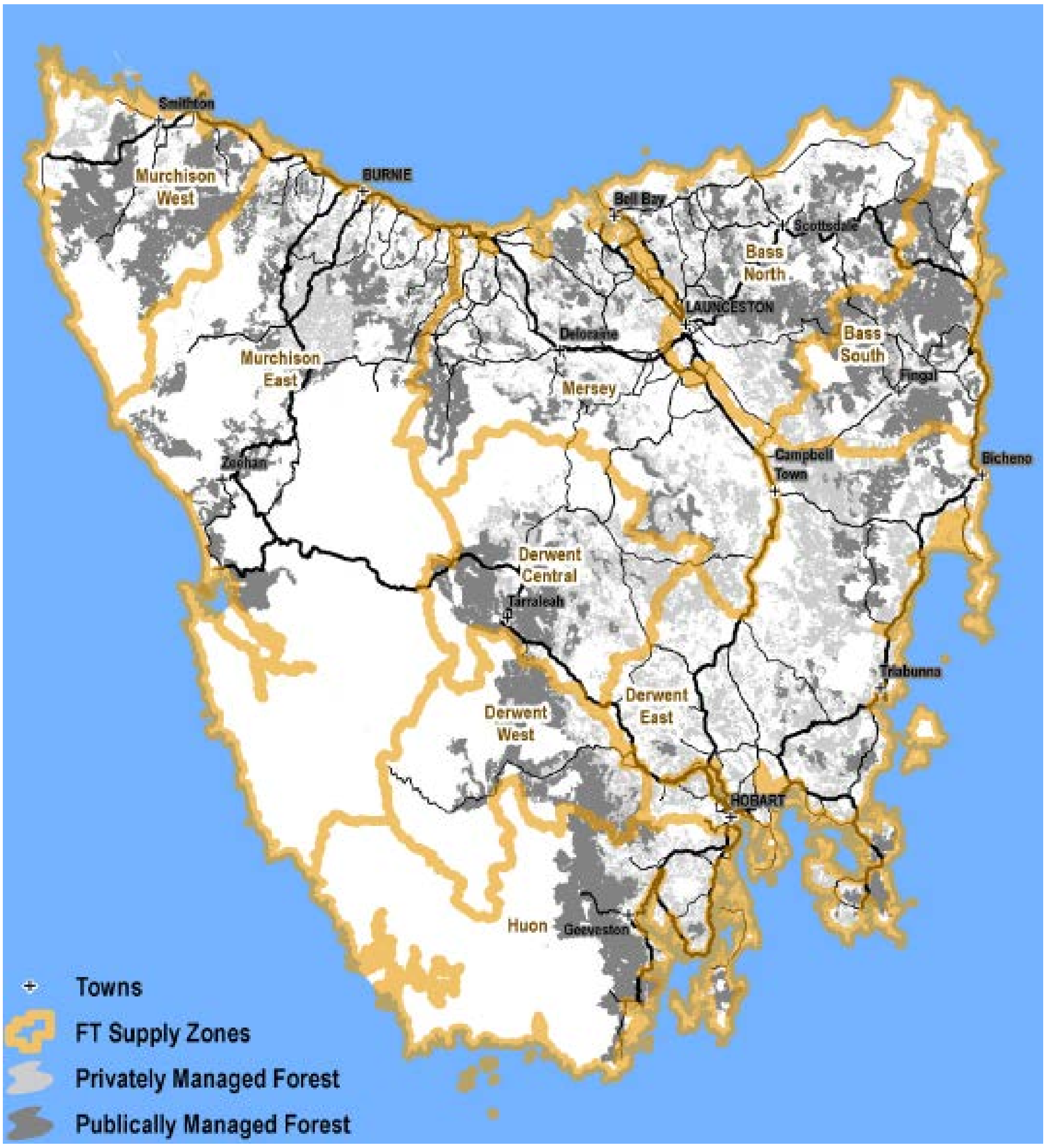
Modelling of forest residue availability was completed by FT for public native forests and plantations as part of initial TFA implementation process. PFT completed wood flow modelling for private native forests and plantations as an independent input to this project. Two types of forest residues are modelled:

- **Pulpwood** – classified as logs of any size that are not suitable for solid wood processing to a small end diameter of 8cm; and
- **Other Stemwood** - non-merchantable stemwood that is usually left in the forest. It also includes the stump but excludes limbs, foliage and roots.

Pulpwood is generally recovered during harvesting operations, where it commercially feasible to do so. Other Stemwood is not currently recovered from harvesting operations. Therefore the viability of collecting Other Stemwood material will be determined by a combination of end market suitability and the economic and environmental impacts associated with recovering, processing and delivering this type of material.

The distribution of forests in Tasmania outside of the national park reserve network is shown in Figure 2-7. FT's supply sub-regions are also presented as this is the level residue flows are aggregated to. This level of detail is adequate for the Stage 1 analysis. More in-depth analysis would be required for Stage 2 where it may be necessary to identify the physical characteristics of the various residue types and the economics associated with supply from within these regions.

Figure 2-7 Distribution of Tasmanian forest resources by tenure and FT supply zone



Source: FT

Residue flows are aggregated into three lustrums over a 30 year timeframe. The periods correspond with various milestones including FT's contracted supply commitments:

- Period 1 – 2014/15 – 2018/19 (five years);
- Period 2 – 2019/20 – 2026/27 (eight years); and
- Period 3 – 2027/28 – 2043/44 (15 years).

For presentation purposes the residue flows were annualised assuming an equal annual harvest volume within each modelling period. In practice forest wood flows are dynamic and constantly influenced by a range of physical and market factors that can result in material changes to harvest levels over time.

2.1.3.1 *State Forest modelling background and assumptions*

Approximately 488,000 ha (61%) of the 800,000 ha of Permanent Timber Production Zone Land is designated for wood production. The remainder is not available for operational or ecological reasons, or is set aside as informal reserves. The management strategy for public forests is based on the TFA (2012) and subsequent legislation enacted in 2013. FT's forest modelling methodology for public eucalypt native forests is described in Whiteley (1999), McLarin *et al* (2014) and Forestry Tasmania (2014).

Forest residues from public native forests are produced largely as an arising from FT's contracted sawlog supply obligations. FT's residue estimates relate to potential gross supply. However, not all of this volume would necessarily be available as actual production is influenced by a range of operational and market related factors. In part the sawlog supply from native forests reflects the view that plantation sawlogs suitable for high quality native forest sawlog substitution would not be available until at least 2027.

As FT's wood flow modelling methodology has been subject to a number of comprehensive independent reviews in recent years the residue estimates have been accepted as provided. From the perspective of assessing the modelling process for the purpose of predicting residue availability URS notes:

- FT's wood flow optimisation process maximizes sawlog recovery from native forests based on an assessment of the productive capacity of the estate. A wood flow profile that is optimised based on economic criteria may produce a different harvest profile;
- The eucalypt plantation estate is comprised largely of *E.nitens* and limited information is available on its performance of this species as a high quality sawlog or peeler log. Studies on younger (< age 20 years) *E.nitens* plantation logs indicate surface checking and fibre stiffness are potential issues. Trials on the performance of logs sourced from older *E.nitens* plantations are currently in progress and these results will provide useful guidance on the expected outturn from processing long rotation plantation sawlogs. There is no discussion on the implications to supply if these issues mean the logs aren't well suited to their intended purpose; and
- FT (2014) acknowledges that the yield predictions for eucalypt plantations can only be realised if there is continued investment in thinning and pruning future rotations.

2.1.3.2 Private forests background and modelling assumptions

The private forest estate in Tasmania comprises approximately 858,000 ha of native forest (~6% is rainforest and non-eucalypt forest) and approximately 200,000 ha of softwood and hardwood plantations.

The native forest resource is highly dispersed with PFT estimating the estate is distributed across some 7,500 land owners. Due to the difficulties in aligning land owner objectives over such a broad ownership base, residue volumes were determined using a 'sustainable yield' model developed by PFT in 2012 (Wilson, 2012). The model assumes the available native forest resource is harvested and reforested over a 360 year period to allow several rotations of slower growing dry eucalypt forests to be included in the wood flow. The model assumes harvesting occurs in accordance with the requirements of the Forest Practices Act as soon as the forest reaches a commercial volume and is of an age at which it could be successfully regenerated.

Tasmania's softwood plantation estate is concentrated in private ownership. The uniform age class profile means wood flows are expected to remain relatively stable over time. The model used to estimate softwood residue availability is not based on company expectations and may therefore not reflect actual annual yields. Pulpwood estimates are based on one or two thinning events and a clearfall age of 30 years. Other Stemwood estimates for softwood plantations assume an additional 20% over and above total stemwood volume from first thinning, an additional 10% from second thinning and an additional 5% from clearfell operations.

As at August 2014, ownership of the two largest private hardwood plantation estates was in transition with plantations managed by Gunns Limited (in Liquidation) and Forest Enterprises Australia Limited (FEA) (in Liquidation) currently going through a sale process. These two companies account for more than half of Tasmania's hardwood plantation resource. The bulk of these plantations were established for the production of pulpwood on a rotation of 12 – 18 years.

A significant proportion of the expansion in the hardwood plantation estate was driven by the Managed Investment Scheme (MIS) sector. With the subsequent collapse of the MIS sector, there is considerable uncertainty on the level of replanting that will occur, especially on land currently leased from third party land owners. To reflect this uncertainty PFT modelled two potential scenarios. The first scenario assumes all hardwood plantations are replanted following harvesting. The second scenario assumes:

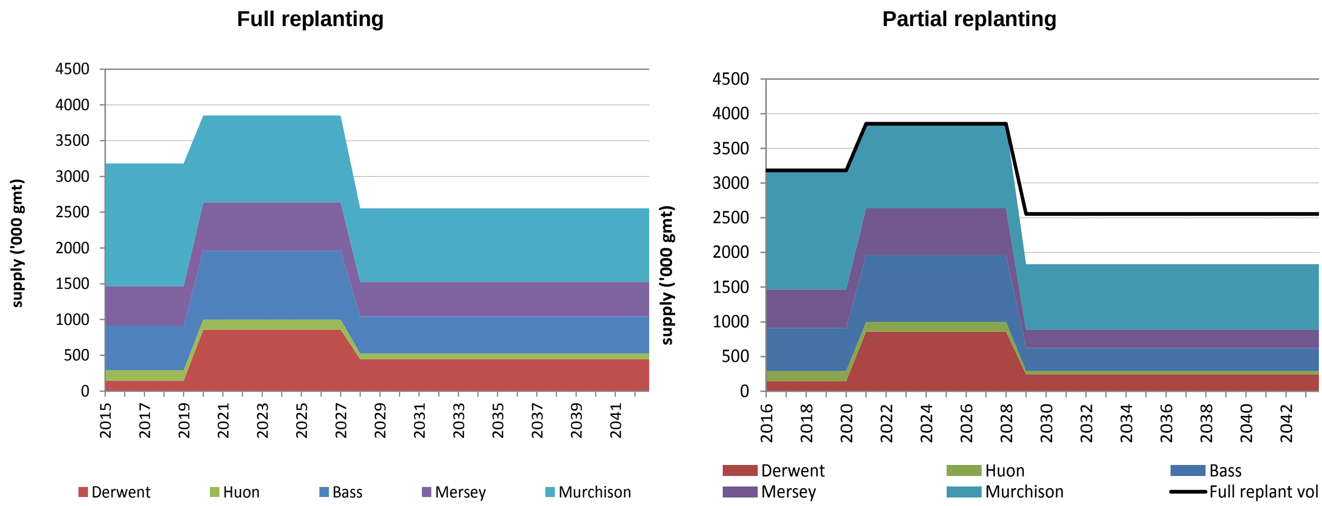
- Only 50% of the plantations established on private independently managed hardwood plantations are replanted. As this represents a small part of the overall resource this has little impact on the overall wood flows; and
- No company managed plantations established on third party leasehold land are assumed to be replanted.

Pulpwood estimates from hardwood plantations are based on a minimum harvest age of 15 years for high and medium quality sites and 20 years for low quality sites. No sawlogs or peeler logs were modelled from privately managed hardwood plantations. Other Stemwood residues from hardwood plantations were assumed to be an additional 5% of the pulpwood stem volume.

Figure 2-8 shows the impact of the reduced replanting scenario on hardwood planation residue availability. It indicates the existing resource will be sufficient to maintain supply until around 2027. Beyond this point the existing resource is assumed to have been harvested and wood flows will depend on the level of replanting that has occurred.

Based on PFT's assumptions, the total difference between the full and partial replanting scenario is a reduction of 28% (~725,000 tonnes/year) in residue availability. The regional distribution of this reduction varies with little reduction in the Murchison region where most plantations are established on company owned land. The reduction in residue availability is greater for the other regions where company ownership of land is lower ranging from 35%-45%.

Figure 2-8 Hardwood pulpwood supply scenarios by sub-region from private owned hardwood plantations



Source: PFT, FT

Based on trends occurring in other hardwood plantation regions in Australia, a reduction in the size of the plantation estate is not unreasonable; therefore plantation residue availability presented in this report is based on the partial replanting scenario.

The actual level of replanting will depend on a number of factors including: the objectives of the new plantation owners; market trends for hardwood pulpwood; the potential development of new markets in Tasmania and internationally; and trends in land values for non-forestry land uses.

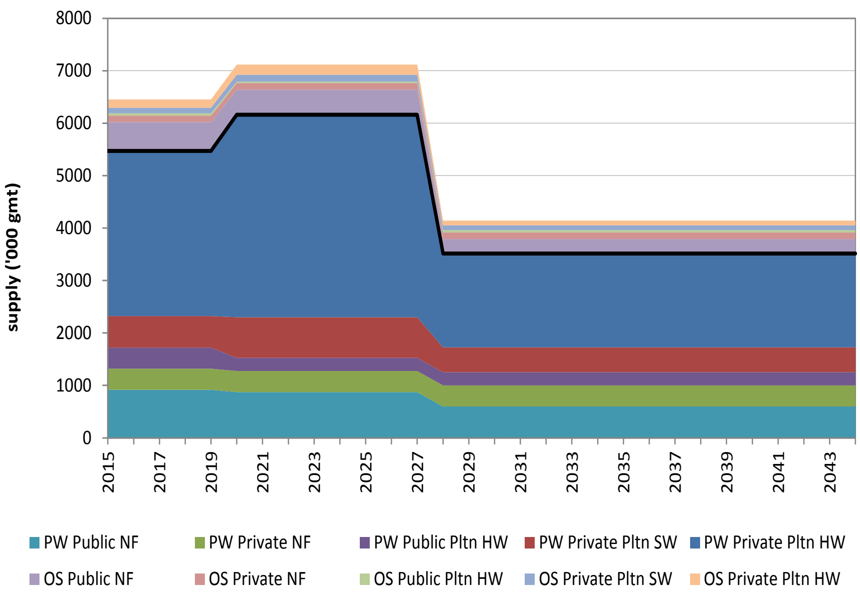
In addition, replanting in the Derwent and Huon regions is likely to be contingent on the development of an alternative pathway to market that has a more economical haulage cost. The closure of the Triabunna woodchip export facility means there are currently limited market options available for supply from these regions.

Estimated residue supply from Tasmanian forests

Figure 2-9 shows total forest residue availability by forest type. Key trends from the data include:

- Hardwood plantations provide the bulk of the available residue supply accounting for 60% of total volume available until 2027. Native forest residues are the next most common source of fibre accounting for a further 25-30%. Softwood residues account for the remaining 10-15%;
- Privately owned plantations represent 60-70% of the early supply with public native forests accounting for a further 20-25%. Private native forests and public plantations make up the balance; and
- Pulpwood (PW) accounts for 85-90% of total residue availability with Other Stemwood (OS) contributing 10-15% to the total forest residue volume.

Figure 2-9 Estimated residue availability from Tasmanian plantations and native forests



Key: PW – pulpwood, NF – native forest, Pltn – plantation, OS – other stemwood

Source: FT and PFT

The analysis assumes a significant increase in hardwood pulpwood production compared to recent harvest levels as shown in Figure 2-5. Trade data for 2012/13 indicates a total export volume of logs and woodchips from Tasmania of slightly more than one million green tonnes. To be in a position to supply more than three million green tonnes/ year from Tasmania, Australian hardwood woodchip exporters will need to be more competitive relative to other global suppliers than is currently the case. While this is potentially possible, it will require improved competitiveness in international hardwood pulpwood markets or the rapid development of new residue markets.

While this is not necessarily a material issue from the perspective of residue availability, the hardwood woodchip market represents the status quo in terms of market options available for residues sourced from hardwood plantations and native forests. The impact of a lower level of residue production in the short-term would be an increase in available supply over a 15 year timeframe.

Other Stemwood accounts for 950-980,000 tonnes/year over the first 15 years and around 630,000 tonnes/year from 2027. At the present time there are few examples of this material being recovered from harvesting operations.

In 2011 the CRC for Forestry and Australian Forest Operations Research Alliance published the results from a mechanised slash bundling trial that was carried out in a 15 year old Tasmanian *E.nitens* plantation. The study showed that hardwood harvest residues could be successfully bundled but there was scope to improve recovery methods, which in turn would improve the calorific value of the bundles. The results from operational trials to recover non-log residues from plantations in New South Wales and Western Australia indicate the economics of collecting and transporting this material to be marginal for its use as a potential feedstock. While it is reasonable to identify this material as a potential source of fibre, the capacity of the market to utilize Other Stemwood will need to be determined on a case-by-case basis.

Figure 2-10 presents forest residue availability (including Other Stemwood) by region and forest type. It shows plantations have the capacity to supply up to 4-5 million tonnes of residues per year from the current rotation (up to 2027). Beyond that residue availability is expected to decline. The PFT scenario analysis assumes long-term availability to be slightly less than three million tonnes from 2028 onward.

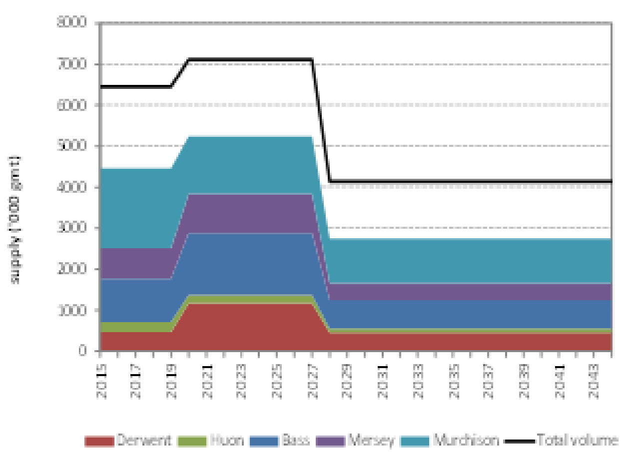
Total residue availability from public and private native forests is estimated to around two million tonnes per year and progressively declines to around 1.5 million tonnes per year.

The bulk of the plantations and native forest residues are located in northern Tasmania with the Murchison, Mersey and Bass regions accounting for approximately 70% of total residue volume. Pulpwood supply from these regions is currently allocated to export markets through ports located at Burnie and Tamar.

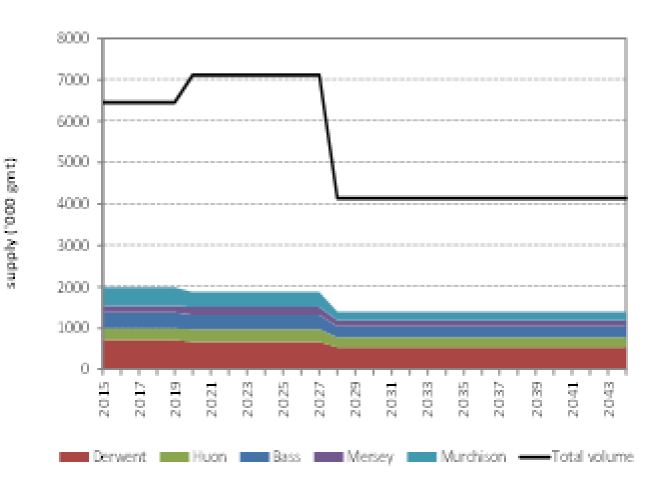
The Derwent and Huon regions are located in south east Tasmania and account for the remaining 30% of expected supply. Residues from northern parts of the Derwent region have access to port facilities in the north east so woodchip exports represent a potential market for these regions. However, forest residues from the southern parts of the Derwent region and the Huon region have no ready access to export markets and forest growers are experiencing difficulty in selling residues due to the distance required to transport this material to export ports in the north of the state.

Figure 2-10 Residue profile from plantations and native forests by region

Plantations



Native forest



Source: FT & PFT

More detailed consideration of market demand on potential wood flows is required as part of the Stage 2 analysis. The potential to feasibly supply Other Stemwood also requires more detailed consideration.

2.2 Processing residue utilisation

Processing residues are created from the sawing or peeling of logs into a range of wood products. These residues include bark, solid wood losses associated with preparing a log for processing, fibre losses through the sawing and peeling process as well as offcuts from trimming green and dried material to length. This section considers the availability of these residues; their utilisation within Australia and an assessment of availability within Tasmania.

One of the limitations associated with the residue data provided to URS is it identifies processing residue based on the source of supply, rather than the location of the processing facility. As a consequence other information sources were sought to confirm the distribution of processing residues in Tasmania. The most current assessment of the Tasmanian processing sector is a survey completed in 2013 (Schirmer unpubl.). The survey results are currently at a draft stage, but provide the best estimate of current levels of woodchip and other processing residue production and utilisation.

2.2.1 Australian overview

The timber processing sector in Australia is focused primarily around the sawing and peeling of native hardwood and plantation softwood species. Logs from native forests are processed into a range of timber products for appearance and structural markets. With the exception of Victoria, residues arising from processing logs sourced from native forests are largely exported as hardwood chip. Victoria has the largest domestic market for hardwood processing residues with this material used as a feedstock by the Australian Paper mill. Other residue by-products such as bark, sawdust or timber offcuts are sold to a variety of end markets.

Softwood processing is focused on the production of structural and non-structural timber products for the domestic market. A significant volume of softwood residues are also used domestically to produce pulp and paper as well as a range of panel products. In some regions softwood processing residues are surplus to domestic demand and are exported, predominantly to Japan, for the production of pulp and paper products.

Most hardwood plantations in Australia were established to supply the export woodchip market. To date no mills in Australia focus on processing logs sourced from hardwood plantations.

Table 2-1 presents an overview of harvest production by forest type for each of the main plantation regions of Australia. The utilisation of residues within each region is also shown by product for domestic processing and by port where production is exported. States identified as having major export levels represent the areas where opportunities exist to undertake additional domestic processing and can be viewed as potential competitors to undertaking similar processes in Tasmania.

Table 2-1 Overview of regional processing residue supply demand balance in Australia

	Level of production			Residue utilisation				
NPI region	SW_plant	HW_plant	NF	SW domestic	SW export	NF domestic	NF export	HW export
Western Australia	500 - 1000	>1000	< 500	Panels	Bunbury	Silica	Bunbury	Albany/Bunbury
Green Triangle	>1000	>1000	-	Panels	Portland/ Geelong			Portland/Geelong
Central Gippsland	500 - 1000	< 500	500 - 1000	Pulp	Geelong	Pulp		
Central Victoria	500 - 1000	-	-		Geelong			
East Gippsland - Bombala	500 - 1000	-	500 - 1000		Eden	Pulp	Eden	
Murray Valley	>1000	-	-	Pulp, panels				
Central Tablelands	>1000	-	-	Panels	Kembla		Newcastle*	
North Coast	< 500	< 500	< 500			Panels	Newcastle*	Brisbane
South East Queensland	>1000	-	< 500	Panels	Brisbane			Brisbane
North Queensland	< 500	< 500	-		Mouriliyan			
Tasmania	500 - 1000	>1000	>1000	Pulp	Burnie/Tamar		Burnie/Tamar	Burnie/Tamar

Newcastle* – closed by Boral in 2013. Small regions such as Mt Lofty, Tablelands and Northern Territory excluded
Source: ABARES

2.2.2 Tasmanian processing sector

The Tasmanian processing sector has evolved over time to reflect changes in resource availability. In May 2011, there were 50 wood and wood fibre processing businesses operating across 64 sites in Tasmania. These businesses included sawmills; woodchip mills; veneer mills; pulp mills; and downstream processing businesses (Schirmer *et. al*. 2011). The key input source and relative scale of these operations is presented in Table 2-2. It shows the processing industry is dominated by small to medium sized employers, with the majority utilising logs sourced from native forests. There are currently no businesses in Tasmania that exclusively specialise in processing hardwood plantation logs.

Table 2-2 Tasmanian processing sites by feedstock type as at May 2011

INPUT	SMALL SITE (EMPLOYING 1 – 19 PEOPLE)	MEDIUM SITE (EMPLOYING 20-99 PEOPLE)	LARGE SITE (EMPLOYING > 100 PEOPLE)	TOTAL
Native forest	33	13	1	47
Softwood plantation	1	2	1	4
Hardwood plantation	0	0	0	0
Native forest and softwood and hardwood plantation	4	5	1	10
Total	**41**	**20**	**3**	**64**

Source: Schirmer *et. al*. 2011.

Since the survey was completed a number of mills have subsequently closed as a result of structural adjustment across the timber processing sector.

2.2.3 Tasmanian processing residue availability

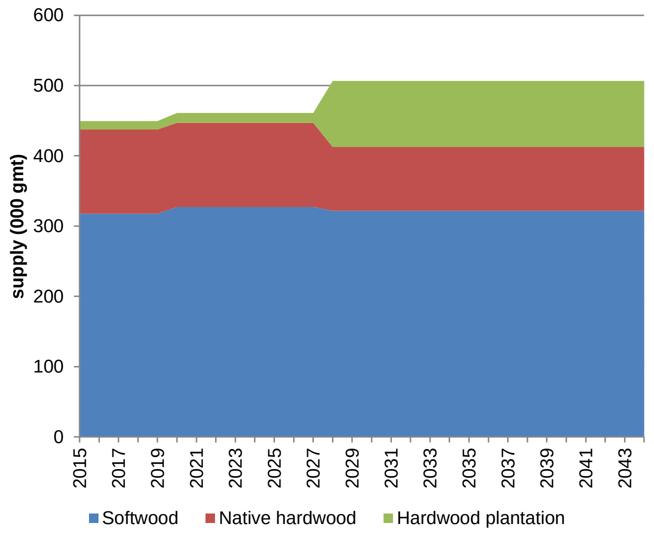
As part of the wood flow modelling FT and PFT estimated the volume of processing residues potentially available based on sawlog and peeler log volumes. The analysis assumes the following proportion of roundwood log is converted into processing residues:

- 60% of native forest and hardwood plantation sawlogs;
- 50% of softwood plantation sawlogs; and
- 11% of native forest and hardwood plantation peeler logs.

Figure 2-11 shows the composition of residues by forest type. It shows softwood processing residues provide the bulk of the volume, accounting for up to two thirds of the estimated 450,000 tonnes of processing residues available over the first 15 years. Residue volumes are predicted to increase to around 500,000 tonnes/year from 2028 when FT's long rotation hardwood plantations mature.

The total processing residue volume estimated by FT and PFT is consistent with the most recent industry survey (Schirmer unpubl.) and other recent surveys of the wood processing sector (Rothe 2013).

Figure 2-11 Processing residue profile for private and public forests in Tasmania

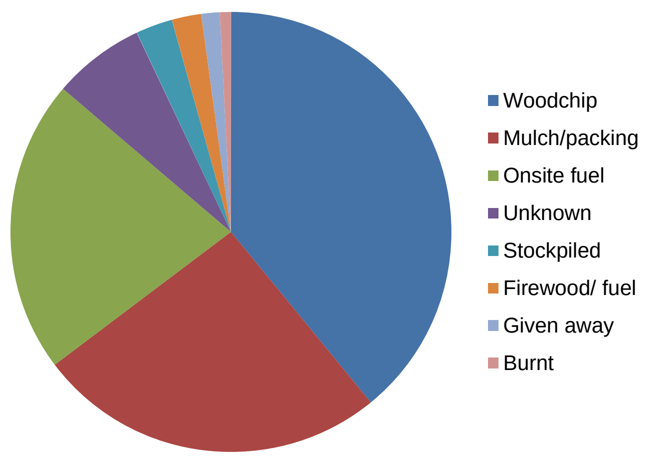


Source: FT, PFT

The largest softwood processing facility in Tasmania is the Timberlink mill which is located in the Bass region. Native forest sawmills represent the second largest timber processing group. As Table 2-2 shows these mills are much smaller than the Timberlink mill. The 2013 industry survey identifies the distribution of these mills by local government area, which broadly corresponds to FT's supply region. It shows total residue supply is spread relatively evenly between the Huon (23%), Derwent (19%), Bass (23%), Mersey (11%) and Murchison (24%) regions.

The FT/PFT analysis provides no breakdown of residue type (bark, chip, sawdust etc) or end use. However, the 2013 timber industry survey provides this detail which is presented in Figure 2-12.

Figure 2-12 Distribution of end uses for processing residues in Tasmania



Source: Schirmer (unpubl)

Woodchips are the most common residue accounting for nearly half of all residues produced. Woodchip exports are the largest market for residues with exporters combining processing residues with forest residues to supply pulp markets in Asia. With the recent downturn in the export woodchip market a number of processors have supplied small volumes of woodchips to domestic markets for a range of uses.

Sawdust and shavings are the next most common residues produced. These are sold to a range of domestic customers including nurseries, chicken farms, stables and for use as a packing or lining material. This material is typically sold in small quantities. Where residues are used as a fuel, they are typically burnt for on-site energy, but in some instances this material is sold outside of the forest industry to be used for energy production. These three end uses account for over 90% of total processing residues produced.

Firewood is a common by-product but the commercial market has limited capacity to absorb the volume produced by the wood processing sector (Schirmer unpubl.).

Through the consultation process a number of organisations advised they had surplus processing residues in various forms. These companies had explored a range of options for utilising this material. Key barriers to implementing alternative residue solutions included:

- A lack of feedstock scale;
- Competition from alternative products such as gas and coal for electricity and steam generation;
- Incompatibility with the requirements of alternative end users; and
- The capital cost associated with utilising processing residues often exceeding the benefits that could be derived from the investment.

These factors highlight some of the difficulties faced by the processing sector in seeking viable end markets for processing residues.

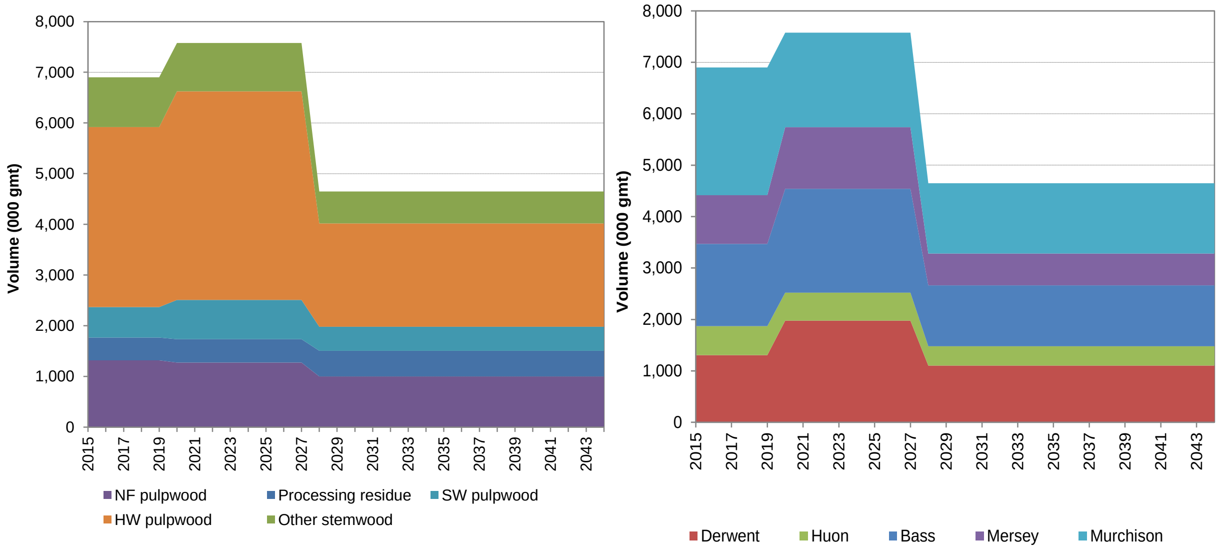
2.3 Summary of residue availability in Tasmania

Figure 2-13 shows the distribution of residues in Tasmania by residue type and region. At a State level, resource modelling indicates total residue availability of up to seven million tonnes from Tasmania over the next 15 years, decreasing to around five million tonnes from 2027. The decline from 2027 is based on an assumed land use change following harvesting of parts of the hardwood plantation estate. This is a hypothetical outcome and while it is not unreasonable to expect some decline in the size of the estate, it may not be as large as presented in the scenario analysis.

The actual level of residue production in Tasmania is currently around one million tonnes, far lower than what is shown in Figure 2-13 as being available. This differential represents the opportunity for the development of new residue markets.

Figure 2-13 Summary of residue availability in Tasmania

By residue type **By sub-region**



Source: FT and PFT

The majority of residues available from Tasmania are expected to be derived from hardwood plantations located in northeast and northwest Tasmania. The availability of residues from these forests over time will depend on:

- The objectives of the new owner's of the two largest hardwood plantation estates which are currently going through a sale process;
- Trends in hardwood chip and log export markets, especially the competitiveness of Australian supply compared to other international competitors; and
- The potential to develop domestic markets for residues with a greater capacity to pay than woodchip exports.

Native forest residues are the next most common residue type followed by processing residues. These residues are more geographically dispersed than the hardwood plantation resources.

Forest and processing residues are spread right across the state. Residues from the Bass, Murchison, Mersey and northern parts of the Derwent region have ready access to port facilities so woodchip exports represent a potential market.

Forest and processing residues from the southern parts of the Derwent region and the Huon region have no ready market for residues and the mills and forest growers in this region are experiencing difficulty in selling residues due to the distance required to transport this material to export ports in the north of the State. Supply from these southern regions account for approximately 30-35% of Tasmania's total residue volume.

2.3.1 Actions required for Stage 2

Further refinement to the residue models will be required for Stage 2. Some of the key tasks to be completed include an assessment of available forest residue, engagement with forest sector participants, mapping of processing residue availability and consideration of delivered costs of residues.

3 OVERVIEW OF OPTIONS FOR RESIDUE UTILISATION

Key messages:

This section provides background information relevant to the multi criteria analysis presented in Section 4

The key residue processing themes considered include: pulp and paper; composite panels; engineered wood products; bioenergy; biofuels; other products such as charcoal and emerging technologies that may have long-term potential.

The following section provides an overview of the processing options considered as having potential for Tasmanian residues. Each option is reviewed in respect of the following key factors:

- *Processing technology* – description of the manufacturing process based on industry best-practice;
- *Commercial status of the technology* – existing commercial operations and markets;
- *Feedstock requirements* –quality and volume of wood fibre required to establish an operation;
- *Environmental and social impacts* – what are the range of environmental and social flow-on effects of the operation from a positive and negative perspective; and
- *Market outlook* –likely future of this processing/product type in terms of technology and market prospects

The processing options reviewed cover established fibre processing technologies, some of which are, or have already been developed in Tasmania. Other technologies considered are still emerging either within Australia and/or internationally where the products and markets may only be at a fledgling stage.

The objective of this section is to provide an overview of each potential option and its current status. As such the discussion is general in nature. The analysis of each option in terms of its suitability in a Tasmanian context is presented in Section 4.

3.1 Pulp and paper

Pulp production can be undertaken through a chemical process, a mechanical process or a combination of the two. Pulp made from softwood generally has longer fibres that give paper strength and improve its runnability for high speed printing processes such as newsprint. Hardwood pulp has shorter fibres that produce high quality paper and is most commonly used for printing paper production. Three types of pulp are considered, with each with different end markets: kraft pulp, sulphite pulp and mechanical pulp.

Process overview

Kraft (or sulphate pulp) is produced through the digestion of woodchips at high temperature and pressure. The digestion process separates the lignin from the cellulose. The separated cellulose fibre is then washed, screened and dried into pulp, sometimes using a bleaching process. The leftover dissolved lignin and chemicals, termed ‘black liquor’, can be recycled through a chemical recovery process or burnt to produce heat and steam that can be used in the paper production process.

Sulphite pulp is produced by digesting wood fibre in an acidic solution. The acidic reaction de-lignifies the wood fibre. Sulphite pulping results in a high cellulose recovery with the pulp being stronger, more pliable, and naturally brighter than kraft pulp. The chemicals used in sulphite pulping cannot be re-used in the same way as for the kraft pulping process. Sulphite pulping can also be used for the manufacture of dissolving pulp by adding a process to remove the hemicellulose from the pulp.

Mechanical pulp is produced by using a grindstone or metal discs to pulverise woodchips into fibre fragments. Thermo-mechanical (TMP) or chemi-thermo-mechanical (CTMP) pulps are variants to the mechanical pulping process where high pressure and heat (TMP) and chemical softening (CTMP) are added to the process to improve fibre breakdown. Mechanical pulps are generally of lower strength than chemical pulps and longer length fibre often needs to be added to improve pulp strength.

Commercial status

Australia does not produce any significant volume of internationally traded kraft pulp. Softwood kraft pulp is produced by Visy Industries at Tumut, NSW which in turn is manufactured into a range of packaging materials. Australian Paper produces a mixed hardwood/softwood kraft pulp at its Maryvale facility in Victoria. This pulp is used as a feedstock to produce paper within their integrated pulp and paper operation. Before going into receivership, Gunns was proposing to develop a new hardwood kraft pulp mill at Bell Bay in Tasmania.

Internationally, kraft pulp accounts for around 80% of the world’s pulp production with production assets spread globally. Bleached kraft pulp in particular, is a highly traded commodity used in the production of printing and writing papers, packaging products such as linerboard and carton board and tissue paper. Because bleached kraft pulp can be readily printed on and easily coloured, it is an extremely versatile feedstock for a range of paper making processes.

Most of the recent investment in pulp mills internationally has been in hardwood kraft pulp production for international export to China. Much of this development has been in South America, notably Brazil, where several world scale operations (production >1 million tonnes/year) have been commissioned in the past 2-3 years.

Sulphite pulp is no longer produced in Australia. Kimberly Clark Australia operated a sulphite pulp mill at Tantanoola, SA until 2011 when the facility closed and the company switched to imported pulp. Internationally sulphite pulp is used for a range of products. Due to its strength and brightness, sulphite pulp is often combined with mechanical pulp in the production of newsprint. Its other main use is as a feedstock for producing a range of tissue and sanitary products along with textiles.

Mechanical pulp is used extensively throughout the world for newsprint and magazine paper but is not traded internationally in the same volumes as kraft pulp. Norske Skog is Australia's sole manufacturer of mechanical pulp with mills located at Boyer in Tasmania and Albury in NSW. The Boyer facility uses a thermomechanical process to produce softwood pulp. This pulp is used to produce around 290,000 tonnes of newsprint, book grade and lightweight coated paper per annum. The Albury mill uses softwood pulp and recycled fibre to produce around 275,000 air dry tonnes (ADT) of newsprint per annum, which represents around 40% of Australia's requirements.

Feedstock requirements

Modern kraft pulp mills generally produce around 1.3-1.5 million ADT of pulp per annum and require a feedstock of approximately four million green tonnes of wood fibre per annum. Kraft production can use hardwood or softwood feedstock. Hardwood pulp tends to be used for higher quality paper products whereas softwood pulp tends to be used for lower quality, higher volume packaging paper, paper board and tissue.

Mechanical and sulphite mills tend to be much smaller than modern kraft mills with feedstock requirements typically less than one million tonnes per annum.

Environmental and social impacts

Pulp manufacturing is a large scale industrial process that has significant electricity, water and chemical requirements. The intensive use of chemicals in the kraft process means that the management of liquid and particulate chemical wastes is one of the main challenges in the environmental management process. Modern mills are capable of minimising the impacts of waste water pollution through recirculating process streams through filters and biological treatment processes to reduce the suspended solids and oxygen demand (NZIC, undated). The toxicity of bleaching chemicals is also reduced significantly in mills that are elemental chlorine free (ECF), which has a lower impact when discharged into the environment. Despite this, kraft pulp producers still have a significant challenge in working with public perceptions and reaching agreement on their environmental needs and management processes. Kraft pulping is generally close to energy neutral due to the utilisation of much of the waste streams during the production process.

Mechanical pulp is more resource efficient compared to chemical pulp as there is a high recovery of fibre through the grinding process and lignin is not removed. However the process is much less energy efficient than chemical pulping due to the significant electricity demands associated with the grinding process and the lower scope for recycling production wastes.

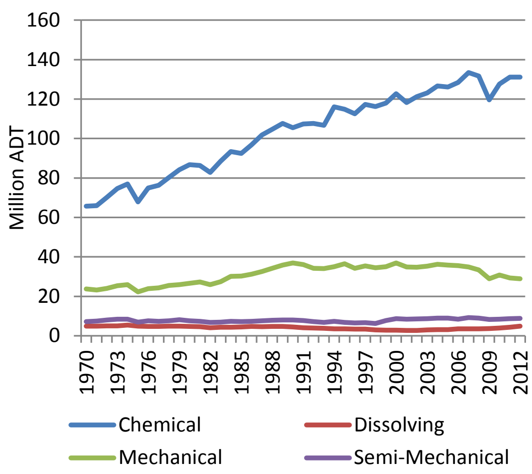
Pulp mills, due to their size and complexity, tend to be large employers both directly and indirectly. A kraft pulp mill of around 1.5 million ADT pa would be expected to employ around 400-600 people directly, but would have a significant requirement for a range of ancillary services.

Market outlook

The market for kraft pulp is expanding internationally, driven by strong growth in Chinese demand for paper and packaging products. Figure 3-1 shows that annual production of chemical pulp has grown strongly over the last 20 years relative to the production of mechanical, semi-mechanical and sulphite pulp. Figure 3-2 shows that the clear majority of this growth in chemical pulp production has been in bleached sulphate (kraft) pulp.

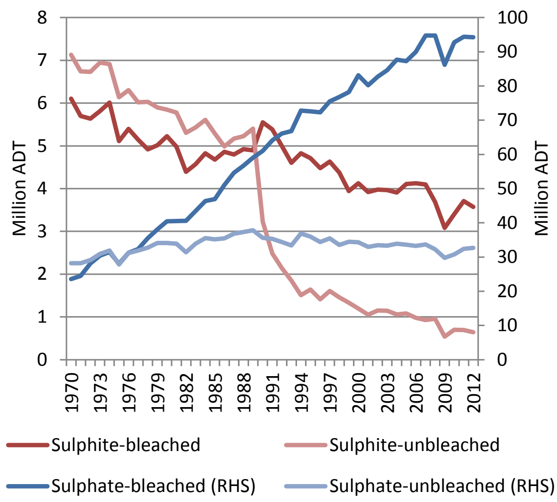
As Chinese consumption has grown over time, domestic paper mills have become increasingly reliant on imported chemical pulp. Figure 3-3 shows growth in Chinese demand for imported pulp since 1995, where it has grown from near zero to around 17 million ADT/year and the largest market in the world. Most of the growth has come through increased imports of sulphate (or kraft) pulp. Chinese demand is expected to increase significantly over the next 10 years as paper and packaging demand grows in conjunction with economic growth.

Figure 3-1 Annual world pulp production by type



Source: FAOSTAT

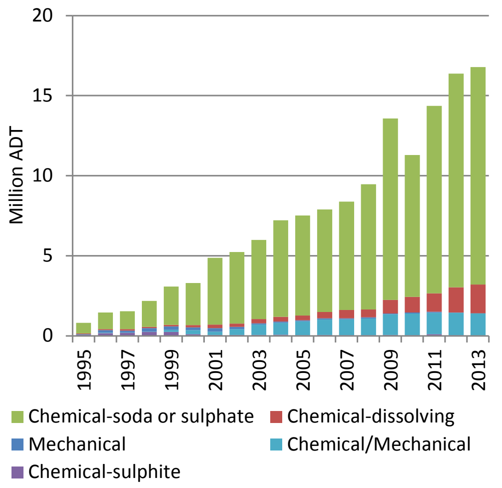
Figure 3-2 Annual world chemical pulp production by sub-type



Source: FAOSTAT

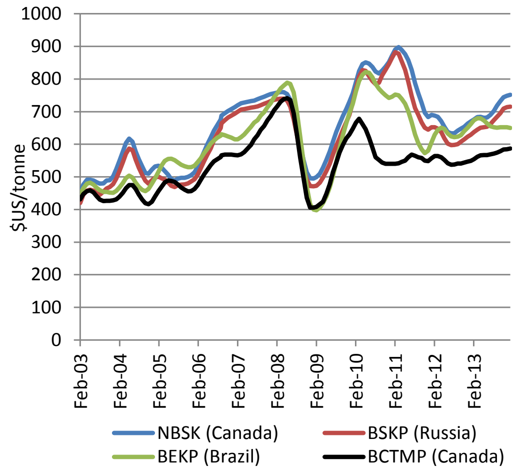
Figure 3-4 shows price trends for Chinese pulp imports from a variety of sources. Due to the market being heavily supplied by internationally-sourced pulp, pulp prices tend to be highly volatile. Growth in demand has prompted large investments in kraft pulp production capacity. As a result it is important for manufacturers supplying pulp internationally to operate at a large scale using modern technology to be able to offer competitive prices.

Figure 3-3 Chinese pulp imports by type



Source: FAOSTAT

Figure 3-4 Chinese price of internationally sourced pulp



Source: Hawkins Wright, 5 month moving average

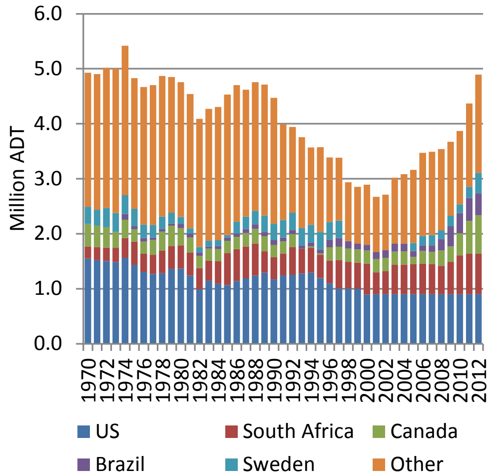
The volume of sulphite pulp produced internationally has declined over time, particularly compared to kraft pulp. Imports of sulphite pulp to key growth markets, particularly China, have been limited. The decline in sulphite pulp production is the result of aging international assets and the increasing investment in kraft production pulp which has significant cost advantages.

There is currently increasing growth in demand for dissolving pulp internationally, which can be produced using a sulphite or kraft pulping process. The largest use of dissolving pulp is currently viscose-rayon production. Where much of the textile trade has been focused on other materials such as cotton, increasing commodity prices in recent years has triggered demand for alternative materials, such as rayon. This is particularly pronounced in periods of low global cotton production, which might arise from factors such as crop failure.

With many of the world's sulphite plants being closed over the last 10 years, companies are increasingly looking at re-opening these assets for dissolving pulp production. As shown in Figure 3-5, world production of dissolving pulp declined from the mid-1980's until the early-2000's when production began to increase again. From 2000 to 2012, dissolving pulp production increased by 4% per annum.

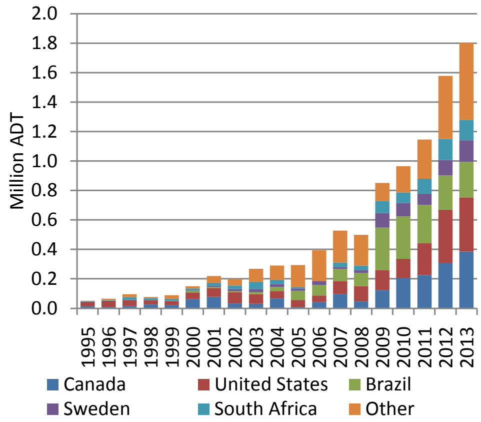
China's textiles industry has driven much of the increased demand for dissolving pulp, expanding their importation of this product four-fold between 2006 and 2012 (see Figure 3-6). However, this expansion in capacity has led to a state of oversupply and dissolving pulp prices are expected to remain under significant pressure.

Figure 3-5 Annual world dissolving pulp production by producer country



Source: FAOSTAT

Figure 3-6 Annual Chinese dissolving pulp imports



Source: GTA

In 2012, international production of mechanical pulp was around 33 million ADT, significantly less than the 130 million ADT of kraft pulp production. According to the FAO only 2.3% of mechanical pulp production volume in 2012 was traded internationally. Between 1990-2003 mechanical pulp production remained flat. From 2003-2012, production declined steadily as mechanical pulping capacity was rationalised in many countries as demand for newsprint and magazine paper has declined.

3.2 Composite panels

3.2.1 Particleboard and medium density fibreboard

Particleboard is a low cost panel product used for construction and manufacturing. Medium Density Fibreboard (MDF) is a composite panel that is used as a substrate for joinery and for non-structural decorative applications such as mouldings.

Process overview

Particleboard is made by combining fragmented wood fibre with a synthetic resin or binding agent. This mixture is extruded and pressed into board dimensions. Wood fibres used for the manufacture of particleboard typically includes: sawmill residues including woodchips, sawdust as well as a component of forest pulpwood.

MDF uses fewer processing residues and more roundwood than particleboard. Feedstock is ground into small particles under heat and pressure. The fibres are then combined with a wax and resin and kept as a mixture until ready for pressing. Like particleboard, other additives can be mixed with the resin which is then pressed and dried. After drying the sheet is sanded and cut to size.

Commercial status

In Australia, particleboard is typically used as a low cost flooring substrate in timber houses and in joinery applications where it is laminated. Its lower density and coarser finish compared to MDF limits its use in appearance applications. However, particleboard's cost-effectiveness and suitability for coatings, including metal, synthetics and veneer, make it a versatile product.

MDF panels are used as a substrate in furniture and joinery production and also in residential and commercial building applications. Increasingly MDF is used for mouldings where its high density and fine finish mean it can be worked into decorative shapes and finishes can be applied.

There are seven particleboard and four MDF mills in Australia producing a total volume of around 850,000m^3 and 450,000m^3 of product in 2012/13 respectively. All production in Australia is based on softwood fibre. While there is no domestic production of particleboard or MDF using hardwood species, some production occurs internationally.

In 2004, a CSIRO project trialled the mechanical and physical properties of a number of WA *Eucalyptus* species for the production of particleboard (Olsen *et al*., 2004). The study found none of the species had the conformability[1] of radiata pine and as a result would have a greater level of surface area in the particles used. Eucalypt species also generally have a higher fines content which means a significantly higher amount of resin is required in the production process and for both reasons would result in a denser and heavier product (as well as being higher cost).

In 1998 CSIRO carried out a limited investigation into preparing MDF from three eucalypt species from the East Gippsland region including messmate, silvertop ash and white stringybark (Coutts *et al.*, 1998). In line with studies on other composite products, CSIRO found that to produce a panel of acceptable strength, a higher board density was required, well beyond that of radiata pine-based MDF. The properties of hardwood fibre, including higher absorption, surface area and fines content, meaning a much greater volume of resin is required in the production process resulting in a heavier product.

Feedstock requirements

A new particleboard mill is likely to require around 200-400,000m^3 of wood fibre pa whereas a new MDF plant would typically require around 400-600,000m^3 pa. A particleboard plant would normally require a substantial volume of its feedstock as processing residues where MDF mills would most likely require a greater proportion of its feedstock as roundwood.

Environmental and social impacts

Particleboard and MDF manufacture is generally undertaken at a large scale and requires intensive use of chemicals in the production process. Much of the potential environmental impacts are from the drying of the fibre and the use of resin where volatile organic compounds (VOCs) are produced. VOC's require filtering and containment as a pollution control measure. In modern mills, emission control devices such as thermal oxidisers, catalytic regenerative oxidisers and biofilters can be used to minimise particulate matter and pollutant gases released during the production process (Puettmann *et al.* 2013).

[1] Conformability is defined as the ability of wood to compress into the next particle to ensure maximum bonding area

In addition, the formaldehyde based resins often used in particleboard and MDF must be monitored for the safety of workers and the environment. Concerns regarding formaldehyde emissions after the production process have encouraged some producers such as Alpine MDF in Wangaratta, Victoria to produce MDF products with little to no emitted formaldehyde.

Other potential environmental impacts from particleboard and MDF production may include increased noise, traffic congestion and run-off waste (e.g. dust and petroleum) into stormwater which will require management by the producer and engagement with government and public during site planning and development.

Due to their scale, particleboard and MDF plants would tend to employ around 150-250 people. Their scale and the complexity of the manufacturing process mean these operations would likely generate a significant number of indirect jobs.

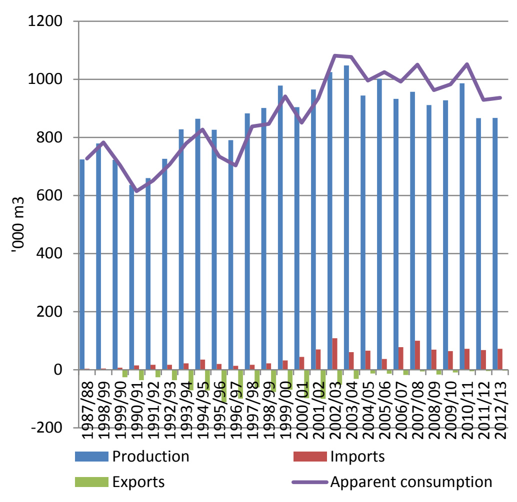
Market outlook

Particleboard has been an effective substitute for solid timber and plywood in internal applications where appearance and strength are less important than cost. Production and consumption of particleboard has increased steadily in Australia since the late 1980's to around 2003. Since this time, domestic production and consumption have been relatively flat with little international trade in particleboard either from or to Australia.

Most particleboard mills in Australia are relatively old and are generally considered to be high cost compared to international benchmarks. Particleboard production retains a cost advantage over other wood products in that it can utilise a low quality feedstock, however this lowers its price and limits the distance over which it can be economically transported.

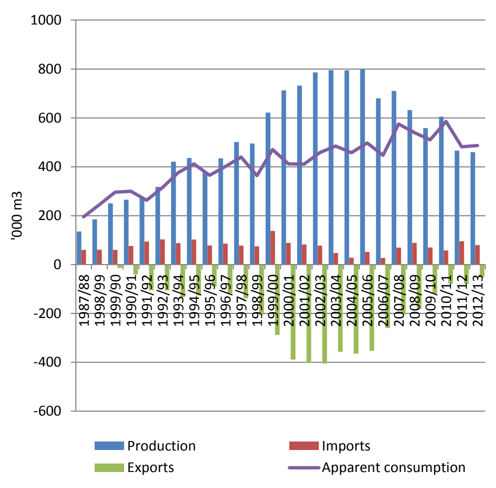
MDF consumption in Australia grew steadily from the 1980's through to the mid 2000's and through the middle of the last decade, Australia exported around 40% of its MDF production. However the industry has retreated from international markets as local producers became less competitive and exports have declined as a result. This has led to a decline in overall production to a level that aligns with domestic demand.

Figure 3-7 Annual Australian apparent consumption of particleboard



Source: ABARES (2013)

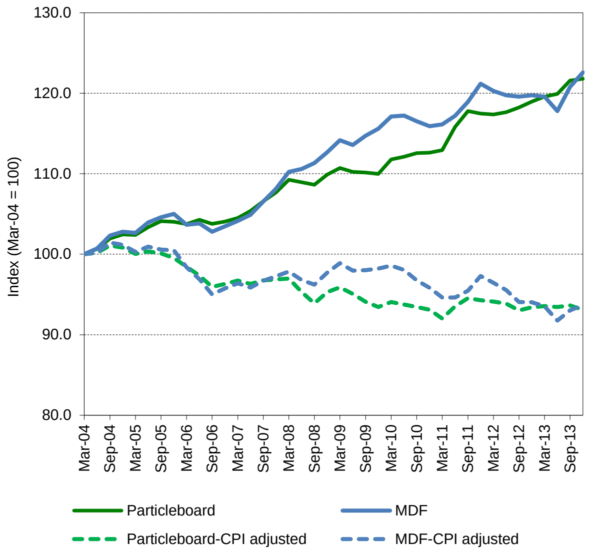
Figure 3-8 Annual Australian apparent consumption of MDF



Source: ABARES (2013)

The nominal price of particleboard and MDF has increased steadily since 2004 reflecting stable demand for the product from a range of market segments (Figure 3-9). In real terms, prices have declined marginally over time but remained relatively stable. By contrast, solid timber markets tend to show much higher levels of volatility and a stronger correlation with residential construction activity.

Figure 3-9 Quarterly Australian particleboard and MDF nominal price index



Source: ABARES (2013), URS estimates

3.2.2 *Oriented strand board*

Oriented Strand Board (OSB) is a composite panel product mostly produced in North America as a low cost structural panel.

Process overview

OSB is manufactured by producing strands of wood fibre usually from lower grade logs, which are then dried, combined with resin and pressed into large panels with the strands oriented in parallel.

Commercial status

OSB is mostly used in North America where it has been produced since the 1970's. In the US, OSB is a structural panel which is used as a low cost substitute for plywood for house sheathing (e.g. wall and roof coverings) and sub-floors. Its high thermal insulation properties make it suitable for internal cladding, which is required in building design in these markets. OSB is estimated to have 75% of the volume share in the residential building market compared to 25% by plywood (www.prosalesmagazine.com).

Australian house design typically doesn't include a large component of sheathing or strengthening as observed in North American markets.

OSB is not currently produced in Australia and domestic demand for this product is low compared to plywood. Although plywood is typically more expensive than OSB, it has some advantages including being lighter, stiffer and less susceptible to absorbing water than OSB. For lower cost structural applications in Australia (e.g. sub-flooring), particleboard is often used as an alternative to plywood.

Feedstock requirements

OSB can use pulpwood grade hardwood and softwood where the whole log can be processed as feedstock. To be competitive with US imports, a local OSB operation would require fibre input in the order of 200-400,000m^3 per annum.

Environmental and social impacts

OSB requires the use of phenolic formaldehyde resins that produce carbon monoxide, nitric oxide and nitrogen dioxide (NOXs) and VOCs during the drying process. Modern mills operate using a sealed drying process where airborne particles and VOCs are filtered and removed before the hot air is discharged into the outside environment (SBA, 1999).

A large scale OSB mill would be expected to employ around 130-150 employees. Due to the scale requirements for a new OSB plant and its relatively complex manufacturing process, it is likely that a greenfield operation would generate a significant number of indirect jobs through the additional external servicing requirements.

Market outlook

The lack of a domestic market would create a challenge for a new operation particularly due to the likely limited export opportunities in the Asia Pacific currently. Any domestic production would need to displace plywood and particleboard in the highly competitive market for sub-floor products. Export opportunities to the US and Canada are limited at present due to the relatively low value of OSB and the significant amount of idle production capacity in the US that can be re-activated to supply the growing housing market.

3.3 Sawn timber

Sawn timber is the largest volume wood product produced and consumed in Australia servicing a number of major construction markets.

Process overview

Hardwood sawmilling in Australia has developed to suit the available resource, which over the past century has often included large diameter logs. As harvesting increasingly shifts toward regrowth forests, the sawmilling sector is processing smaller diameter logs which are challenging the specifications and efficiency of existing technologies.

Commercial status

According to ABARES industry surveys, in 2012/13 there were around 200 hardwood sawmills in Australia producing around 740,000 m^3 pa of timber products. This is a reduction from the 2010/11 ABARES survey which identified 241 hardwood sawmills. Australian hardwood sawmills are typically of a small scale compared to softwood mills.

There are no sawmills that are solely focused on processing plantation (or smaller diameter regrowth) hardwood logs. However URS understands some Tasmanian sawmills have developed the expertise necessary to saw, kiln dry and process small native forest logs and plantation sawlogs into appearance timber products.

Tasmanian sawn timber (including the sawn plantation hardwood timber noted above) is generally marketed as Tasmanian oak, a marketing name for three commercial Tasmanian species (mountain ash, alpine ash and messmate). Tasmanian oak is a highly regarded timber species for appearance markets such as flooring and joinery. It also has good properties for structural applications.

Feedstock requirements

A modern new reciprocating hardwood sawmill producing appearance grade products might process between 40,000-70,000m^3 pa. Beyond this volume the mill would have to run a double shift where the throughput volume would need to double to ensure unit costs were effectively spread.

A modern linear sawmill such as a HewSaw requires a throughput volume of around 250,000m^3 pa and as a result is a much larger operation. Linear mills rely on logs being processed at high speed and as a result require logs that are consistent in size with minimal structural defects. Due to these scale and quality requirements, a linear mill system is not likely to be suitable for many Australian native hardwood species. However sufficient volume may be available from the hardwood plantation resource to meet these requirements.

Environmental and social impacts

Due to limited requirement for chemicals and water, hardwood sawmills have relatively benign environmental impacts compared to other wood processing operations. The largest environmental concerns relating to sawmilling operations tend to be, noise, dust and traffic. Sawmills tend to require large land areas for log and timber storage and moving product to and from the mill.

For regional areas sawmills are often a significant source of employment. Smaller operations generally require more employees per cubic metre of input due to relatively lower levels of automation compared to larger sawmills. A typical mill of around 50,000m^3 pa input might require staff of around 15-20 people. A larger operation in the order of 300,000m^3 pa input, with the latest level of automation, might require staff of around 40-60 people.

Market outlook

Australia has a mature market for sawn timber. Much of the market for hardwood structural products has been captured by softwood timber and engineered softwood products as a result of strong price competition through the 1990's and 2000's. Hardwood still retains a competitive advantage in several areas particularly in applications where its appearance is valued. Some Australian hardwoods also retain an advantage over other softwood and hardwood species due to their natural durability. Much of the future market demand for hardwood timber is likely to lie in targeting these two areas of advantage for higher quality logs and for other hardwood logs pursuing engineered wood products that improve their inherently lower value.

From a Tasmanian residue perspective, the availability of additional sawlog volume from native forests is likely to be minimal as straight logs with a small end diameter between 20cm and 30 cm are likely to be sold as peeler billets, which allow for shorter log lengths. The best prospect for expanding sawn timber production is for the processing small diameter sawlogs sourced from hardwood plantations.

One of the greatest challenges in processing small diameter hardwood logs the effective handling of growth stresses. The tensioning of fibres is more evident in regrowth forests due to faster growth rates and shorter rotation lengths. Growth stress related processing issues generally relate to sawing accuracy, board distortion and end-splitting (de Fégely, 2004). Multi-saw technology has been shown to be an effective approach for improving efficiency in processing smaller diameter hardwood logs. This technology allows for the release of growth stresses in the log through multiple simultaneous cuts (Washusen & Innes, 2008). Appropriate drying regimes would also need to be developed to reduce the likelihood of defects such as internal checking occurring.

As previously noted some Tasmanian sawmillers have overcome these issues and are processing plantation hardwood logs into a range of appearance products. This timber is being marketed in combination with timber sourced from native forests.

One issue identified by the sector is the lack of end markets for the low value timber created as an arising from the sawing process. While much of this material timber is also of appearance grade, it is too short or narrow for current timber specifications. A modern sawmilling operation could also be the basis for a hybrid operation that not only produces sawn timber but also has other secondary value-adding operations on site such as a glulam line and/or a CLT plant (as discussed in Section 3.4.3), if these markets were to be developed further in Australia.

An alternative approach given the small diameter of the logs would be to install a linear mill that would primarily produce timber for structural markets. Provided several pre-conditions of the log resource can be met, linear mills are potentially a modern, cost-effective method for reducing the historically high costs of processing hardwood logs. However the outturn of appearance grade timber from a linear mill is likely to be far lower than a mill that specialises in producing timber for appearance markets.

3.4 Engineered wood products

Engineered wood products (EWPs) include a range of timber and veneer based products for lumber and panel markets. They are constructed by gluing together veneer sheets or small timber sections to form larger dimension products. EWPs generally exceed the strength of equivalent-sized, solid wood products and can be made for a lower cost. This section considers three types of EWP: laminated veneers, oriented strand lumber and laminated secondary timber products.

3.4.1 Veneer and laminated veneer products

Laminated veneer products are manufactured by gluing together timber veneer sheets to produce panel or lumber sized dimensions.

Process overview

Veneer is generally produced using a rotary peeling system where a lathe cuts a thin sheet of veneer from a rotating log. In modern operations, spindle-less lathes increase veneer recovery down to a small core and are highly suited to processing smaller dimension logs where veneer recovery is critical.

The efficiency of peeling operations is strongly correlated with log size and wood quality. Large, plantation grown softwood logs of uniform quality for example, are easy to peel and the recovery of veneer per log is high, reducing unit costs. In contrast, smaller more defect-prone logs significantly increase handling costs and increase the volume of reject material.

The veneer sheets are then used in a secondary process to produce plywood or laminated veneer lumber. These products are produced by layering and gluing veneer sheets together. These are then pressed into a panel or lumber products of varying thicknesses and dimensions. The lumber or panel is sawn into batch dimensions and sanded. A higher quality veneer can be added to the external face to improve the product’s appearance.

For plywood, veneers are cross-laminated (layered with the grain at right-angles) to provide the panel with the highest strength and stiffness in all directions. For laminated veneer lumber (LVL) the veneers are laminated in parallel to maximise longitudinal strength, as LVL is generally sawn into narrow dimensions where strength is required only in one direction.

Commercial status

Plywood is a large volume market in Australia and is used extensively in residential construction and for industrial formwork. Hardwood plywood forms a relatively small part of overall supply, with the only domestic manufacturing currently undertaken by Big River Group in NSW with the remainder imported. Australian hardwood plywood is used for industrial and commercial formwork where its durability (and re-usability) is valued.

Tasmania currently has two international scale veneer operations owned by Malaysian company Ta Ann. Collectively the sites have the capacity to process around 157,000 m^3 pa of peeler logs with the veneer sheets exported to Malaysia for plywood production. In 2014, Ta Ann Tasmania announced its intention to construct a plywood mill adjacent to its Smithton veneer mill. The mill is expected to produce a range of structural and appearance grade plywood products.

The production of LVL in Australia is limited to one WA based softwood operation of around 80,000 m^3 production output. Domestic LVL production has faced increasingly challenging business conditions in recent years due to the increasing competitiveness of New Zealand and US sourced LVL imports.

While LVL is generally produced using softwood species, there are commercial examples of hardwood LVL in the US. Production trials in Australia concluded hardwood LVL could be made from regrowth messmate and alpine ash logs of 45cm average (McCombe, 1992; McCombe and Collins, 1993). More recently, Forestry Tasmania has developed a commercial hardwood LVL product based on Tasmanian oak which is marketed as Hardlam[2]. In addition to structural applications, Hardlam is also suited to a range appearance end markets such as: flooring, staircases, panelling and visible internal beams. After undergoing testing, Forestry Tasmania announced the successful completion of its trials and its readiness to engage with potential investors to fund Hardlam production. In 2013 the rights for developing an operation were awarded to Oakdale Industries – a local manufacturer – to produce a range of Hardlam products as part of the market development process.

Feedstock requirements

A competitive veneer operation would likely require around 150-200,000 m^3 pa of roundwood input. Internationally competitive LVL and plywood mills would require feedstock of around 150,000 m^3 pa and would normally be integrated with a veneer operation. Plywood and LVL could use softwood and/or hardwood as a feedstock assuming markets could be sourced for the product.

Hardlam has a key point of difference from softwood LVL in that it is targeting niche appearance markets as well as structural markets. The appearance market is much smaller than for structural LVL market, so the necessary scale of a greenfield mill producing Hardlam is likely to be lower than if competing directly with softwood LVL.

Environmental and social impacts

Like composite board products, the resin used in plywood and LVL production often contains formaldehyde however the amount of resin used is substantially less than for composite panel products (~2% by weight, compared with ~10% for particleboard and MDF) (AWC, 2012). Formaldehyde emissions in Australian plywood and LVL operations are maintained below recommended health levels in accordance with Worksafe Australia regulations (EWPA, 2013). In manufacturing plants, modern dust extraction and management systems mean that risks to workers and to the broader environment by formaldehyde, as well as VOCs and carbon monoxide (produced during the drying process) are minimised.

Other potential environmental impacts from veneer, plywood and LVL production include noise, increased traffic and run-off of dust and petroleum into stormwater which would all require management by the company and engagement with government and the broader public.

A veneer operation with a plywood and/or LVL manufacturing line would be expected to directly employ around 50-100 people.

[2] http://www.hardlam.com.au/

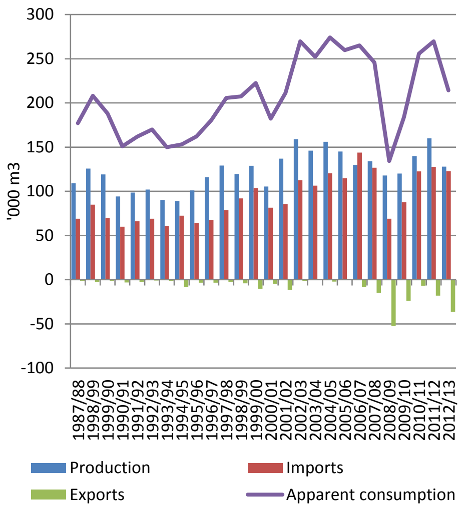
URS

Market outlook

Veneer is in demand internationally for the production of plywood and LVL and – in the case of higher quality veneer – as surface laminates for joinery, furniture and other products.

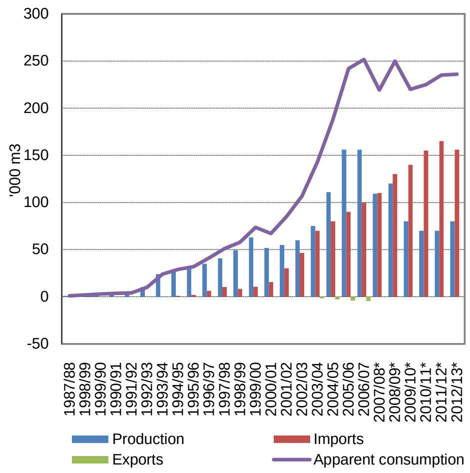
The markets for plywood and LVL are driven to a large extent by residential construction. In Australia there are viable markets for both plywood and LVL. Demand, particularly for LVL has grown strongly over the past 10 years (see Figure 3-10 and Figure 3-11). Imported products have become increasingly competitive in both markets and this has been facilitated by the recent strength of the Australian dollar and the aging Australian manufacturing assets.

Figure 3-10 Plywood apparent consumption in Australia



Source: ABARES; URS
NB: Import volumes estimated

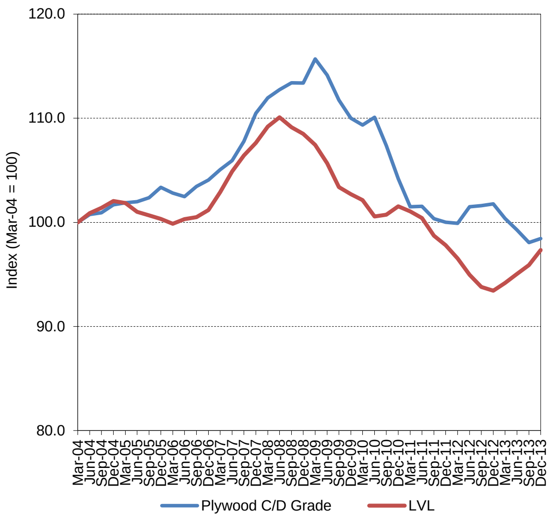
Figure 3-11 LVL apparent consumption in Australia



Source: ABARES; URS
NB: Import volumes estimated; production volumes estimated since 2007/08

The historic price of plywood and LVL in Australia has trended downwards since mid-2008 (see Figure 3-12). The Australian housing market has been relatively weak through this period however the Australian dollar has strengthened at the same time which has increased competition from lower cost imports into the Australian market. Domestic suppliers were reported to have reduced production volumes through this period. Prices continued to fall in nominal terms during this period of intense competition and it is only recently showing signs of stabilising.

Figure 3-12 **Quarterly nominal price of softwood veneer products in Australia**



Source: ABARES; URS

There are no established markets for hardwood LVL. However, pricing for other timber products such as solid timber and engineered wood products would provide useful benchmarks to test the competitive position of any new product.

3.4.2 Oriented strand lumber

Oriented strand lumber (OSL), sometimes called 'Engineered' or 'Laminated' strand lumber ((ESL or LSL) is a reconstituted lumber product used for high strength residential and commercial construction.

Process overview

OSL is manufactured in a similar way to OSB, by flaking low grade logs and recombining the fibre flakes as a board with resin. Different flaking technologies are used depending on the manufacturer and product produced. Continuous presses are often used which enable the production of very long lumber lengths.

Commercial status

OSL is not currently produced in Australia. Like OSB, this product is mostly produced and consumed in the North American market. OSL has been produced for over a decade in the US and Canada by companies such as Weyerhaeuser and Louisiana-Pacific and is generally made from low-medium density hardwoods such as poplar, aspen and maple.

Australian company Lignor Ltd has developed commercial plans to produce a product like OSL, using plantation and/or native eucalyptus species as a feedstock. Lignor is proposing to build a plant using continuous press technology similar to that employed in many North American mills but has been unable to secure financing to date.

Feedstock requirements

A mill producing OSL would be expected to be similar in scale to an OSB plant processing around 200-400,000 m^3 pa. An Australian operation would face challenges in terms of market size and technical understanding would need to be developed over time through pilot and developmental programmes. One potential pathway may be to develop OSL as an addition to an existing processing operation.

Environmental and social impacts

Like the other panel products, the resin used in OSL produces formaldehyde and other VOC emissions during the drying, pressing and sawing process. These can be minimised using modern dust extraction and management systems. Lignor is proposing to utilise an alternative resin, PMDI, (polymeric diphenyl methane diisocyanate) instead of a formaldehyde based product.

An OSL plant would generate noise, increase traffic and may result in run-off of contaminated water into stormwater. This would require careful management and close engagement with government and the broader public.

An OSL operation would most likely directly employ around 100-150 people.

Market outlook

OSL has potential for house construction, particularly for higher strength and larger dimension applications (e.g. headers, beams and I-joists). OSL can also be used for framing, particularly for builds where high ceilings take advantage of the product's suitability for long length and straightness.

OSL could potentially be cost competitive with large dimension solid timber and LVL due to its lower relative feedstock cost. OSL also compares favourably against steel and concrete in certain residential applications.

OSL products have several advantages over traditional solid wood products in that they have a more stable moisture content (of below 10%), which makes them less prone to twisting and warping after installation. When sawn onsite OSL is reported to retain its shape and straightness better than solid timber. This may allow producers to provide more comprehensive warranties with their products. The consistent quality, good machining and nail holding ability, and ease of treating with fire retardant and pesticide additives contribute to the product's competitiveness.

3.4.3 Cross laminated timber (CLT) and glulam

CLT and glulam are laminated lumber products used in high strength residential or commercial building applications.

Process overview

CLT and glulam are produced by bonding and pressing multiple layers of lumber together to produce large dimension panels and lumber products. Glulam products are generally marketed as high strength beams or columns. Large CLT panels are generally used in an integrated operation where they are custom sawn for prefabricated house or apartment design.

Commercial status

Glulam is produced in Australia by several operators with two of the largest being Hyne Timber in Queensland and Australian Sustainable Hardwoods (ASH) in Victoria. The Hyne operation produces glulam from softwood timber, whereas the ASH operations use hardwood timber. Both mills are co-located with their sawmilling operations and use the glulam line as an important value-add to their overall operations.

Glulam is predominantly produced for heavy structural applications in the residential market particularly as beams, columns, bearers and lintels. Glulam can be a substitute for steel and LVL in construction applications and competes against these products in price, strength, sustainability and portability. Glulam can be bent during the production process to produce curved shapes making it an ideal product for internal arch designs.

CLT is not currently produced in Australia but has been imported as made-to-order panels from European manufacturers that use softwood timber feedstock. Global production of CLT is estimated to be 700,000 m^3 and has grown significantly over the past 10 years. Most CLT production occurs in Austria and Germany centred near the product's largest sources of demand.

There is currently only sporadic consumption of CLT in Australia with only a handful of mainly demonstration projects having been commissioned over the past few years. CLT's advantages are that it can be manufactured to order in exact dimensions as a pre-fabricated panellised construction material. As a result the wooden panels can be screwed into place easily resulting in a significant reduction in construction time. Like other wood products CLT also has strong environmental attributes and is highly portable relative to non-wood alternatives. These factors have all helped to bolster its initial success as a building product in the European market.

Feedstock requirements

A typical CLT or glulam operation could be as small as 5,000 m^3 pa or up to 50,000 m^3 pa depending of the size of the market opportunity and the investment characteristics of the operation. Both CLT and glulam rely on a steady supply of sawn timber and on a small scale are ideally run in cooperation or coordination with a sawmilling operation. As part of a broader process, glulam and CLT production can help to make use of lower quality or short length timber residues that would normally have limited value.

Environmental and social impacts

The resin contained in glulam and CLT usually contains formaldehyde however like plywood and LVL there is a relatively small percentage of resin by weight, due to the high proportion of wood in these products. Modern dust extraction and management system can limit the concentration of formaldehyde and VOC emissions at the production site and this is regulated by Worksafe Australia.

A glulam or CLT plant would generate a relatively small amount of noise and road congestion. The small production space would also mean that dust and particulate are minimised. As a result the overall environmental impacts are likely to be low.

A glulam or CLT operation would directly employ around 10-50 people, depending on the scale of production.

Market outlook

The future of glulam in the Australian building industry will depend on the relative cost of the product to alternatives such as LVL, solid timber and other non-wood competitors, particularly steel. As consumers increasingly look to environmentally friendly products to fill structural building needs, glulam is likely to increase in use. For glulam demand to increase, customers will need to be aware of its merits and where it has a competitive advantage over other products. Currently it is a highly specialised product and will require greater market engagement from producers to expand the market share against other heavy structural products.

CLT is a relatively unknown product in Australia. Because it is used for pre-fabricated housing, its uptake will require a change in product selection and building design and construction methods. CLT is currently considered to be most suited to the construction of buildings 5-10 storeys high. Engagement by producers or importers with the commercial building industry (and potentially also government) to develop showcase buildings will help to secure greater interest. Investment in Australian production is likely to be faced with difficulties in the absence of a strong source of existing demand. The development of a small pilot scale operation, with a view to scaling up may be the best approach for greenfield investors.

3.5 Bioenergy (heat and power)

The following sections outline a range of bioenergy products that either have current potential or growing future potential as end uses for wood residues generated by the Tasmanian forestry industry.

3.5.1 Combustion (including Organic Rankine Cycle units)

Process overview

Conventional combustion technologies create heat and use this heat to generate steam which in turn may be used to produce electricity. Alternatively, heat may be captured and used to drive Organic Rankine Cycle units for power generation. In all cases it is possible to combine power generation and heat recovery, which is called cogeneration or Combined Heat and Power (CHP). Cogeneration improves the overall thermal efficiency of combustion plants.

A number of combustion technology variants have been developed to suit different feedstock and plant sizes.

Commercial status

Direct combustion is the best-established and most commonly used technology for converting biomass to heat. Approximately 90 percent of the world's large-scale bioenergy plants operate through combustion processes. The US alone has some 12,000 megawatt (MW) of installed bioenergy capacity, which is approximately 10 times the total electricity use in Tasmania.

Technology is readily available for a range of plant sizes. Examples in Australia include:

- Large cogeneration facilities in the sugar industry, where waste fibre (bagasse) is used to generate process heat and 30 MW or more of power;
- Combustion plant and Organic Rankine Cycle units at sawmills, generating heat for kilns and electricity for use on site; and
- Small package boilers at regional centres, burning wood chip for building heating etc.

Combustion technology has been developed over many decades and is mature relative to some other bioenergy technologies. This is a beneficial attribute for raising capital, as the reliability of the technology has generally been demonstrated elsewhere. On the other hand it means that significant breakthroughs with new technology and greater efficiency or lower capital costs are unlikely.

Feedstock requirements

A wide range of technologies and equipment is available to carry out biomass combustion, which makes it possible to use a wide range of feedstock. Combustion systems can utilise softwoods and hardwoods including wood, bark and other residues. It is generally not necessary to dry the feed before use, as combustion systems can be designed to utilise feed with the moisture content of fresh wood. It is also possible to design systems that can utilise a range of particle sizes, from sander dust and sawdust through to large pieces of wood.

One important requirement is to match the plant design to the feedstock, and not to vary the feedstock significantly from the original specification. It is also important to minimise the contamination of biomass feed, with impurities such soil or stones.

Environmental and social impacts

Combustion creates flue gas, which is made up of the gaseous products of combustion plus entrained particulate matter. Combustion plants are therefore built to comply with EPA regulations, which set acceptable standards for release of these materials into the environment.

- Carbon dioxide is produced during combustion. Bioenergy is considered to be renewable because the carbon dioxide released is supposed to be matched by the carbon dioxide captured from the atmosphere via the photosynthesis that drives plant growth and creates the biomass that will go into the bioenergy plant;
- Before release to the environment the flue gas is cleaned to capture particulate matter; and
- Nitrogen oxides (NOx) are also produced and limits may be set for their discharge. NOx reduction can be achieved by modifying the combustion process.

The level of employment depends on the scale of the combustion operation. Small cogeneration plants will have a relatively low labour requirement, whereas large stand-alone facilities will require significant labour inputs.

Market outlook

Opportunities for combustion are generally associated with specific sites that have a local source of biomass and require heat, power, or a combination of the two. In such situations the heat and some or all of the power will be used on the site, replacing heat created by other energy sources (such as natural gas or waste oil) and power purchased from the electricity grid.

Stand-alone power generation is another option, with a power plant utilising biomass to generate electricity which is fed into the electricity grid. It is important to take grid infrastructure into account when selecting a location and size for a bioenergy plant. A bioenergy plant may enhance the operation of the grid if that part of the grid is struggling to meet increased demand and a line or substation upgrade is being contemplated. On the other hand, if a bioenergy plant is remote from the grid or generates more electricity than the local grid is capable of accepting, a costly grid upgrade may be required to accommodate the bioenergy plant or the plant may operate at a sub-optimal level.

The federal government has a long standing program that supports and promotes renewable energy via incentives for the generation of electricity from eligible renewable sources. Originally known as the Mandatory Renewable Energy Target (MRET), this program is currently known as the Large Scale Renewable Energy Target. Woody biomass has been an eligible renewable energy source since the original version of the scheme was put in place more than ten years ago. However the definition of woody biomass was changed in 2011 to exclude material sourced from native tree species. The operation of this scheme is currently under review and the whole renewable energy policy may be subject to material changes.

3.5.2 Gasification

Gasification is a process where biomass is heated and thermally degraded to produce combustible gases.

Process overview

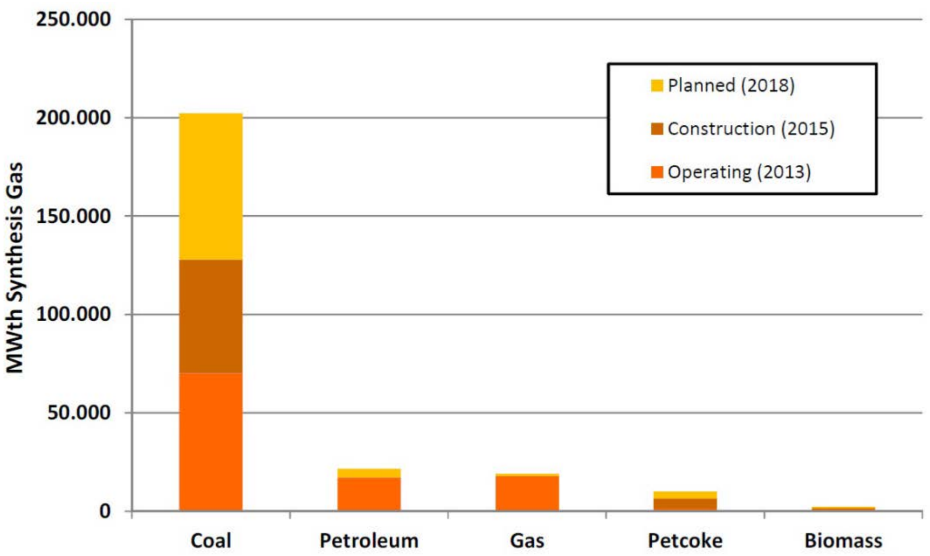
Where combustion normally occurs with excess air present, gasification of biomass takes place in a restricted supply of air or oxygen. The process produces a fuel gas that is rich in combustible carbon monoxide and hydrogen. This gas has lower specific energy (or calorific value) than natural gas but can still be used as fuel for heaters and boilers. It can also be used in engines after rigorous cleaning to remove tars and particulates.

A variety of gasification reactors have been developed over several decades for small and large scale operations. Pressurised gasifiers are under development to reduce the physical size of major equipment; however these gasifiers are currently at the pre-commercial stage.

Commercial status

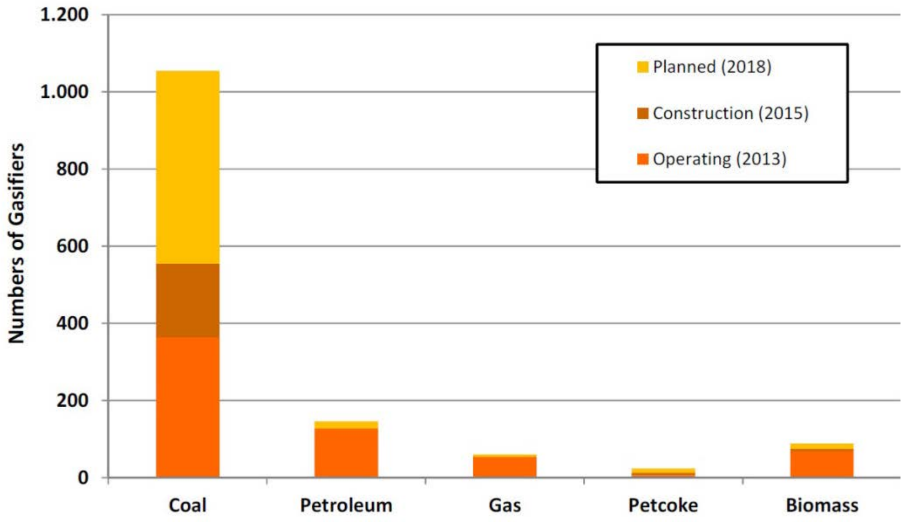
Large scale commercial gasification occurs in various parts of the world to make chemicals, power and liquid fuels. The main use of gasification is for chemical production, particularly for the production of ammonia and methanol. Figure 3-13 and Figure 3-14 show the main feedstock for this process is generally coal, followed by petroleum and natural gas. The use of biomass is currently very limited.

Figure 3-13 International production of synthesis gas by feedstock type



Source: Industry sources

Figure 3-14 Worldwide installed capacity of gasifiers by feedstock type



Source: Industry sources

Small scale biomass based gasifiers (less than 1 MW of electrical output) generally have a simple design with the combustible gas used to generate heat. Most development interest in this technology is to use the gas to drive engines which in turn are attached to generators to produce electricity. The critical step in such plants involves gas cleaning to remove tars and particulates. These impurities can cause rapid engine failure if not removed.

India is currently the largest manufacturer and user of small scale gasifiers, primarily from two companies (Ankur and Infinite Energy). Several hundred of these units have been installed throughout India and nearby countries. Several units have been installed in Western countries for research or demonstration purposes. However there appear to be few if any being used outside Asia on a commercial basis.

A number of European and American companies have built and sold small scale gasification systems but total production of these units worldwide over the past fifteen years is estimated to be less than twenty units, including prototypes. Several Australian organisations have also sought to design and market small scale biomass gasifiers for power generation. A number of prototypes have been built but no commercial sales have occurred in Australia over the last fifteen years.

Feedstock requirements

The feedstock requirements for small scale gasifiers are generally quite narrow. The moisture content of biomass must be below 15%, so green wood must be dried before use. The majority of the wood must also be within a defined size range, for example sawdust, wood chips or chunks of fuel. Mixes of these different sizes can create difficulties for the solid-gas interface that is essential for the proper operation of the gasifier.

Small gasifiers can require as little 600 dry tonnes of feedstock per year. A large scale biomass gasifier would require in the order of 100,000 dry tonnes of feedstock per year.

Environmental and social impacts

The comments made for combustion in Section 3.5.1 are generally applicable to gasification. An additional consideration for small scale gasifiers is the gas cleaning process that is required before the synthesis gas can be used in combustion engines. Some gas cleaning methods can create a waste stream containing carcinogenic tars. Appropriate methods of disposal must be provided for any liquid stream or solids that are contaminated with tars (for example using sawdust as a waste filter).

Market outlook

The market outlook for bioenergy generated through gasification are similar to those identified in Section 3.5.1 for combustion. Development of this market in the future will rely on a combination of specific local and regional demand characteristics and support by government for alternative forms of renewable energy.

3.5.3 Pyrolysis

Pyrolysis is the term given to the thermal degradation of wood in the complete absence of oxygen (air).

Process overview

Pyrolysis is the degradation process that occurs when biomass is heated without oxygen present. The biomass is unable to conventionally burn and the high temperature results in the solid being converted into a combination of solid char, combustible gas and liquid (usually called pyrolysis oil or bio oil).

Pyrolysis technologies are generally categorised as “fast” or “slow” according to the time taken for processing the feedstock into pyrolysis products. Slow pyrolysis converts most of the wood into char and gas, with very little oil produced. In contrast, the yield of bio oil from fast pyrolysis can be 70% or more with char and gas making up the remaining products in roughly equal amounts.

Commercial status

There are currently no commercial scale slow pyrolysis facilities in operation for power generation anywhere in the world. Australian company Pacific Pyrolysis has built and operated a large demonstration facility in NSW, and in 2011 and 2012 it received offers from government for a total of $9 million representing approximately 50% of the capital cost to develop commercial scale plants in NSW and Victoria, however it is yet to finalise matching funds from private industry to allow the construction of these plants. Other Australian companies, such as Earthsystems and Crucible Carbon, have built and operated small scale prototype slow pyrolysis plants.

Conversely there is considerable activity worldwide on the commercialisation of fast pyrolysis. There are currently no commercial fast pyrolysis plants anywhere in the world operating solely for heat and power applications, despite active pre-commercial trials being underway in Australia and Europe. However, several companies in North America have built and operated commercial scale fast pyrolysis plants, some for a number of years. The bio oil produced from these plants has been used mainly for the manufacture of specialty chemicals for US markets, with subsequent use of the residual oil as boiler fuel.

A number of groups have demonstrated that it is feasible to use bio oil as fuel for stationary engines and also for turbines, both of which may be used for power generation. While this technological development is at a pre-commercial stage, such an approach to power generation enables bio oil in engines or turbines to work as a load-following or peaking source of renewable energy, which may match generation needs that cannot be met by base load power from a combustion plant.

Feedstock requirements

A wide range of biomass can be pyrolysed, including hardwood and softwood residues as well as agricultural residues. For fast pyrolysis, the particles must be small (2mm or less) to encourage rapid heat transfer. For slow pyrolysis a wider range of particle sizes can be used, depending on the characteristics of the pyrolyser.

A dry feedstock is preferred for fast pyrolysis in particular with the moisture content normally around 10% by weight.

Other issues

The environmental and social impacts resulting from a pyrolysis operation are similar to those outlined in Sections 3.5.1 and 3.5.2.

The market outlook for this industry is similar to that outlined in Section 3.5.1 on bioenergy through combustion processes. This is due to the majority of pyrolysis plants being at a pre-commercial stage with market demand uncertain.

3.5.4 Wood pellets

Wood pellets are short compressed cylinders of wood with a diameter of 6 - 8 mm that are primarily used as a convenient fuel for combustion in small and large scale bioenergy and co-generation plants.

Process overview

Wood pellets are generally produced from sawdust, shavings, chips or bark that are first dried then ground to small particles. The particles are pressed through a perforated matrix or die. Friction from the pressing process provides enough heat to soften the lignin in the biomass making it more pliable. During the subsequent cooling, the lignin stiffens and binds the material together. The manufacturing process typically increases the bulk density of the feedstock from 100 to 650 kg/m^3. The energy content of pellets is approximately 17.5 GJ/tonne with a moisture content of 8-10%.

Pellet specifications can vary by particle size, ash content and colour based on the intended end market.

Commercial status

Australia has a range of small scale and large scale pellet production facilities. Some of the most notable pellet producers include:

- Plantation Energy Australia built a 250,000 tonne pa pellet plant near Albany in Western Australia. This plant was built to export pellets to power companies in Europe, but ceased operations in early 2012, citing lack of suitably priced feedstock and the strong Australian dollar impacting on competitiveness;
- Pellet Heaters Australia (PHA) commenced operations in Woodburn, NSW in 2003 and manufacture pellets from softwoods for the domestic heating market and also as animal bedding and spill adsorbents. Their original plant produces around a 3,000 tonne/year;
- East Coast Wood Shavings in Gatton, Qld make pellets, mainly for animal bedding and litter markets using a similar pellet machine similar to PHA;
- Scottsdale Hop Growers in Scottsdale, Tasmania can produce up to 3,000 tonnes/year of pellets for animal bedding and domestic heating markets; and
- Pellet Fires Tasmania are constructing a new facility beside McKay Timber's sawmill in Glenorchy. The plant will use Tasmanian oak residues from the mill as feedstock, producing pellets for the local heating market.

In 2013 global wood pellet consumption was estimated to be over 24 million tonnes, with most pellet production occurring in Europe and North America. Most of this global production was supplied to energy producers in Europe where the European Union has a goal of sourcing 20% of the region's total energy needs from renewable sources by 2020. This is leading to a rapid expansion in pellet demand for heating as well as electricity generation.

Feedstock requirements

Wood pellet production can utilise softwood and hardwood feedstock. The feedstock needs to be of a small size with a residual moisture content of approximately 10%. Accordingly, stemwood requires the most processing into pellets. These steps include: debarking, chipping green (moist) wood, drying, dry grinding, pre-conditioning, pelletising, cooling, storing and loading for transport. Drying can often be the most expensive step in the process. For wet raw materials, drying is reported as accounting for some 29% of the cost of the pellets.

A wide variety of biomass can be pelletised at various scales of production. Wood pelletising technology is available for throughputs of as low as 200 kg per hour to large-scale plants of up to 40 tonnes per hour (i.e. from less than 2,000 tonnes to more than 300,000 tonnes per year).

Environmental and social impacts

Pellet use for large scale power generation in Europe or Asia is likely to have similar environmental effects as those previously noted. Any substitution of wood heaters by pellet heaters is expected to have a net positive impact on smoke, other particulate emissions, and greenhouse gases as pellets burn more efficiently than firewood.

Market outlook

There is potentially a small market for pellets in Tasmania, particularly where LPG or electrical heaters are currently used. Possible customers include:

- Individual homes for heating and hot water;
- Small industries, such as dairying operations, for hot water production; and
- Heating municipal facilities, such as halls, schools, hospitals, and swimming pools.

The approach to these markets is purely commercial and not associated with any government incentives. It is not expected that pellets will be able to compete commercially against firewood gathered by individuals or against natural gas. If major pellet facilities are built for the export market a portion of their output may be directed to Tasmanian customers. Alternatively, in the absence of any export pellet facilities, small scale pellet production in Tasmania is expected to come from the use of sawdust that is currently going to landfill, such as the operation currently being developed by Pellet Fires Tasmania in Glenorchy.

Global wood pellet demand is set to grow for at least the next five years with the European Union expected to remain the major market for pellets. Some analysts have suggested that the amount of biomass needed for heating, electrical production, and transportation fuels will translate into demand for wood pellets exceeding 28 million tonnes by 2020.

A number of large European power producers are in the process of converting, or have announced their intention to convert coal-fired powered stations to biomass wood pellets. Most conversions are being supported by long-term subsidies and will be reliant on pellet imports as a source of supply.

Closer to Australia there is potential for significant pellet use in South Korea and Japan. Both countries have traditionally used small quantities of pellets for domestic heating. However recent government initiatives to increase the production of renewable energy are expected to create a significant increase in pellet consumption, for co-firing in coal-fired power stations. Details of the outlook of both countries are summarised below:

- South Korea – the South Korean government has established a renewable portfolio standard to set increases in renewable energy each year, and feed in tariffs to provide increased revenues for eligible renewable energy. It is possible that pellet consumption in South Korea will grow to more than five million tonnes per year by 2020 under these programs; and
- Japan – there is an expectation that the Japanese market for pellets (or wood chips) will grow substantially over coming years, based on the renewable energy incentives put in place by the Japanese government in 2012. The Japanese Agency for Resources and Energy (METI) offers a feed in tariff of 24 or 32 yen/kWh after tax (equivalent to 25.3 or 32.7 cents/kWh) for electricity generated from woody biomass.

With South Korea and Japan having limited capacity to expand domestic pellet production, any major increase in demand is expected to be met by imports, which could come from Australia but also from existing pellet mills in Canada (particularly British Columbia), Russia, New Zealand or other Asian countries.

3.6 Biofuels

The following section outlines a range of biofuel products that have either current or growing future potential as end uses for wood residues generated by the Tasmanian forestry industry.

3.6.1 Ethanol

Ethanol is an alcohol that can be produced through the fermentation of starchy or woody feedstocks. Its main use is as a transportation fuel where it can be blended with petrol as a renewable fuel additive.

Process overview

A number of alternative process pathways are available to turn woody (or lignocellulosic) biomass into ethanol. However, they all have three main stages:

- Pre-treatment to prepare the biomass for further processing;
- Breakdown of biomass into components, via hydrolysis or gasification; and
- “Reformation” of those components into ethanol, via fermentation or catalytic synthesis.

Commercial status

A number of commercial-scale lignocellulosic ethanol plants are now operating or are under construction overseas (see Table 3-1). Each of these commercial-scale plants is the result of hundreds of millions of dollars of development work, including construction and operation of pilot plants and demonstration plants prior to commercial scale activity. In many cases there has been significant government financial support for these commercial prototypes.

The lessons learnt constructing these prototypes will enable the companies concerned to offer commercially demonstrated design packages to Australian licensees in the future, with considerably lower risk and thus greater chance of funding than other technologies still at a pilot or demonstration scale.

Table 3-1 Summary of global lignocellulosic ethanol production

COMPANY/ TECHNOLOGY	FEEDSTOCK	PLANT SIZE	LOCATION/STATUS
1. Abengoa	Corn stover and wheat straw	1,000 dry tonne per day feed to 95 ML/y plus 18 MW electricity[3]	USA - Under construction
2. Beta Renewables	Straw for first plant, also hardwood	50 ML/y plus electricity	Italy - Operational
3. COFCO	Straw	60 ML/y	China - Under construction
4. DuPont	Corn stover for first plant. Other feeds tested.	110 ML/y	USA - Under construction
5. Enerkem	Wood, municipal solid waste	100,000 dry tonne biomass/year for 40 ML/y ethanol	Canada - Under construction
6. Granbio	Sugar cane fibre (bagasse)	80 ML/y	Brazil - Under construction
7. Ineos Bio	Wood, municipal and agricultural wastes[4]	150,000 tonne/year feed. 30ML/y plus 6 MW electricity	USA - Operational
8. Poet	Corn stover	95 ML/y	USA - Under construction

Source: Industry sources

Feedstock requirements

The type of feedstock used in ethanol production is dependent on the production process used. Ethanol produced through gasification can accept a wider range of biomass feedstocks than hydrolysis-based production which is being commercialised overseas. Both processes could accept hardwood and softwood fibre. If commercialised to its full potential, ethanol production based on wood residues could consume a medium-large volume of supply from the Tasmanian forestry sector.

The US Government's National Renewable Energy Laboratory (NREL) examined the yield of ethanol from biomass and has also estimated the projected cost of a full scale commercial plant. In its May 2011 report it examined a plant designed to process some 700,000 dry tonnes per year of corn stover. If green wood at 50% moisture content is used as feedstock instead of corn stover this suggests a feedstock requirement of approximately 1.4 million tonnes per year. Ethanol yield is assumed to be 270 litres per dry tonne (79 US Gal/dry ton).

[3] http://hayandforage.com/marketing/cellulosic-ethanol-plants-near-start
[4] http://www.chemicals-technology.com/projects/ineosbioenergyfacili/

Environmental and social impacts

The main environmental impact of fermentation ethanol plants has traditionally been associated with the waste water created in the plant, known as dunder or vinasse. This water contains organic material and cannot be discharged into the environment without proper treatment or planning. Ideally the organic material would be recovered, for example to be used as a soil fertiliser, however in a number of cases the waste water is simply treated before being discharged.

Current commercial scale biofuels plants are highly automated with facilities estimated to require at least 30-50 direct full time jobs. In addition there would be an indirect labour requirement to maintain the facilities.

Market outlook

The international market for ethanol that is blended with petrol is around 100,000 megalitres (ML) per year. In such transport applications ethanol is generally used in blends of up to 10% in petrol, which is acceptable to most current motor vehicles. Ethanol can also be blended with diesel however such blends create safety and performance issues, and are not used in any significant volume internationally. The realistic maximum market for ethanol in Tasmania is thus 10% of the state’s petrol market or approximately 40 ML per year. This could only be achieved with 100% uptake of ethanol-petrol E10 blends across the state.

At present the Australian production capacity for ethanol is 440 ML/year. It would appear that the installed capacity is underutilised, with one plant shutting down for three weeks recently due to a lack of market demand. Australia’s petrol use is approximately 20,000 ML/year, so even though a 10% blend is acceptable in most motor vehicles, the actual use of ethanol in Australia is closer to just 2% of all petrol. Translating these national figures to potential market penetration in Tasmania suggests that the current market for ethanol in Tasmania is one fifth of 40 ML/year or just 8 ML/year. A plant producing 8 ML/year would likely require around 50,000 tonne/year of wood fibre, however a plant this size is unlikely to be commercially viable.

In addition, the blending and delivering of ethanol based petrol would require additional infrastructure expenditure beyond what currently exists.

3.6.2 Hydrocarbons (including renewable petrol and renewable diesel)

Hydrocarbon biofuels or “drop in” biofuels are effectively indistinguishable from petrol, diesel and jet fuel. They provide the opportunity to use new biofuels interchangeably with existing fuels derived from crude oil. This potentially avoids the requirements for storage, blending and separation of service station facilities that are associated with ethanol blends.

Process overview

There are a range of conversion processes that allow biomass to be processed into hydrocarbon biofuels. Some of the major processes include:

a) Fast pyrolysis followed by upgrading of the pyrolysis oil;

b) Gasification followed by Fischer Tropsch synthesis to hydrocarbons (plus power generation);

c) Gasification followed by catalysis focused on petrol; and

d) Supercritical water processing to make a crude oil, followed by processing in a conventional oil refinery.

The fast pyrolysis process is described in Section 3.5.3. The pyrolysis oil is not a hydrocarbon and is made up of a range of combustible chemicals and water. It can be upgraded to transport fuels, typically using a two stage process that first converts the pyrolysis oil to a hydrocarbon and then further upgrades the hydrocarbon to a mixture of petrol, jet fuel and diesel.

It is also feasible to make biofuels via the gasification of biomass into syngas, followed by a synthesis step known as the Fischer Tropsch (FT) process to create a mixed hydrocarbon liquid. The biofuels produced from gasification and FT synthesis are hydrocarbons and are compatible with existing fossil fuels and transport fuel infrastructure.

A second pathway involving syngas is known as the methanol to gasoline (MTG) process. This pathway uses different catalysts and process steps to the FT process. With the MTG process, syngas is first converted to methanol, which is then upgraded to gasoline.

Another approach to making hydrocarbon biofuels has been developed by Licella in Australia. The Licella technology uses supercritical water (water under intense heat and pressure) to break down the carbon-oxygen linkages in pulverised biomass. This process creates a biocrude oil that may then be transported to existing oil refineries; where it is intended to be blended with traditional crude oil and refined into a series of transport fuels.

Commercial status

Fast pyrolysis technology is already used commercially in a limited number of plants in North America, where Ensyn and Dynamotive have built pyrolysis plants to operate at rates ranging from 40 to 200 tonnes per day of feedstock (typically at 10% moisture content).

While biofuel applications may offer markets in the longer term, current commercial markets for the pyrolysis oil are primarily niche opportunities for speciality chemical production in North America. In contrast to the small-scale efforts of a number of research groups, both Ensyn and Dynamotive have routinely made commercial quantities of pyrolysis oil that is stable, suitable for transport and extended storage.

Pyrolysis oil must be upgraded to make transport fuels. One commercial scale upgrading plant has been built in the USA by KiOR, although this plant has recently shut down, citing technical delays and a resulting need for additional finance. Two other groups (Envergent, involving Ensyn and UOP, and Dynamotive/IFPEn) are currently upgrading their technology at a smaller scale. Envergent has received US government funding for a demonstration plant. Dynamotive first demonstrated the upgrading process at its Canadian laboratory and IFPEn is now developing and scaling the process at its facilities in Lyon, France where multiple pilot plants are available.

A commercial opportunity for fast pyrolysis and upgrading was examined in a recent Australian study, funded by Airbus and conducted by the CRC for Future Farm Industries. The study considered the use of Dynamotive/IFPEn technology in Western Australia to convert plantation mallee eucalypts into jet fuel for use by Virgin Australia. This feasibility work identified the large-scale, “triple bottom line” benefits (commercial, environmental, social) that could be achieved if wood to biofuel plants are built in rural locations. The study report also described the ongoing project development work to be undertaken if Australia seeks timely use of the various biofuel technologies that are now being commercialised overseas.

The FT process was developed by German scientists almost 100 years ago. It has already been used at commercial scale to make synthetic fuels. Large scale, coal-based FT plants have been operated by SASOL in South Africa for some fifty years and large scale plants using natural gas are now operational overseas. However no commercial FT plants are being operated that use biomass as a feedstock. The most advanced commercial project is the proposed Forest BTL plant at Ajos in Finland. This project is expected to use approximately one million tonnes of wood to produce 115,000 tonnes per year of biofuels. The contract for front end engineering was awarded mid-2013 and the plant itself could be built by 2016.

FT synthesis is also being developed at small scale, notably by UK company Velocys although, as above, there are no commercial projects expected to be operational for several years.

The MTG process has been demonstrated commercially in New Zealand where natural gas was used as feed in a plant built by Mobil. Biomass gasification followed by upgrading to transport fuels has recently been demonstrated in the USA. A demonstration plant processing approximately 20 tonne per day of feed has made gasoline at this facility in Illinois.

The Licella process to make biocrude oil has been successfully demonstrated in its three tonne per day pilot plant. The company has recently built a larger demonstration facility and, with federal government funding support, is now developing preliminary engineering and an investment case for a pre-commercial plant capable of making biocrude from processing 50,000 tonne per year of pulverised feed (measured on oven dry basis).

Feedstock requirements

All of the above processes are capable of accepting a range of biomass feedstock, including hardwoods and softwood biomass. If successfully commercialised, the potential scale of hydrocarbon production from biomass is very large with potential feedstock requirements of over one million tonnes per year.

Environmental and social impacts

The emissions from a hydrocarbon biofuel plant will depend in part on the technology selected. Typically some combustion takes place, with emissions and emission controls similar to other combustion plants. The fast pyrolysis plants that have already operated in North America have generally been located alongside existing sawmills and, in at least one case, adjacent to houses in a country town.

Market outlook

"Drop in" hydrocarbon biofuels are not expected to have the blending issues of ethanol and petrol, and should thus be capable of direct substitution for existing petrol and diesel in Tasmania. All of Tasmania's transport fuels are imported. From extrapolation of 2007 data and growth rates for fuel use it is estimated that current imports of petrol and diesel into Tasmania are approximately 800 million litres per year. A typical yield for a drop-in fuel is 300 litres per dry tonne of wood, suggesting that the maximum requirement for wood to make fuel for all of Tasmanian transport needs is 2.7 million dry tonnes per year (approximately 5 million green tonnes per year).

Based on the size of the Tasmanian market for petrol and diesel, all the available forest industry residues in Tasmania could be used to produce drop-in biofuels within the current market size.

3.6.3 Other fuels (including methanol and dimethyl ether)

By gasifying dry biomass, as described in Section 3.5.2, synthesis gas can be produced which allows the production of a range of other useful chemicals including methanol and dimethyl ether (DME).

Process overview

Methanol is routinely produced around the world, using natural gas or coal as the feedstock for the manufacture of syngas, which is then converted to methanol using suitable catalysts. By producing synthesis gas and following a similar catalysis process to that used for coal and natural gas, biomass based methanol can also be produced. In addition to methanol, DME can also be produced where an additional catalysing reaction is performed that converts methanol into DME.

Commercial status

There are no commercial scale biomass-to-methanol plants operating anywhere in the world. One commercial plant has been built in Canada and is expected to begin operation in 2014 or 2015, using methanol as an intermediate product for the final manufacture of ethanol and other chemicals. A large scale demonstration plant to make DME from black liquor has been built in Europe.

Feedstock requirements

Softwood or hardwood biomass could be gasified to create the syngas needed for methanol and DME manufacture. Due to the lack of any commercial scale biomass-to-methanol plants, feedstock demand is likely to be small, relative to other types of residues processing options.

Environmental and social impacts

Methanol and DME manufacture will have environmental emissions that are similar to the gasification bioenergy process outlined in Section 3.5.2. As noted, both chemicals are already routinely made in facilities around the world and have well established processes in place for managing emissions and production wastes.

Market outlook

Total worldwide methanol production is currently around 90,000 ML/year. Methanol is generally made from coal or natural gas and is the world's largest volume chemical commodity. It is used for a wide variety of applications, including as a base chemical for the production of DME. It is also the main chemical used to produce formaldehyde which is a key component in wood product resins.

Methanol has been used as a transport fuel in Europe, primarily as a small volume, blended additive in petrol. More recently methanol made from coal has been used in fuel blends in China. DME is currently being trialled as a fuel by Volvo in Europe and this has included DME produced from black liquor.

As noted previously, there is currently no commercial production of either methanol or DME from biomass. The only company with a commercial biomass to methanol plant under construction at present intends to convert the methanol to ethanol for use in the established ethanol/petrol fuel market in North America. Methanol and DME both require dedicated infrastructure for use as transport fuels.

Currently there is relatively limited potential for methanol or DME production from biomass in Tasmania, either for the transportation fuels market or for the industrial chemical market.

3.7 Other residue markets

3.7.1 Wood plastic composites

Wood plastic composites (WPCs) are materials made via the combination of wood fibre and plastics to produce a composite substitute for timber.

Process overview

WPCs typically combine wood fibre with polyethylene, polypropylene and polyvinyl chloride that is often obtained from recycled plastics. The mixture of wood and plastic is made into useful shapes via extrusion and injection moulding. The addition of wood fibre to plastic improves its mechanical strength. Typically ground wood is used as the fibre base, however some companies prefer to use sawdust or wood flour due to the importance of gaining complete resin mixing and the strength advantages the wood fibre base can provide.

Commercial status

The largest use for WPCs is the external decking market where WPCs are valued for their durability, consistency and low maintenance compared to natural timber products. Other uses include automotive interiors and outdoor fencing.

High quality WPCs can last in an external environment for approximately 30-50 years and offer strong durability attributes. However the nature of the blended wood and plastic means that recycling after the product's lifespan may be difficult.

In Australia there are several companies producing WPCs for building and industrial applications including ModWood, Advanced Plastic Recycling and Biowood. These companies use varying amount of wood fibre in their processes – typically up to 50% wood by weight depending on the end product.

Internationally the US and China are the largest manufacturers and users of WPCs however the market is still in a growth stage. The total global production of WPCs is expected to increase from 1.45 million tonnes pa in 2010 to 2.7 million tonne pa in 2015, largely via growth in production and use in China. The market in the North America and Europe is small by comparison, estimated to be around 30,000 tonnes in 2010 but is expected to grow to 55,000 tonnes by 2015.

Feedstock requirements

WPCs can potentially use a wide range of wood fibre substrates including virgin and recycled fibre. The attractiveness of using recycled fibre results from the potential for it to be marketed as a perceptibly more sustainable product.

In a product with a hypothetical 50:50 ratio of wood fibre to plastic, a typical new plant of around 50,000 tonnes pa may require dry wood fibre input of up to 20-25,000 tonnes of dry processed fibre. On a green basis this would indicatively equate to 50,000 tonnes pa.

Sawdust, wood flour or recycled building materials are the preferred source of fibre, limiting the potential for the use of forest residues as a feedstock.

Environmental and social impacts

Environmental emissions from the manufacture of WPCs are expected to be minimal as the processes involve the mixing and extrusion of wood particles and plastics that have already been manufactured. The plastics typically selected for WPCs are intended to minimise the level of VOCs produced in the mixing and extrusion process and this limits emissions from the production process.

Market outlook

There is limited information available on the size and level of growth of WPC demand in the Australian market. The emergence of several relatively large companies undertaking high profile marketing campaigns in recent years indicates that there may be some potential for growth in consumption of these products in the future. With the declining availability of durable hardwoods in Australia, there is likely to be growing interest in new, low cost products that can withstand outdoor conditions.

If WPCs can compete with treated softwood timber on cost and quality, and can overcome any negative perceptions related to its synthetic nature, there may be opportunities for market development in Australia. However at this stage the growth potential of WPCs remains relatively untested.

3.7.2 Charcoal

Process overview

The charcoal-making process involves heating wood to drive off moisture and volatile gases to concentrate the fixed carbon as the desirable component. This heating may occur:

- In the absence of air (pyrolysis);
- With air present but below the levels required for full combustion (gasification); or
- With excess air present but strictly controlled conditions to allow partial combustion.

Around the world, charcoal manufacturing ranges from simple pits in the ground or clay kilns used to make small quantities of cooking charcoal in batches, through to large, continuous industrial plants capable of producing thousands of tonnes of product each year with tight quality control and emissions management. Charcoal production from biomass in Australia is currently at a pre-commercial stage.

Commercial status – metallurgy

A wide variety of markets exists for charcoal, each with its own requirements for quality, quantity and price (which incorporates location due to the potentially significant cost associated with transporting charcoal). Key uses of wood based charcoal include the metal industries.

The metals industries are large users of carbon around the world. The iron and steel industries in Australia use large quantities of carbon, all of which is currently derived from coal and petroleum coke. The industry has investigated wood-based carbon for a number of years; however it has not yet made any commercial changes or commitments in this regard.

Apart from iron and steel, a number of non-ferrous metallurgical industries use large amounts of carbon. Aluminium and silicon are two major examples in Australia. Silicon metal production already uses wood based carbon extensively however this only occurs in Western Australia. A silicon smelter was proposed for Tasmania several years ago but did not progress beyond the initial feasibility stage. The aluminium industry uses carbon derived from fossil fuels and there are no known plans for this industry to move to a wood based source of carbon.

Commercial status – other uses

Charcoal is also commonly used for cooking and is generally sold in two forms:

- Briquettes – the majority are made and used in Australia for barbecues. Briquettes are mostly made using coal, with some wood included. The wood is typically surplus sawmill residues available close to the briquette manufacturer. While prices at retail outlets suggest high values for the char in these briquettes, most of the cost at the retail level is made up by packaging (which can cost as much as the briquettes themselves), transport and retail margins.
- Lump charcoal – lump charcoal is used in significantly smaller quantities than briquettes. It is typically made from hardwoods such as red gum by small producers in Victoria and South Australia, often on a part-time or seasonal basis.

There is considerable research interest in the addition of charcoal to soils to enhance the agricultural or horticultural attributes of the soil. This charcoal is commonly referred to as “biochar”. The benefits achieved from the application of biochar are influenced by:

- Nature of the feedstock – for example biochar made from chicken manure can be rich in useful nutrients;
- Production method – this can influence carbon content, porosity, particle size;
- The volume applied to the soil;
- The nature of the soil being treated; and
- The crop being grown.

In addition to the possibility of enhanced plant growth, placing charcoal in the soil offers a way to take carbon out of the atmosphere and sequester it. This reporesents one way charcoal can be used to reduce greenhouse gases in the atmosphere, the other being to simply use the charcoal (or the biomass that would have been be used to make the charcoal) instead of fossil fuels for heat or power production.

NSW DPI carried out wide ranging research to consider the benefits of biochar and determined that, in many applications, biochar enhances plant growth. However in some applications biochar has been found to offer no benefit or even adversely affect plant growth. As a result, placing a value on biochar for horticultural and agricultural applications can be a complex issue.

At present the commercial market for biochar is at a formative stage. In addition to commercial charcoal technologies used overseas, a number of Australian companies have developed processes for char manufacture. As noted in Section 3.5.3 Pacific Pyrolysis, is proposing to develop two commercial scale plants in NSW and Victoria. In addition to producing syngas, these plants would also create biochar. Matching funding from private investors is required for both plants and to date no funding announcements have been made. This situation highlights the uncertainty that currently surrounds biochar markets and related commercial investments.

Feedstock requirements

It is possible to make charcoal from a wide range of biomass types. Actual feedstock requirements vary depending on the manufacturing process and proposed use for the product. If the use was aimed at industrial scale ferrous or non-ferrous metallurgical plants, then production scale could be large, potentially requiring up to 500,000 tonnes per year of fibre input.

Environmental and social impacts

Emissions will vary with process technology, scale and whether charcoal is the only product or merely a co-product of another process (such as fast pyrolysis).

Market outlook

The market outlook for charcoal production appears limited at present due to:

- The lack of any steelmaking capacity in Tasmania;
- The absence of a large scale market for charcoal in Tasmania and limited sign of a new market developing;
- Minimal markets in the rest of Australia, apart from the use of charcoal for silicon smelting in Western Australia, which is met via charlock made at the smelter; and
- The only commercial initiatives for biochar in Australia have focused on either low value urban residues or nutrient-rich agricultural residues. Two proposed commercial biochar plants have failed to eventuate despite half of the capital cost being met by government.

Markets may develop in the future for charcoal use in steel manufacture at Wollongong and Whyalla. If that occurs, the position for Tasmanian charcoal will need to be assessed based on the specification, quantity required and competitive position of other possible sources of charcoal on the mainland.

3.7.3 Activated carbon

Process overview

Char, whether it is made from biomass or coal, is a highly porous material that can be used as a filter in many applications. Activated carbon is produced by further processing char to significantly increase its porosity and thus increase its capacity to act as a filter. This “activation” is generally carried out with steam; however acids are also used in certain applications. In general the yields of activated carbon are approximately half of the initial quantity of the char that is to be activated.

Commercial status

Activated carbon has many different applications. Some of the major end uses include:

- Water treatment, mainly for removal of contaminants from drinking water;
- Gold recovery, which is the major user of activated carbon in Australia. Most of the material used for gold recovery is coconut shell carbon sourced from SE Asia, as this carbon offers the required physical hardness at the most competitive price. Wood-based granular carbons do not provide sufficient hardness for this market; and
- The food, pharmaceutical and chemical industries use activated carbon in many applications; for example the brightening of beer is carried out using activated carbon.

CSIRO has demonstrated that high quality activated carbon can be made from eucalypt wood. Mallee eucalypts from Western Australia were used to make trial quantities of activated carbon that were shown to be of equivalent, if not better quality than commercially available material. The yield of activated carbon was approximately one tonne for every ten tonnes of fresh mallee eucalypt (at 40% moisture content). Yields from other eucalypts may vary, particularly with differing moisture contents in the fresh biomass and differing levels of fixed carbon.

Feedstock requirements

Commercial activated carbon is routinely made from coal, wood and coconut shell. Wood based activated carbon has been made from sawdust by US forestry company MeadWestvaco for more than 90 years. Its plant in Virginia, USA makes more than 26,000 tonnes of activated carbon each year. Activated carbon is also made from wood in France by Jacobi Carbons. In Australia activated carbon is made as a by-product of the mineral sands industry in Western Australia, which uses coal as the feedstock.

Feedstock consistency is important to achieve production consistency and it is likely that plantation eucalypts will provide a more uniform feedstock than mixed residues from native forests. A plant producing 5,000 tonnes/year of activated carbon would require approximately 50,000 green tonnes/year of a highly consistent fibre such as from a single species plantation.

Environmental and social impacts

Activated carbon has a similar production process to charcoal manufacture. As such the environmental and social impacts described in Section 3.7.2 are likely to be very similar.

Market outlook

Pricing for activated carbon varies with method of production and application. The total global market is many hundreds of thousands of tonnes per year, however it is comprised of many smaller market segments with specific price ranges and well defined product attributes. Thus it is possible to purchase activated carbon at under $1,000 per tonne for general water treatment applications or large scale gas cleaning. There are also multiple markets in Australia and overseas for activated carbon at several thousand dollars per tonne. However, some of these markets in Australia may be for less than fifty tonnes of carbon each year and that carbon will require quite specific attributes.

Within the global market for activated carbon there is a substantial segment for high value carbons that can be made from woody biomass. However, these markets are already well developed and there is no apparent market interest in producing this material in Tasmania.

3.8 Emerging technologies

3.8.1 Torrefaction

Torrefaction is a process by which woody biomass can be converted into torrefied wood which can act as a coal substitute.

Process overview

Torrefaction involves the thermochemical treatment of biomass at 200 - 300°C so its physical and chemical properties are closer to the properties of coal. The main objective is to use torrefied biomass as a fuel, especially as a pellet, so it has similar grinding properties and storability as coal. In this way it has the potential to replace large volumes of coal in existing power plants.

Commercial status

The incentive for torrefied pellets as opposed to wood pellets is based on increased targets for renewable energy in Europe and the blending limits for wood pellets in many existing coal-fired power stations. Large-scale coal fired power plants in Europe have increasingly been co-firing with wood pellets to increase the proportion of renewable energy and reduce GHG emissions, guided by local legislation and regulations. In most plants, pellets are mixed with coal and sent together through grinders. However, wood pellets have different properties than coal, and can only provide up to 5-10% of the total supply before they begin to gum up the grinders. In order to increase the proportion of biomass, these coal plants would have to invest considerable capital to upgrade their equipment. A possible alternative is to use torrefied wood, which has properties much more similar to coal, and can be used in coal-fired power plants without limitation.

Pilot and demonstration-scale plants are reported to be in operation in Europe and North America. However, in 2013 VTT reported that full commercial scale operations remain hampered by numerous technical constraints. Additionally, plans for the development of commercial plants by Magnolia, Keyflame and Topell Energy have been announced in recent years. However as at April 2014 none of these plants have been built, although a demonstration plant has been constructed by Topell in The Netherlands. In Quitman Mississippi, New Biomass Energy has constructed the largest torrefaction plant in the USA, with a current output of approximately 70,000 tonnes/year with plans to significantly increase output during 2014.

Other issues

A torrefaction plant would be expected to use softwood and hardwood feedstock at a similar scale to that described in Section 3.7.2 on charcoal production.

The environmental and social impacts of torrefaction would be expected to be similar to the pyrolysis process described in Section 3.5.3.

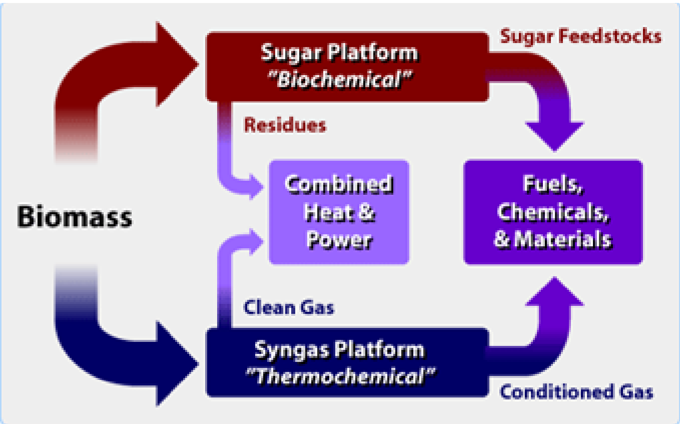
Like the market for charcoal outlined in Section 3.7.2, the market outlook for torrefied wood in Australia is uncertain at present due to: the uncertainty of demand; the cost competitiveness of torrefied charcoal with coal; and the changing policy environment. However, as a major user of coal for energy production, the development of a market for torrified pellets as a direct substitute for coal has some significant long-term potential for further development in Australia.

3.8.2 Biorefining

Process overview

Oil refineries use crude oil as the starting point for the manufacture of a range of materials, including plastics feedstock, fuels for motor vehicles, heavy fuels for heating and ships, and bitumen for road-making. In this way the productive use of the crude oil is maximised which enhances the commercial viability of the oil refinery. The concept for biorefineries is to use bio-based materials in a similar way, with multiple products produced to enhance the refinery's commercial viability. The National Renewable Energy Laboratory summarise the biorefinery concept in the schematic shown in Figure 3-15.

Figure 3-15 Biorefinery concept



Source: National Renewable Energy Laboratory

Commercial status

The Australian sugar industry already follows this model, making sugar, stockfeed, ethanol and electricity and is currently seeking additional uses for bagasse and other fibre residues. The sorghum to ethanol plant at Dalby in Queensland may also be considered as a biorefinery as it makes ethanol and a range of feed products.

Overseas, bioplastics are made commercially by two companies:

- Natureworks LLC operates a plant in Nebraska that uses sugars derived from corn to make poly lactic acid and other chemicals. First opened in 2002, this plant has been further developed over the past twelve years and a second plant in Thailand is now being considered; and
- DuPont operates a plant in Texas that uses sugars from corn to make propanediol, which is the starting point for a variety of renewable plastics and chemicals.

These two plants show that commercial production of renewable plastics is possible. However the fact the neither plant has been replicated suggests that limited markets for the products are a hurdle to industry growth. Both the above plants use sugar as the basis for fermentation to create their products. The sugar is derived from corn, in the same way that corn is used across much of the USA to provide sugar for ethanol fermentation.

The second main pathway for a biorefinery involves gasification followed by processing of the syngas to create value-added materials. When coal and natural gas are used to make syngas and then methanol, that methanol is the starting point for a wide range of industrial chemicals. Methanol produced from biomass gasification could also be used for chemical manufacture. It would not achieve the scale and cost efficiencies of a large methanol plant fuelled by natural gas, however it will offer a methanol stream that has a lower greenhouse gas footprint. A number of companies, such as Enerkem in Canada, are conducting research to develop chemical products from biomass-derived methanol or syngas. These technologies are still at a pre-commercial stage and it remains to be seen whether the cost premiums likely for the manufacture of such chemicals are matched by increased value in the marketplace.

Feedstock requirements

When processing technology is commercially available, and markets exist for the products, the biomass requirements will be similar to those for ethanol fermentation and drop-in hydrocarbons. If successfully developed at a commercial scale, the technology would be expected to use softwood and hardwood feedstock in substantial volumes.

Environmental and social impacts

The biorefinery model is a production model and in itself does not create any environmental or social impacts. The biorefinery would most likely be centred around either a pyrolysis or gasification process (see Sections 3.5.3 and 3.5.2) or a biofuel process (see Section 3.6.1), potentially with a number of secondary chemical processes. The impacts from these processes have been discussed in previous sections.

Market outlook

The following factors work against the biorefinery concept as a stand-alone opportunity for Tasmanian residues in the short to medium term:

- The markets for bioplastics and biochemical products is still small worldwide;
- The bioplastics market is not growing rapidly, as evidenced by the lack for replication of commercial plants built to date;
- The current preferred feedstock for a fermentation biorefinery is sugar, usually sourced from corn or sugarcane. Sugar sourced from woody biomass is more difficult to process due to the presence of lignin; and
- Biorefineries using gasification and syngas are still at a pre-commercial stage.

However if for example, hydrocarbon biofuel production became established in Tasmania, based on a strong local market for transport fuels, it is conceivable that co-products would be a logical progression for those biofuel plants, leading to the development of biorefineries as an extension to the fuel manufacturing process.

3.8.3 Nanotechnology

Process overview

The various forms of nanomaterials produced from cellulose are often collectively referred to as cellulosic nanomaterials or nanocellulose. The diameter of this material ranges from 5 - 100 nano metres. The extraction of cellulose nanofibrils (CNF) and cellulose nanocrystals (CNC) from plants (and also from bacteria and some animals) is the subject of worldwide research.

CNC is manufactured via acid hydrolysis of wood pulp. CNF can be made via a variety of mechanical and chemical/bio-mechanical pathways.

Commercial status

Nanocellulose technology has been around since the 1980’s but early commercialisation was unsuccessful due to the energy required to delaminate the wood fibres. Recently new technologies have emerged that significantly reduce this energy requirement. However, the development of nanocellulose technology remains at a pre-commercial stage. The world’s first pilot plant was built in Sweden in 2011 and the largest plant in the world appears to be the one tonne per day facility operated in Canada by Celluforce, which commenced operation in 2012 and was supported by more than $30 million in government funding. Nippon Paper is also actively researching CNF production through the establishment of a pre-commercial plant at one of its pulp mills in October 2013.

Feedstock requirements

The highest quality and strength nanomaterials are being produced exclusively from the cellulose component of wood. The quantities required for commercial scale nanocellulose production are not yet known but are most likely to be manufactured as an extension to the pulp production process, rather than by processing roundwood.

Environmental and social impacts

In the absence of any commercial technology or markets it is too early to make an assessment of these impacts. However, as with biorefining this technology is largely a secondary process and would most likely have limited environmental impacts.

Market outlook

Potential product applications for nanocellulose include its use as a reinforcing agent in composite materials due to its high strength properties and light weight. Other potential uses include coatings, films and as additives in foods pharmaceuticals and cosmetics.

At present nanocellulose is the subject of ongoing research and small scale production at large, well established forest products research facilities in North America, Japan and Europe. It is possible that the commercial development path will mirror that of bioplastics, with one or two international leaders in large scale use of cellulose committing to commercial scale plants overseas that are used to develop commercial markets for nanoproducts over five to ten years. These new production plants may be closely aligned with existing cellulose production facilities. It is therefore considered unlikely that any large scale opportunity for nanocellulose production in Tasmania will occur without the presence of a pulp mill to supply the feedstock.

4 ANALYSIS OF OPTIONS

Key messages:

Each of the 23 product options was assessed using an unweighted multi criteria analysis

The following product options showed the best results: plywood, glulam/CLT, stand-alone bioenergy, industrial cogeneration, hydrocarbon biofuels and torrefied wood pellets

Kraft pulp appears to be a potentially viable option, however, it is not recommended for further analysis, as there is a pulp mill proposal being sold on the open market. The outcome from the sale process will provide the best guide as to the viability of this option

Composite panel products did not score well due to the lack of commercialisation for the manufacture of hardwood panels and their inferior properties in end markets

Charcoal products as well as sulphite pulp and mechanical pulp also had negative assessments

URS applied a multi criteria analysis (MCA) methodology to assess the potential of each product option. The MCA provides a flexible methodology that allows for a meaningful comparison of quantitative and qualitative information. One of the main benefits of the MCA is it provides a standardised assessment that is transparent and simple to follow.

Following discussions with the Advisory Group, no weighting was applied to each of the key indicators used for the assessment. However, in considering the options that show the greatest promise for further analysis as part of Stage 2, issues such as technical and financial viability thresholds were considered.

4.1 Development of multi criteria analysis framework

The development of the MCA was primarily guided by the principles of the TFA. These guiding principles were refined to produce a series of Criteria and Indicators to be considered as part of the evaluation. The criteria used for the analysis and a brief description of the indicators used for the assessment are outlined in Table 4-1.

Table 4-1 Primary criteria and indicators used to assess residue processing options

EVALUATION PRINCIPLE	CRITERIA	INDICATORS
Impact on residue volumes (time periods 5,15 and 30 years)	Residue volume required and timescales: • Likely volumes • Potential timing of uptake • Utilisation rate	Total volume Location of supply Impact on overall supply
Technical feasibility	Status of manufacturing: • Current commercial use • Research and development phase • Requirements needed for commercialisation	Manufacturing process widely use Property right controls
Market potential	Market preparedness: • Product definitions • Price data Market dynamic: • Market size • Market evolutionary position • Status of competitor products	Established market offering History of prices Market size Market development phase Alternative suppliers
Economic viability	Business case viability: • Capital requirements • Direct economic impacts • Indirect economic impacts	Supply security Supply scale Supply cost/charge Financing needs Economic impacts
Social factors	Social factors: • Existing operations displaying community acceptance • Effects noted by stakeholders • Employment impact	Product certification status Social history of similar processes Estimated employment
Environmental sustainability	Environmental requirements: • Regulatory framework • Infrastructure needs • Supply attributes	State environmental approval requirements Beneficial supporting infrastructure Supply certainty
Financing requirements	Financial aspects: • Enterprise financing • Government financing	Capital required Inferred risk of investment Government supported financing (direct/indirect)
Feasibility timeframes	Feasibility assessment: • Timeframes • Approval requirements	Feasibility approval processes

4.2 Evaluation of residue processing options

The assessment for each criterion incorporates a 'score', in indicative terms, based on a scale from +2 to -2, reflecting whether an indicator is highly aligned (+2) or highly incompatible (-2). Positives and negative assessments are shown with (✓) and (✗) respectively. An indifferent assessment is indicated by (Neutral).

The indicators for each of the criteria were assessed and scored. These were added together to determine a summary score to be applied to the 5 year benchmark. Where the average score was marginal (i.e. either a ✓ or ✓✓) a subjective assessment was made to score something positively (round-up) or negatively (round-down).

The 5 year assessment was used as start point for the 15 year and 30 year assessments. Consideration was also given to the nature of the resource available over an extended timeframe and how this might affect each product option. The longer term assessment was generally only adjusted if there was considered to be a strong likelihood of a change to the status of the criteria over that period.

Table 4-2, Table 4-3 and Table 4-4 present the summary results for the 5 year, 15 year and 30 year assessments respectively. More detailed information on the underlying assessment of each product option is presented through the latter part of this section.

The overall result for each option is calculated as the sum of the scores for each of the eight criteria. As a consequence it can be positive or negative with a potential overall score range from – 16 to + 16.

Table 4-2 Summary of options for a 5 year timeframe

Option	Process description	Product	Residue required	Manufacturing status	Market potential	Economic viability	Financing requirements	Feasibility timeframes	Environmental sustainability	Social factors	5 year result
1a	Pulp	Kraft	✓✓	✓✓	✓	Neutral	✗	✗	✗	Neutral	2✓
1b		Sulphite	✓	✓✓	Neutral	✗	✗	✗	✗	Neutral	1✗
1c		Mechanical	✓	✓✓	Neutral	Neutral	✗✗	✗	✗	Neutral	1✗
2a	Composite panels	Particleboard	✓	✗	✗	✗	✗	✗	Neutral	✓	3✗
2b		MDF	✓	✗	✗	Neutral	Neutral	✗	✗	✓	2✗
2c		OSB	✓	✗	✗	✗	✗	✗	Neutral	✓	3✗
3	Sawn timber	Sawn timber	Neutral	✗	Neutral	Neutral	✗	Neutral	✓	✓	Neutral
4a	Engineered wood products	Plywood	Neutral	✓✓	✗	Neutral	Neutral	✓	Neutral	Neutral	2✓
4b		LVL	Neutral	✗	Neutral	Neutral	Neutral	✓	Neutral	Neutral	Neutral
4c		OSL	✓	✗	✗	✓	Neutral	Neutral	✓	Neutral	1✓
4d		Glulam/CLT	✗	Neutral	Neutral	Neutral	✓	✓	✓	✓	3✓
5a	Electricity	Stand-alone power	✓	✓✓	✓✓	✗	✗	Neutral	Neutral	✓	4✓
5b		Export pellet/chip	✓✓	✓✓	✗	✗	✗	Neutral	Neutral	✗	Neutral
6a	Cogeneration	Industrial	✗	✓✓	Neutral	✗	✓	Neutral	✓	✓	3✓
6b		Domestic/commercial	Neutral	✓✓	✗	✗✗	✓	Neutral	✓	✓	2✓
7a	Biofuels	Hydrocarbons	✓	✗	✓✓	Neutral	✗	✗	✗	✓	Neutral
7b		Ethanol	✓	✗	✗✗	Neutral	✗	✗	✗✗	✗	6✗
8a	Other	Wood Composites	Neutral	✓✓	✗✗	Neutral	Neutral	Neutral	Neutral	✓	1✓
8b		Charcoal	✗✗	Neutral	✗✗	Neutral	Neutral	✗	Neutral	Neutral	5✗
8c		Activated Carbon	✗	Neutral	✗	✗	✓	Neutral	Neutral	Neutral	2✗
9a	Emerging	Torrefaction	✗	Neutral	✗	✗	Neutral	Neutral	✓	✗	3✗
9b		Biorefining	Neutral	Neutral	Neutral	✗	✗	Neutral	✓	Neutral	1✗
9c		Nanotechnology	Neutral	Neutral	✗	✗	✗	Neutral	Neutral	Neutral	3✗

Table 4-3 Summary of options for 15 year timeframe

Option	Process description	Product	Residue required	Manufacturing status	Market potential	Economic viability	Financing requirements	Feasibility timeframes	Environmental sustainability	Social factors	15 year result
1a	Pulp	Kraft	✓✓	✓✓	✓	Neutral	✗	✗	✗	Neutral	2✓
1b		Sulphite	✓	✓✓	Neutral	✗	✗	✗	✗	Neutral	1✗
1c		Mechanical	✓	✓✓	✗	Neutral	✗✗	✗	✗	Neutral	2✗
2a	Composite panels	Particleboard	✓	✗	✗	✗	✗	✗	Neutral	✓	3✗
2b		MDF	✓	✗	✗	Neutral	Neutral	✗	✗	✓	2✗
2c		OSB	✓	✗	✗	✗	✗	✗	Neutral	✓	3✗
3	Sawn timber	Sawn timber	Neutral	✗	Neutral	Neutral	✗	Neutral	✓	✓	Neutral
4a	Engineered wood products	Plywood	✓	✓✓	✗	Neutral	Neutral	✓	✓	Neutral	4✓
4b		LVL	Neutral	✗	Neutral	Neutral	Neutral	✓	Neutral	Neutral	Neutral
4c		OSL	✓	✗	✗	✓	Neutral	Neutral	✓	Neutral	1✓
4d		Glulam/CLT	Neutral	Neutral	✓	Neutral	✓	✓	✓	✓	5✓
5a	Electricity	Stand-alone power	✓	✓✓	✓✓	✗	✗	Neutral	Neutral	✓	4✓
5b		Export pellet/chip	✓✓	✓✓	Neutral	✗	Neutral	Neutral	Neutral	✗	2✓
6a	Cogeneration	Industrial	Neutral	✓✓	Neutral	✗	✓	Neutral	✓	✓	4✓
6b		Domestic/commercial	Neutral	✓✓	✗	✗✗	✓	Neutral	✓	✓	2✓
7a	Biofuels	Hydrocarbons	✓✓	✓✓	✓✓	✓	Neutral	Neutral	Neutral	✓✓	9✓
7b		Ethanol	✓	✓✓	✗✗	Neutral	Neutral	Neutral	✗	Neutral	Neutral
8a	Other	Wood Composites	Neutral	✓✓	✗✗	Neutral	Neutral	Neutral	Neutral	✓	1✓
8b		Charcoal	Neutral	Neutral	Neutral	Neutral	Neutral	✗	Neutral	Neutral	1✗
8c		Activated Carbon	✗	Neutral	✗	✗	✓	Neutral	Neutral	Neutral	2✗
9a	Emerging	Torrefaction	✓	✓✓	✓	Neutral	✓	Neutral	✓	✗	5✓
9b		Biorefining	✓	✓✓	✓	Neutral	Neutral	Neutral	✓	Neutral	5✓
9c		Nanotechnology	Neutral	✓	Neutral	Neutral	✓	Neutral	Neutral	Neutral	2✓

Table 4-4 Summary of options for 30 year timeframe

Option	Process description	Product	Residue required	Manufacturing status	Market potential	Economic viability	Financing requirements	Feasibility timeframes	Environmental sustainability	Social factors	30 year result
1a	Pulp	Kraft	✓✓	✓✓	✓	Neutral	✗	✗	✗	Neutral	2✓
1b		Sulphite	✓	✓✓	Neutral	✗	✗	✗	✗	Neutral	1✗
1c		Mechanical	✓	✓✓	✗	Neutral	✗✗	✗	✗	Neutral	2✗
2a	Composite panels	Particleboard	✓	✗	✗	✗	✗	✗	Neutral	✓	3✗
2b		MDF	✓	✗	✗	Neutral	Neutral	✗	✗	✓	2✗
2c		OSB	✓	✗	✗	✗	✗	✗	Neutral	✓	3✗
3	Sawn timber	Sawn timber	Neutral	✗	Neutral	Neutral	✗	Neutral	✓	✓	Neutral
4a	Engineered wood products	Plywood	✓	✓✓	✗	Neutral	Neutral	✓	✓	Neutral	4✓
4b		LVL	Neutral	✗	Neutral	Neutral	Neutral	✓	Neutral	Neutral	Neutral
4c		OSL	✓	✗	✗	✓	Neutral	Neutral	✓	Neutral	1✓
4d		Glulam/CLT	Neutral	Neutral	✓	Neutral	✓	✓	✓	✓	5✓
5a	Electricity	Stand-alone power	✓	✓✓	✓✓	✗	✗	Neutral	Neutral	✓	4✓
5b		Export pellet/chip	✓✓	✓✓	✓	✗	✓	Neutral	Neutral	✗	4✓
6a	Cogeneration	Industrial	Neutral	✓✓	Neutral	✗	✓	Neutral	✓	✓	4✓
6b		Domestic/commercial	Neutral	✓✓	✗	✗✗	✓	Neutral	✓	✓	2✓
7a	Biofuels	Hydrocarbons	✓✓	✓✓	✓✓	✓	Neutral	Neutral	Neutral	✓✓	9✓
7b		Ethanol	✓	✓✓	✗✗	Neutral	Neutral	Neutral	✗	Neutral	Neutral
8a	Other	Wood Composites	Neutral	✓✓	✗✗	Neutral	Neutral	Neutral	Neutral	✓	1✓
8b		Charcoal	Neutral	Neutral	Neutral	Neutral	Neutral	✗	Neutral	Neutral	1✗
8c		Activated Carbon	✗	Neutral	✗	✗	✓	Neutral	Neutral	Neutral	2✗
9a	Emerging	Torrefaction	✓✓	✓✓	✓✓	Neutral	✓	Neutral	✓	✗	7✓
9b		Biorefining	✓	✓✓	✓✓	Neutral	Neutral	Neutral	✓	Neutral	6✓
9c		Nanotechnology	Neutral	✓✓	✓	Neutral	✓	Neutral	Neutral	Neutral	4✓

4.2.1 Pulp processing

The following assessments highlight key issues identified for the development of a pulp mill in Tasmania. The analysis considered kraft, sulphite or mechanical pulp markets.

Residue required	• Kraft mill would require 3-4 million gmt pa while sulphite and mechanical mills would require < 1 million gmt pa. • Sufficient volume available from around the state to meet fibre requirements. • Each pulping process is capable of utilising residues from all forest and processing types but preference would be for uniformity in feedstock with plantation hardwood and ash regrowth preferred for a kraft mill.
Manufacturing status	• Modern technology exists for each pulp product and is being deployed commercially in other countries. • Kraft production expanding with new mill technology. • Sulphite production largely brownfield conversion of existing pulp mills. Low profitability mechanical mills currently being closed or converted to other products. • Australian based expertise for pulp production is very limited. Requires lead proponent familiar in financing, construction and operation. • Permits are in place for construction of a kraft pulp mill in Tasmania.
Market potential	• All three pulp types are freely traded global commodity products that operate in mature markets. • Kraft pulp - largest growing market in China dominated by supply from Brazil, Indonesia and domestic pulp mills. Some potential for import replacement from Australia. • Sulphite pulp – recent expansion but key markets expected to remain is a state of oversupply for an extended period. • Mechanical pulp – experiencing structural decline in domestic and international markets with a decrease in demand for newsprint. • No existing supply chain into market pulp production from Australia. • Significant exposure to international export markets - USD prices, with most costs in AUD.
Economic viability	• Requires securing long term supply agreement with minimal volume and price uncertainty, with two or three major suppliers. • Significant economic impact for the state.
Financing requirements	• Investment in greenfield pulp plants currently occurring in Brazil, Chile, Indonesia and Vietnam. • Large capital requirement into long term illiquid assets. • Would benefit from major project government support level
Feasibility timeframes	• Major proponent feasibility studies required for financing, design completion, supply and sales agreements, commissioning.
Environmental sustainability	• Pulp mills have major environmental impacts. For the kraft option, these impacts have been assessed and reported. Additional assessments would be required for a sulphite and mechanical pulp mill but the impacts would be less than for a kraft mill.
Social factors	• Major greenfield development - significant new employer. • Would require significant investment in training and development to develop expertise to operate facility.

Summary of suitability for further analysis

A sulphite pulp mill and a mechanical pulp mill did not score as high as a kraft pulp mill in the MCA. Substantial new capacity has entered the dissolving pulp market which is currently in a state of oversupply. A greenfield development of a sulphite mill in Tasmania is unlikely to be as cost effective as a brownfield conversion of an existing pulp mill. Demand for mechanical pulp has declined in recent years and there is unlikely to be investor support for additional capacity from Tasmania which would need to be supplied to international markets.

There is currently potential for the construction of a new kraft mill in Tasmania as the permits for the mill are in place. The nature of the rights being offered would allow a proponent to commence construction immediately.

The process for the acquisition of the rights to the pulp mill have been made more complicated with the sale of Gunns plantation and chip processing assets. To establish an adequate long term supply, the operator of a pulp mill would have to enter into a long-term contract for the supply of plantation fibre. While long-term supply agreements are not uncommon in Australia a separation in ownership of the forests and pulp mill would mean pricing would be set on an export parity basis rather than through an internal transfer price mechanism. Pricing based on export parity would potentially introduce a degree of volatility to feedstock prices.

As the rights to the pulp mill are currently being offered to the market, URS does not propose including kraft pulp as part of the Stage 2 analysis. Vendor due diligence on the potential acquisition of the rights to construct the mill would be comprehensive with a sale reflecting the vendor's confidence in the viability of the project.

4.2.2 Composite panels

This section reviews the prospects for the development of a composite panel processing facility in Tasmania. The analysis considered the option of producing particleboard, MDF or OSB.

Residue required	• A new panel facility would require 100-500,000 gmt pa. • Sufficient volume is available from around the state to supply the required fibre requirements. • Softwood species are preferred as a feedstock for all panel products considered.
Manufacturing status	• There are few examples of panel products being produced from hardwood species. Some OSB is manufactured using low density hardwoods such as poplar and aspen. • The Starwood MDF facility at Georgetown originally used a combination of softwood and hardwood feedstock to produce MDF but switched to softwood only before closing in 2006. • Aside from this facility, production of panels using eucalypt species in Australia has only been completed at a research stage.
Market potential	• Market demand is static in Australia with multiple competitors using preferred softwood species. • Export markets are limited with China currently a net exporter of panels. Has the potential to become a net importer over time but international preference would be for softwood panels. • Limited existing market for OSB in Australia and no competitive advantage to producing it in Tasmania.
Economic viability	• Low capacity to pay for logs compared to alternative markets.
Financing requirements	• Range of risks – including technical risk, manufacturing risk and market risk
Feasibility timeframes	• Major proponent feasibility studies required to justify capital investment
Environmental sustainability	• Chemical use in the manufacturing process. Would require comprehensive approval process.
Social factors	• Globally accepted product. • Major greenfield development - significant new employer

Summary of suitability for further analysis

Panel products are not considered a potential prospect for utilising Tasmanian residues because:

- The manufacture of particle board and MDF in Australia is predominantly based on radiata pine as a feedstock. Research trials indicate that while various *Eucalyptus* species can be used to manufacture panel products, their performance is inferior to radiata pine; and
- A greenfields mill constructed in Tasmania would rely substantially on export markets, which also have a preference for softwood panels.

The best prospect would be for the utilisation of softwood residues sourced from plantations and softwood mills in northern Tasmania. Even if the preferred feedstock was available, it would be difficult to see any competitive advantage in establishing a new processing operation in Tasmania, compared to other plantation regions such as the Green Triangle (south west Victoria and south east South Australia) where there is currently a significant surplus of softwood residues and pulpwood available, and greater accessibility to domestic markets.

4.2.3 Sawn timber

Consideration of sawn timber as an option in the context of this study relates to the capacity to identify markets for logs not currently utilised by the processing sector.

Residue required	• A new sawmill would require 100-500,000 gmt pa if cutting mainly structural timber or 50-70,000 gmt pa if producing appearance grade timber. • Limited supply from native forests as logs to 20 cm small end diameter can already be supplied to Ta Ann as peeler billets. Any additional sawlog supply would be sourced from the hardwood plantation estate. • Issues such as end splitting, warping and checking during drying have been identified when processing hardwood plantation sawlogs but there are examples in Tasmania where these issues have been overcome.
Manufacturing status	• No sawmills in Australia currently specialise in processing small diameter hardwood plantation sawlogs. • However, processing of this material is possible and could be developed further.
Market potential	• Producing a standardised timber product that would need to compete in domestic timber markets. • Potential to be supplied as a feedstock for secondary processing to produce products such as glulam or CLT.
Economic viability	• Would need to compete and displace native timber (appearance) and radiata pine (structural) in end markets.
Financing requirements	• Would require significant investment as existing hardwood sawmilling technology not suited to high production volumes.
Feasibility timeframes	• Major proponent feasibility studies required to justify capital investment
Environmental sustainability	• Few adverse environmental impacts
Social factors	• Hardwoods already widely used in domestic building and renovation markets. • Greenfield development – would generate new employment compared to woodchip exports

Summary of suitability for further analysis

The production of sawn timber from residues is a low priority option. One potential pathway to market would be to integrate a sawmilling operation with secondary value-adding operations such as a glulam line and/or a CLT plant, if these markets were to be developed further in Australia.

4.2.4 *Engineered wood products*

EWP's comprise a range of potential product options. The MCA assessment included plywood, LVL, OSL as well as secondary wood products such as glulam and CLT. The assessment of LVL includes Hardlam.

Residue required	• Plywood and LVL require logs within a tight specification compared to LSL which can utilise all types of pulpwood residues. Glulam and CLT could utilise offcuts and short length timber from sawmills. • Each option except for LSL would only utilise a relatively small volume of residues compared to other options considered. LSL would require feedstock levels similar to panel products. • Tasmania's native forest species are well suited to EWP manufacture. Trials indicate logs from older hardwood plantations > age 20 years are more suited to peeling than younger plantations. As the long rotation plantation hardwood estate in Tasmania matures, log quality from plantations should improve. CLT is currently only manufactured using softwood species.
Manufacturing status	• Plywood technology is well developed with significant processing capacity already in Tasmania. Glulam is also manufactured in Australia using ash species comparable to Tasmania. • Conversely commercialisation of LVL products for appearance markets has not been confirmed. • OSL and CLT are manufactured overseas, albeit using predominantly softwood species.
Market potential	• All of the EWP's except CLT and Hardlam have established markets. CLT is in an emergent phase with production capacity expanding internationally. The use of LVL for appearance markets is a new innovation. • Australia is a net importer of plywood and LVL and supply from Tasmania could potentially displace this material. However, in structural applications there would be intense completion from other domestic and international suppliers. Competition for Hardlam would be from timber and engineered flooring as well a solid hardwood timber (rough sawn and recycled) and glulam in heavy structural applications. • Supply from each product option would need to access markets outside of Tasmania with the domestic construction market the most prospective market segment. LSL would have the greatest difficulty in penetrating the market as it is does not have an established market presence. • Hardlam is an innovative product with some unique characteristics compared to softwood LVL. The key difference is Hardlam's suitability for appearance purposes. This means Hardlam can be used for a broader range of products including flooring and exposed beams. As such it may be able to capture a strong market niche.
Economic viability	• Relatively small production volumes mean there should be ready access to range of customers. • Small scale plant will have high local but limited state-wide economic impacts.
Financing requirements	• Plywood, Hardlam, glulam and CLT would require relatively low capital costs compared to greenfield investment in LSL or large scale LVL facility. • Processes for making CLT, LVL,OSL etc are not well developed for hardwoods, and this would increase financial risk for investors. • These products have relatively small, niche markets (at least in the short-term), and that the small value of these markets means that it is difficult for an investor to invest in manufacturing these products. Plywood is the exception as it is a commodity product with well understood markets. • The development of new products would benefit from government support during the commercialisation process.
Feasibility timeframes	• With the exception of LSL, the feasibility studies would not need to be excessively complex. For LSL a more in-depth feasibility assessment is required to confirm its capacity to compete with existing products.
Environmental sustainability	• All EWP's require some chemical use in their manufacture. However, their small scale would limit the extent of any environmental impacts.
Social factors	• EWP's are used globally and are readily accepted in construction markets, provided they meet local regulatory and environmental standards. • Limited new employment opportunities.

Summary of suitability for further analysis – plywood and LVL

The MCA suggests plywood has the greatest potential to add value to wood residues. Positives for the development of a plywood facility include:

- The presence of an existing manufacturer in Tasmania who is familiar with handling the product and understands the plywood supply chain internationally and within Australia;
- Increased availability of hardwood plantation logs over time. The presence of a plywood market would allow logs that are not suitable as sawlogs to be peeled, improving overall value recovery from the plantations; and
- Development of a plywood mill in Tasmania would have a low environmental impact as much of the required infrastructure is already in place. The end product, which would utilize regrowth logs, would also have the capacity to displace imported plywood made from tropical hardwoods.

Downsides to this option were mainly market related as production from Tasmania would have to compete with suppliers from the Australian mainland or imports. The market for hardwood plywood in Australia is relatively small and specialised.

The LVL assessment did not score as well as plywood because:

- A large scale hardwood LVL product in Tasmania is unlikely to be able to compete directly with softwood LVL which is currently being imported into mainland structural markets;
- While the development of a LVL product for appearance markets is innovative, market acceptance of Hardlam is not yet proven; and
- The manufacturing process for Hardlam is still at a pre-commercial phase.

Despite this, Hardlam shows promise and has the potential to expand its product range beyond the domestic market. It also allows a relatively low value log to be manufactured into a range of high value products.

Both products show enough potential to be considered for further analysis, with Hardlam occupying a market niche. While not likely to utilise significant additional residue volumes, these products have the potential to expand Tasmania's manufacturing base compared to undifferentiated woodchip exports. The scale of operations could also potentially be expanded through the development of secondary wood products which are discussed below.

Summary of suitability for further analysis– Glulam and CLT

Both Glulam and CLT have the potential to expand the Australian timber industry into areas not previously considered. They represent the new approach to manufacturing where it is necessary to do more with less and to minimise on-site labour and construction times. As urban living intensifies, it is these products that will allow timber to compete in multi-storey developments (as shown by the use of CLT for construction of the 10 storey Forte building in Melbourne).

Factors in favour of this option include:

- A low capital cost relative to other options;
- An expected increase in demand as construction methods using these materials becomes more common. In some countries this is being promoted through government policies specifying timber construction. Demand could also arise due to savings in construction time, and in consumer preferencing in the feel of timber buildings;

- The low environmental impact associated with the manufacturing process and its capacity to displace carbon intensive products such as concrete and steel; and
- Its acceptance as a building product in the market as evidenced by the expansion in production capacity in Australia (Glulam) and North America and New Zealand (CLT).

Downside impacts include: the relatively small volumes that would be involved, the current limited commercial application of these products and the financial viability of the product over the long-term.

The potential of these products is limited in the short-term as the market is in the early stages of development. However, sufficient growth has occurred to consider these products as having upside potential over a 15-30 year timeframe.

4.2.5 Bioenergy (heat and power)

Bioenergy includes heat and power, with end markets either in Tasmania or overseas. The two main categories considered are: electricity generation in Tasmania and the export of pellets/woodchips or torrefied wood for power generation overseas.

Residue required	• Biomass for domestic electricity has the potential to utilise significant residue volumes but will depend on the scale of any bioenergy development. Demand highly localised with limited options across the state. • Woodchip or pellet exports for bioenergy will require production of at least 250,000 tonnes per year to provide the scale required for bulk shipping. • Able to utilise a wide range of forest and processing residues but export options will have tighter specifications with respect to the presence of bark and other impurities and ash content.
Manufacturing status	• Bioenergy and pellet processing technologies are well developed with multiple off the shelf solutions available depending on requirements.
Market potential	• All domestic bioenergy is produced and consumed within Tasmania. • Conversely large scale pellet or woodchip production would supply international markets with significant trade exposure. • Domestic electricity demand in Tasmania is relatively static, whereas international demand for bioenergy is increasing as governments adopt pro-biomass policies to reduce carbon emissions. • Both domestic (hydro, natural gas, LPG, coal) and export (Asia, Russia, Canada and USA) based bioenergy have a number of strong competitors.
Economic viability	• Bioenergy may be viable where avoided capital expenditure on grid can be used to reduce capital cost for electricity plant. Larger plants generally more economically viable. • Tasmanian residues must be competitive against pellets or chips supplied to Asian or European markets. Port access is also vital as is whole ship transport. • Both products highly sensitive to movements in feedstock costs.
Financing requirements	• Relatively low capital costs compared to greenfield investment in large scale wood products manufacturing facility.
Feasibility timeframes	• Both options have a relatively transparent supply chain. Domestic option would require close liaison with transmission companies to identify bottlenecks and locations requiring a network upgrade.
Environmental sustainability	• Bioenergy accepted as a renewable energy source globally with most governments providing favourable policy settings to promote increased use.
Social factors	• Negative perception in Australia around the use of native forest residues for energy production. Regulations currently restrict its use for this purpose. • Limited new employment opportunities.

Summary of suitability for further analysis

Biomass power generation uses mature technology and is widely practised in most parts of the world. Its use in Australia is minimal however due to the low cost of alternative sources of electricity (particularly coal) and the lack of financial incentives for renewable electricity created from forest based biomass.

Stand-alone biomass power in Tasmania is currently uneconomic; however there may be an opportunity for commercially viable power generation in specific circumstances such as if it can be used to avoid upgrades to transmission infrastructure and the funds for those upgrades can instead be directed to biomass power plants.

Modelling of demand growth on the transmission system by Transend identified the following potential emerging transmission constraints:

- Load reduction of 22 MW required between Queenstown and Newton;
- Load reduction of 10 MW required in the Palmerston area; and
- Load reduction of 2 MW to stabilize voltage in southern Tasmania.

While alternative options to these emerging limitations may be preferable, there is the potential to provide a bioenergy based solution to these issues.

The export of wood pellets could be a major potential use for Tasmanian residues. While local markets are small, the global market for wood pellets is already large and is growing rapidly, based entirely on government mandates for renewable power generation. South Korea and Japan are emerging as potential large future markets in the Asia Pacific region.

The world pellet market is currently met almost completely by producers in Europe and North America. These pellet producers have access to a large volume of low value processing residues. Tasmania’s current competitive position is considered to be weak due to the cost of its own residues and its location relative to the European market. This may change in future if the demand for biomass co-firing moves beyond the available supply of low value residues overseas and demand from Asian markets increases. As these markets become established and suppliers secure long-term agreements, the inferred level of risk should decline over time, thereby improving the outlook for this market over time. This option is considered a medium to long-term opportunity but is not recommended as a priority for inclusion in the Stage 2 analysis.

The potential for stand-alone power provides a strong prospect to increase residue utilization within Tasmania while at the same time potentially improving the reliability of Tasmania’s electricity network. Therefore, this option is recommended for further analysis.

4.2.6 *Cogeneration*

Cogeneration options are considered at two levels: industrial heat and electricity; and commercial heating for schools, hospitals and municipal buildings.

Residue required	• Commercial heating likely to have requirement of <100,000 tonnes per year. Industrial cogen potentially marginally larger but will depend on number of heat and power plants that may be required. • Proximity of end markets to biomass sources will strongly influence viability of cogeneration. • Able to utilise a wide range of forest and processing residues.
Manufacturing status	• Technologies are well developed with multiple off the shelf solutions available depending on requirements.
Market potential	• All cogen outputs produced and consumed within Tasmania. • Potential market small with static demand. • Strong competition with alternative options for power and heat based on hydro, natural gas, LPG or coal readily available.
Economic viability	• Viability highly sensitive to movements in feedstock cost. • Little economic impact as cogen an extension of existing infrastructure.
Financing requirements	• Relatively low capital costs compared to greenfield investment in large scale wood products manufacturing facility. • Investment should improve bottom line through a reduction in the cost of heat and/or power.
Feasibility timeframes	• Assessment of options by proponents should be relatively uncomplicated.
Environmental sustainability	• Bioenergy accepted as a renewable energy source globally with most governments providing favourable policy settings to promote increased use.
Social factors	• Negative perception in Australia around the use of native forest residues for energy production. Regulations currently restrict its use for this purpose. • Limited new employment opportunities.

Summary of suitability for further analysis

Cogeneration potentially offers better commercial viability than stand-alone power because revenues can be derived from both heat and power. Individual opportunities need to be assessed to determine whether a biomass cogeneration system will be more cost-effective than current sources of energy, which include coal, gas, LPG and electricity. This was identified as a key barrier to investment during the consultation process. Potential opportunities include: large industrial sites, or smaller sites such as dairy farms and municipal buildings.

Of the options assessed, industrial cogeneration provides the greatest scope for consideration in the Stage 2 analysis. These opportunities will be localised and need to be assessed on a case by case basis.

4.2.7 Biofuels

This analysis considers the potential of biofuels as a transport fuel. There are two potential pathways to this market: bending biofuels with existing fossil fuels or production of hydrocarbons that are interchangeable with petrol and diesel made from crude oil.

Residue required	• Ethanol production would require a limited volume of residues. • Hydrocarbon production would utilise a significant volume of residues, potentially in excess of one million tonnes with capacity to utilise all residues available in the state. • Both processes are able to utilise a wide range of forest and processing residues.
Manufacturing status	• Multiple commercial scale ethanol plants being constructed internationally. Pilot scale technology available in Australia. • Hydrocarbon biofuel technology currently being commercialised internationally and expected to expand significantly over the next decade. No Australian based production.
Market potential	• Ethanol market in Tasmania and Australia constrained by blending limits. • Surplus production would have to be exported and compete in international markets. • With no compatibility issues biofuel hydrocarbons have access to the entire liquid fuels market. • All biofuel hydrocarbons produced could potentially be consumed within Tasmania. • Fossil fuel producers would set price benchmark for biofuel hydrocarbons.
Economic viability	• Viability of ethanol production is highly sensitive to movements in feedstock cost. • Biofuel hydrocarbons currently going through a commercialisation process so returns uncertain. Viability expected to improve over time with a decrease in production costs as more plants are constructed. • Expansion of carbon markets and capacity to offset fossil fuels may improve viability over time. • Little economic impact with ethanol, but significant potential economic impacts associated with large scale hydrocarbon production.
Financing requirements	• Both biofuel types would require significant capital investment with an elevated level of risk associated with new technology. • Production viability of ethanol in Australia currently relies on government excise rebate. Biofuel hydrocarbons may initially require similar treatment.
Feasibility timeframes	• For products relying on large scale production require major proponent feasibility studies covering financing, design completion, supply and sales agreements, commissioning. • Hydrocarbon able to utilise existing fuel supply chain infrastructure.
Environmental sustainability	• Minimal emissions during production and recognised as a renewable fuel.
Social factors	• Should be received positively through displacement of non-renewable fossil fuels. • Capacity to generate significant new employment opportunities.

The Tasmanian market for transport fuels is currently estimated at 800 million litres per year. Petrol and diesel each account for around 50% of total demand.

With high profit margins for biofuels extremely unlikely, use in Tasmania as a substitute for imported fuels was seen as a more attractive option than seeking to export from Tasmania to compete on the mainland or in international markets.

The Tasmanian market for ethanol is very limited. An E10 blend for all of Tasmania would provide a maximum domestic market for some 40 million litres/year of ethanol. However the current market penetration for ethanol on the mainland is only a small fraction of total consumption, indicating that a realistic ethanol market in Tasmania is less than 10 million litres per year, which is too small for even a single commercial plant. This is consistent with the findings from other studies on the potential for ethanol production in Tasmania. Therefore this option is not considered a priority for Stage 2.

Compared with ethanol, the relative benefit of “drop in” hydrocarbon biofuels comes from their ability to be used seamlessly alongside or instead of petrol and diesel. By manufacturing to accepted petrol and diesel specifications, and avoiding the requirement for blending, hydrocarbon biofuels are potentially able to access the entire Tasmanian market for transport fuels.

This would create a long term opportunity to use all of Tasmania’s residues to manufacture renewable fuel for local consumption in an established and relatively stable market. This opportunity is reflected by the highest MCA score for any option over the medium or long-term. While such plants cannot be built immediately, this option represents a major opportunity for Tasmania in the future and further assessment is warranted.

4.2.8 Other residue markets

This section provides an evaluation of alternative product options for the use of residues outside of the key themes already assessed.

Wood Plastics Composites

WPC’s have been around for a number of years. The assessment considers their potential for use as an outdoor domestic construction material, primarily for outdoor decking, railing and window/door frames.

Residue required	• Potentially up to 50,000 green tonnes of fibre with preference for processing residues. • Feedstock consistency required
Manufacturing status	• Technology well known and understood.
Market potential	• Very small market for the SE Asia region. Larger markets in USA and China with Chinese market growing rapidly. • Likely growing demand in Australia but from small base as this is a new product to the market. • Extent of demand potential in Australia is uncertain as it must compete with low cost treated softwood products.
Economic viability	• No obvious competitive advantage in Tasmania particularly against recycled fibre.
Financing requirements	• Risk relatively high as product to be sold both on mainland and internationally given current Australian production capacity.
Feasibility timeframes	• Potentially low-medium capital requirements for establishment.
Environmental sustainability	• No particular difficulties expected.
Social factors	• No particular strengths or weaknesses. • Small industry making relatively innocuous product and with minimal employment opportunities.

The MCA assessment suggests WPC’s provide limited opportunities for expanding residue utilisation in Tasmania.

Charcoal and biochar

Charcoal can potentially be used for metallurgy or as a soil additive.

Residue required	• Potential requirement for up to several hundred thousand tonnes/year. • Depending on product market a range of forest and processing residues can be used.
Manufacturing status	• Large scale commercial technology available from overseas suppliers. Pre-commercial small scale technology being developed in Australia.
Market potential	• Markets do not currently exist. For metallurgical charcoal - a customer is required, such as a silicon smelter in Tasmania. No such use anticipated in near term. • For biochar - no significant market exists. In the absence of extra research focussed on specific Tasmanian applications and a specific carbon mitigation rebate for this material, it is difficult to see any significant market emerging. • Steel industry in NSW and SA may use charcoal in future if carbon pricing re-introduced.
Economic viability	• Low bulk density makes transportation costly. Difficult product to handle. • Potential for significant losses through handling and transportation.
Financing requirements	• Deployment of new technology will require additional consideration of technical and market risk.
Feasibility timeframes	• For large scale plant attention would be needed to demonstrate EPA compliance.
Environmental sustainability	• Like renewable energy, charcoal allows reduced use of fossil fuels and so mitigates carbon dioxide emissions.
Social factors	• Care needed with community consultation as large scale plant may be perceived as a dirty industry even though EPA requirements can be met. • Not likely to be a major employer.

While charcoal can be made from wood residues using a variety of technologies there are no current markets for charcoal in Tasmania and it is not cost effective to transport due to its low bulk density and handling difficulty. The Tasmanian market could change if a major user such as a silicon smelter is built; but there appear to be no plans for such a project at this point in time. Therefore this option is considered a low priority for further assessment.

Activated carbon

Charcoal can be further processed to, increase its porosity and make activated carbon (AC).

Residue required	• Commercial scale AC plant could use at least 100,000 gmt/year of feedstock • Preference is for consistent physical characteristics so best suited to plantation hardwoods. • Work by CSIRO has shown that good AC can be made from eucalypts, but Tasmanian species would need specific testing.
Manufacturing status	• Technology well understood but tends to be proprietary to companies currently making this material. Independent technology is limited
Market potential	• Market preference for existing products such as AC from coconut husk. • Market potential is unclear and will depend on quality and cost. If these are met the market could possibly start at 5,000 tonnes/year and growing to 20,000 tonnes/year over 10-20 years. • Domestic most likely to be Australian mainland or international.
Economic viability	• Cost of feedstock will be major barrier when compared with competing low cost wood processing residues available in the USA • Limited economic benefits.
Financing requirements	• Feasibility would require key supplier to partner with and provide expertise.
Feasibility timeframes	• Would need to start with manufacturing trials and product testing before proceeding to a conventional plant feasibility assessment.
Environmental sustainability	• Minimal emissions.
Social factors	• Value adding process should be readily accepted. • Not likely to be major employer.

There are a number of barriers to the development of an AC plant in Tasmania including: a need to test initial product feasibility; access to technology and marketing networks and an understanding of the cost to develop AC from Tasmanian residues. As there is no clear advantage to produce this material in Tasmania, this option is considered a low priority.

4.2.9 Emerging technologies

This section considers product options that are still largely in a development or pre-commercial stage. These options may present longer term opportunities for processing Tasmanian residues.

Torrefaction

Torrefaction involves heating of organic material to remove water, tar and volatile gas compounds. Once torrefied the wood is ground and pelletised.

Residue required	• Potential to use a significant volume of residues (> 1 million gmt pa), if an international market grows and Tasmania can offer competitive products to these markets • Depending on the technology, a range of processing and forest residues may be suitable. Preference for lowest cost residues so very complimentary to processing residues.
Manufacturing status	• Technology developed by several international groups but is quite new and is still pre-commercial.
Market potential	• Long-term potential considerable as torrefied wood can be used as a direct substitute for coal without the requirement for extensive modifications to existing facilities. • Coal the predominant energy source in Australia, but not Tasmania. Markets from Tasmania would be on the mainland or international, most likely Asia (Japan and South Korea). • Market still in the early stages of development and use of product and market acceptance not widespread.
Economic viability	• Competitive position against pellets is not clear yet. • Likely to be highly sensitive to delivered feedstock costs.
Financing requirements	• Initial risk relatively high given early stage of technology. Significant risk reduction expected over next few years as technology and markets develop.
Feasibility timeframes	• Relatively simple process with well-utilised supply chain. • If implementing on a major scale then - major proponent feasibility studies required for financing, design completion, supply and sales agreements, commissioning
Environmental sustainability	• Relatively low impact manufacturing process. Little waste product produced.
Social factors	• Potential to provide localised but limited employment.

Torrefaction has a number of advantages over wood pellets for energy production including:

- A higher calorific value;
- Better performance when co-fired with coal with no upper threshold to use. In contrast wood pellets have an upper limit beyond which resin and ash build-up become an issue; and
- Torrefied pellets are able to be stored outdoors. However US company Zilkha Biomass Energy has announced it can produce a formulation that allows conventional wood pellets to be stored outdoors without torrefaction.

At present all major industrial markets use wood pellets for co-firing in coal-fired power stations. If demand increases to the point that pellets are not easily used within existing power plant infrastructure, a parallel market for torrefied wood may develop. Given the global level of reliance on coal for energy production, substitution using torrefied pellets represents a significant opportunity. The capacity of these plants to switch to an alternative feedstock will be determined largely by prevailing government policy.

This option represents a promising long-term prospect and is worthy of further analysis to consider how this market may potentially develop.

Biorefining

Biorefining involves the production of a range of chemical products using a biomass feedstock.

Residue required	• Depending on technology a range of residues can be used, with potential to use several hundred thousand tonnes/yr in each region once markets develop.
Manufacturing status	• Technology is new and is only available at pre or early commercial stage from overseas companies. • Expected to develop and become widespread over time.
Market potential	• Current markets very small globally with demand met by products derived from other feedstocks, such as corn. • Potential market and competitive position for Tasmania is unclear.
Economic viability	• Not currently viable using woody biomass. • May be developed as value-adding addition to hydrocarbon biofuel facility that would provide useful infrastructure.
Financing requirements	• Initial risk relatively high given early stage of technology. Significant risk reduction expected over next few years as technology and markets develop.
Feasibility timeframes	• Major proponent feasibility studies required for financing, design completion, supply and sales agreements, commissioning.
Environmental sustainability	• Likely to have minimal emissions.
Social factors	• Potential to provide localised but limited employment.

The most prospective pathway to the development of a biorefinery in Tasmania would be to develop it as an extension to a biofuels facility over the long term rather than as a stand-alone commercial plant in the short-term.

Nanotechnology

Nanocellulose fibres are lightweight, have very high strength and low thermal expansion properties. The potential for this technology is the development of new, high value materials.

Residue required	• Likely to be small user to add value to cellulosic material created by another process • Feedstock most likely be from wood pulp rather than woody residues.
Manufacturing status	• Technology is at a research stage with early pre-commercial development occurring. • Alternative methods of manufacturing nano-particles also being considered (e.g. algae)
Market potential	• Still in development but could be used as an additive to improve strength properties of materials. • Also highly absorbent and could be incorporated into products requiring this characteristic. • High risk of alternative breakthrough technology that supersedes cellulose based production.
Economic viability	• To be competitive, process would need Tasmanian based cellulose production (e.g. sulphite pulping process) as a feedstock. • No current commercially viable production, although this is expected to develop over time.
Financing requirements	• Speculative investment given technology still largely at a research stage.
Feasibility timeframes	• Not clear at this stage. Will depend on market development and complexity of the manufacturing process.
Environmental sustainability	• Produced in relatively small quantities limiting environmental impacts • No evidence of toxicity due to exposure to fine particles.
Social factors	• Potential to provide localised but limited employment.

This emerging technology is expected to take some years to reach its initial commercial status and is then most likely to be associated with major research and industrial groups overseas.

4.3 Summary of findings

Table 4-1 presents the relative score from the MCA assessment over a 5, 15 and 30 year timeframe and the typical feedstock requirement that could be expected for each of the 23 options considered.

Options with a positive score are highlighted green, a neutral score orange and options with negative score red. These results represent the unweighted sum of the eight criteria defined as part of the multi criteria analysis.

Residue priority is also presented and shows each option’s feedstock preference in descending order of priority.

Table 4-1 Summary of multi criteria analysis assessment for Tasmanian residues

OPTION	PROCESS DESCRIPTION	PRODUCT	PREFERRED FEEDSTOCK*	5 YEAR RESULT	15 YEAR RESULT	30 YEAR RESULT	EXPECTED SCALE (GMT RESIDUES/ YEAR)
1a	Pulp	Kraft	All	2✓	2✓	2✓	> 1 million
1b		Sulphite	All	1✗	1✗	1✗	500- 1 million
1c		Mechanical	S	1✗	2✗	2✗	500- 1 million
2a	Composite panels	Particleboard	P,S	3✗	3✗	3✗	100 - 500
2b		MDF	S	2✗	2✗	2✗	100 - 500
2c		OSB	S, H, NF	3✗	3✗	3✗	100 - 500
3	Sawn timber	Sawn timber	H,NF	Neutral	Neutral	Neutral	100 - 500
4a	EWPs	Plywood	NF,H	2✓	4✓	4✓	100 - 500
4b		LVL	S,NF	Neutral	Neutral	Neutral	100 - 500
4c		OSL	H,NF,S	1✓	1✓	1✓	100 - 500
4d		Glulam/CLT	S,P,H	3✓	5✓	5✓	50 -100
5a	Electricity	Stand-alone power	All	4✓	4✓	4✓	100 - 500
5b		Export pellet/chip	All	Neutral	2✓	4✓	500- 1 million
6a	Cogeneration	Industrial	All	3✓	4 ✓	4 ✓	100 - 500
6b		Domestic/commercial	All	2✓	2✓	2✓	50 -100
7a	Biofuels	Hydrocarbons	All	Neutral	9✓	9✓	> 1 million
7b		Ethanol	All	6✗	Neutral	Neutral	50 -100
8a	Other	Wood Composites	All	1✓	1✓	1✓	100 - 500
8b		Charcoal	All	5✗	1✗	1✗	100 - 500
8c		Activated Carbon	H,NF	2✗	2✗	2✗	50 -100
9a	Emerging	Torrefaction	All	3✗	5✓	7✓	> 1 million
9b		Biorefining	All	1✗	5✓	6✓	50 -100
9c		Nanotechnology	All	3✗	2✓	4✓	50 -100

* Residue priority key:
S – plantation softwood, H – plantation hardwood, NF – native forest hardwood, P – processing residues
Source: URS

The results from the assessment show:

- Hydrocarbon biofuel has the highest overall score, but this option is only expected to be realized over the medium to long-term;
- Torrefied wood pellets have the next highest score but only over a longer time horizon. This is not considered a viable option over the next five years;
- Both of these options have the potential to utilize significant residue volumes;
- Secondary wood products Glulam and CLT score well over the entire timeframe, but will only require relatively small volumes;
- Bioenergy also scores consistently well with stand-alone power and industrial cogeneration the highest ranked options;
- The outlook for plywood is also positive, largely on the back of the existing investment in this technology in Tasmania;

- Kraft pulp also has a positive score, albeit lower than some of the other options. Alternative pulp markets have fewer prospects and received a negative score;
- The analysis was relatively neutral on the potential for OSL, LVL and sawn timber (from logs currently classified as unsuitable for sawing) in Tasmania; and
- Composite panel and the charcoal product options consistently scored poorly largely due to the lack of compatibility with the residues available (panels) and lack of end markets (charcoal).

Section 5 provides a short-list of the preferred options identified for further analysis as part of Stage 2.

5 PRIORITISED OPTIONS FOR FURTHER ANALYSIS

Key messages:

Six options are recommended for further analysis with engineered wood products, bioenergy and biofuel options offering alternative residue markets

The most prospective short term options have the potential to utilise up to 30% of the modelled residue volume

Two options have the potential to utilise a significantly greater residue volume, but these are more medium to long term prospects

Stage 2 of this assessment would require more detailed consideration of feedstock requirements, delivered costs, suitable processing technology and trends in end markets

5.1 Summary of preferred options

Table 5-1 provides a summary of the options considered to have the best prospects and should be included in the Stage 2 analysis for increasing the utilisation of forest and processing residues in Tasmania. The rankings are based on the outcome from the MCA analysis which is presented in Figure 5-1.

Table 5-1 Prospective options for further analysis as part of Stage 2

OPTION	PROCESS DESCRIPTION	PRODUCT	EXPECTED SCALE (GMT RESIDUES/ YEAR)	MCA 5 YEARS	MCA 15 YEARS	MCA 30 YEARS
4a	EWPs	Plywood	100 - 500	2✓	4✓	4✓
4d		Glulam/CLT	50 -100	3✓	5✓	5✓
5a	Electricity	Stand-alone power	100 - 500	4✓	4✓	4✓
6a	Cogeneration	Industrial	100 - 500	3✓	4 ✓	4 ✓
7a	Biofuels	Hydrocarbons	> 1 million	Neutral	9✓	9✓
9a	Emerging	Torrefaction	> 1 million	3✗	5✓	7✓

Kraft pulp, chips and/or pellet exports for bioenergy and OSL all scored positively but were not included because:

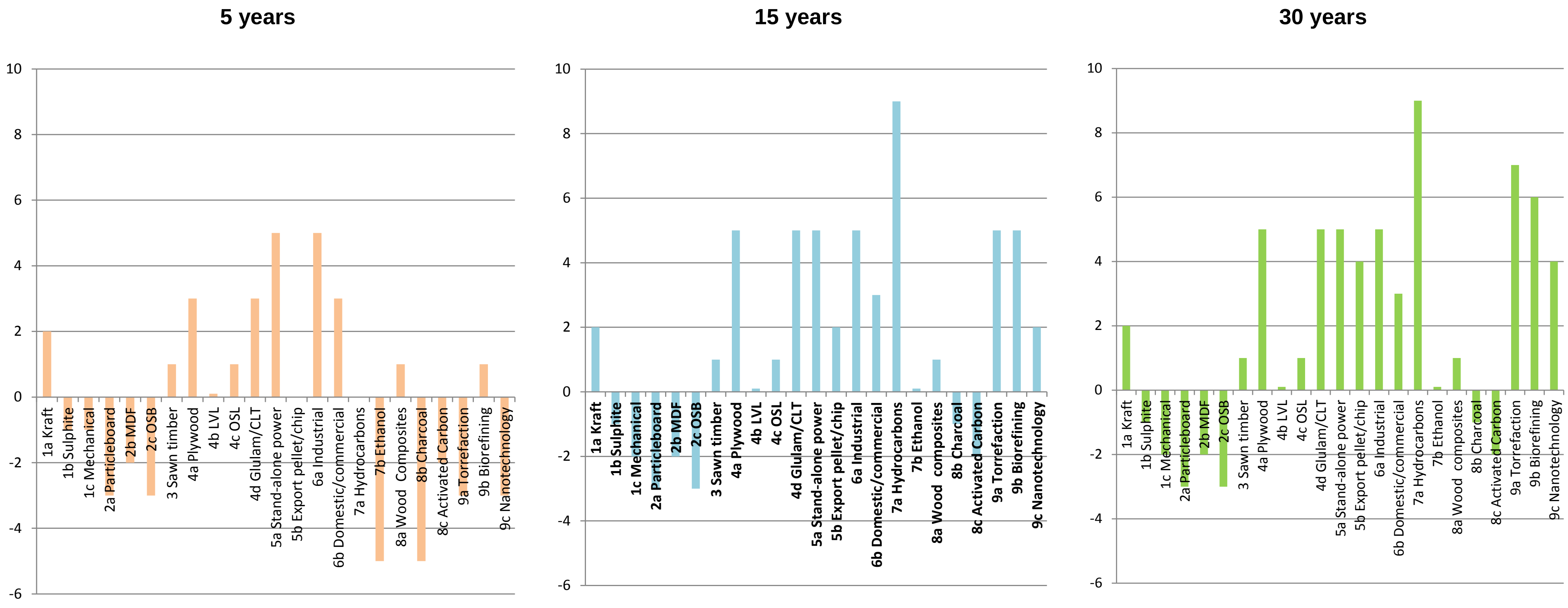
- kraft pulp – the sale of the rights to Gunns proposed pulp mill will provide market evidence as to the viability of this option;
- export chips/pellets – export of torrefied wood was considered a more prospective option and some assessment of this option will be required as part of the assessment of markets for torrified wood; and
- OSL would have difficulty competing in existing construction markets.

Sawn timber, structural LVL and ethanol were relatively neutral over time. This suggests they have some potential, but a number of barriers are present that limit the prospects for these options.

Options with a negative score were excluded on the basis they compared poorly relative to the preferred alternatives. This included panel products, charcoal based products, as well as sulphite and mechanical pulp.

These options are presented based on URS' assessment and are subject to review by the Advisory Group which may provide a different perspective on priorities for further analysis.

Figure 5-1 Summary of results from a multi criteria analysis of residue processing options



5.2 Outline of Stage 2 analysis requirements

Subject to confirmation of the preferred options to be considered for Stage 2, the further analysis will include:

- Review feedstock requirements for the preferred options;
- Market assessments of plywood and CLT/Glulam;
- Review access arrangements and siting options for power generation;
- Develop high level cost modelling; and
- Engage with various supply chain participants.

6 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 Department of Infrastructure, Energy and Resources and only those third parties who have been authorised in writing by URS to rely on this 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 contract dated 13 February 2014.

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