SOUTH EAST FIBRE EXPORTS

Biomass Fuelwood Study

Southeast region sawmill wood by-product study, June 2011

PROJECT BACKGROUND

The Sawmill Biomass Fuel project is supported by funding from the Australian Government Department of Agriculture, Fisheries and Forestry under its Forest Industries Climate Change Research Fund program.

The project began in July 2010 and was completed in June 2011.

South East Fibre Exports (SEFE) managed the project with support from the Australian Forest Products Association (AFPA).

Human resources assigned to the project were:

Peter Mitchell from SEFE as Project Manager and Project Steering Committee member;
Mick Stephens from AFPA as Project Contributor and Project Steering Committee member;
James Gray from Fitzpatrick Woods Consulting (FWC) as Project Resource Officer.

This study was conducted with the assistance of the sawmilling and solid wood product processing industry in South East NSW and North East Victoria.

This project was possible through the joint initiative between the Australian Government Department of Agriculture, Fisheries and Forestry and South East Fibre Exports.

The Australian Forest Products Association (AFPA) also contributed to the project.

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PROJECT SUMMARY

The Sawmill Biomass Fuel Project was successful in developing the following:

(a) An improved understanding of the general size and bio-physical characteristics of the sawmilling wood by-product biomass resource in the study region as a potential feedstock for bioenergy production. This understanding includes a generic model to estimate likely costs of resource supply and handling as well as a spatial map of the wood by-product flows of relevant timber processing facilities;

(b) An assessment of the woody biomass fuel properties (physical and chemical) of nine timber processing facilities in the region. This includes particle size and variation in moisture content, as well as the relevant chemical properties of selected wood samples (Appendix 3). An assessment was also made of current practices of wood by-product generation and handling at each of the nine facilities;

(c) A literature review of wood by-product handling technologies and systems suitable for application to wood processing facilities in Australia. This includes a summary of key knowledge gaps, risks and opportunities for expanding existing sawmill and timber processing practices to also encompass the commercial production of wood by-products for biomass; and

(d) A handling manual for production of biomass for bioenergy at timber processing facilities to minimize adverse environmental impacts and maximize environmental and economic benefits. This manual has national application (Appendix 1);

The project involved intensive analysis of nine timber processing facilities in the region as a potential source of biomass for energy production. This collaboration with the local forest industry has enabled the project to obtain a thorough understanding of the wood waste resource that could potentially be harnessed in the future. This included interviews with mill managers, tours of mill operations with a focus on wood by-product generation, as well as collection of wood by-product samples for analysis. This information was combined with the project team's knowledge as well as available literature to meet the project objectives. The various project outputs are provided in attachments to this report (refer list of attachments). This information will be used to promote wider industry awareness of opportunities to use such woody biomass more effectively.

Project management

A Project Steering Committee was established to guide and manage the project. Peter Mitchell from SEFE took overall responsibility for meeting project milestones. Mick Stephens from AFPA made important contributions and James Gray from Fitzpatrick Woods Consulting was assigned to project tasks.

The Project Steering Committee met formally twice throughout the early phases of the project to plan for achieving project milestones. Other informal meetings of the Project Steering Committee were held throughout the project.

Project outputs

Outputs	Description of how it was completed	Completion date
1 Models to predict woody biomass output from timber processing facilities	The summary report and individual results from the mill based survey provide a basic model for the estimation of woody biomass output from the study region. A spatial resource map also outlines available wood by-product volumes from the nine mills and haulage distances to a proposed bioenergy installation near Eden. In addition, an excel-based model was developed to estimate likely costs of procurement from the local mills.	30th March 2011
2 Woody biomass fuel physical and chemical properties – particle size and distribution, variation in moisture content, chemical properties including calorific value and ash content	Wood by-product samples were collected and examined from each of the mills as part of the study. An examination of the size characteristics and moisture content of wood by-products was conducted at the SEFE facility (Appendix 2). A separate analysis of the chemical properties and calorific value of selected wood samples was conducted by HRL Technologies (Appendix 3).	20th November 2011
3 Descriptions of collection and transport technologies including estimates of costs (capital and operating), energy efficiencies, and feedstock requirements	A literature review was conducted of mill site collection, handling and transport technologies. The range of likely costs of operations and handling were included in the fuel cost model. With regard to energy efficiencies and feedstock requirements, the main focus of the review has been on wood by-product hygiene and moisture management for use as a wood fuel.	30th May 2011
4 Guidelines for production of biomass for bioenergy at timber processing facilities to minimize adverse environmental impacts and maximize environmental and economic benefits	From the information gathered from the project, a manual was developed for the effective handling of wood by-products, such as sawdust and shavings for use as wood fuel in bioenergy facilities (Appendix 1). The target group for using this manual are sawmills and other wood processors in Australia that generate wood by-products. The manual essentially examines 'best practice' in wood by-product handling and covers relevant technologies that could be applied and adapted to existing sawmilling and wood processing operations.	30th May 2011
5 Summary of key knowledge gaps, risks and opportunities for such a development	Knowledge gaps, risks and opportunities were incorporated in the literature review, and relate mainly to OH&S considerations; biomass handling systems and costs (refer output 3 above).	30th May 2011

Local forest industry stakeholders

Local forest industry stakeholders were engaged at the mill sites which involved a questionnaire, a mill tour with a focus on wood by-product generation, and collection of wood by-product samples. The details of each sawmill or processor represented in the study is as follows:

TASCO Softwood Mill
Bombala NSW

Auswest Brodribb Sawmill
Brodribb Vic Via Orbost

Hallmark Oaks
Cann River Vic

Mectec Sawmill
Newmeralla Vic Via Orbost

Blue Ridge Hardwoods
Eden NSW

P.R. Adams Pty Ltd
Nowa Nowa Vic

Boral Narooma Sawmill
Narooma NSW

North Eden Timber
Pambula NSW

Jameson Bros Sawmill
Bendoc Vic

Method of sawmill engagement

The relevant sawmills in the study region were identified in the first Project Steering Committee meeting who were subsequently contacted and agreed to participate in the project.

This was followed by individual visits to each sawmill processing facility, where a senior representative was available to provide a site tour and respond to the questionnaire.

At each site, samples of wood by-products were photographed, containerised (in small air tight tubs) and transported to the SEFE chip facility for further analysis of chemical properties and size characteristics.

A questionnaire was developed to address a number of key objectives of the project. The aim of the questionnaire was to gain a thorough understanding of the volume flows of different categories of by-products and the way in which wood by-products were handled on-site, as well as their consideration for future use of this resource in bioenergy generation.

Individual results for each sawmill can be found in Appendix 2 of this report.

SOUTH EAST REGION SAWMILL WOOD BY-PRODUCT STUDY

Aim of stakeholder engagement of sawmills in the region

To gain an understanding of the flows and volumes of wood by-products created by each sawmill in the study region area, for potential use in bioenergy production from planned/future bioenergy installations. Wood by-products include finer materials such as sawdust, fines and shavings that are created in large volumes in the sawmilling and timber dressing process.

Method of data collection

Eight sawmills, seven of which were hardwood, and one timber moulding facility were identified as relevant stakeholders in the project. All the local mills identified in the study region participated in the survey and data collection. Details of each wood processing operation are outlined below.

The study area was south east NSW and East Gippsland in Victoria. The boundary was limited by 'reasonable' truck haulage distances to proposed bioenergy installations near Eden, being roughly Narooma to the north, Bombala to the west and Nowa Nowa to the south.

The stakeholder engagement and wood by-product data collection process was conducted in the months of July, August and September 2010. Activities included:

- Site visits to individual sawmills
- Completion of a questionnaire prepared for use on-site with mill representatives
- Wood residue sample collection in air tight plastic containers
- Wood residue analysis for moisture and chemical content

The resource map of the biomass fuel study area shows the distance and location of each mill in relation to the proposed SEFE biomass mill, as well as a graphical representation of the residue mix available from each mill (Figure 1).

Results

Hardwood processing by-product flows of various SE operations

Table 1. Hardwood sawmill eucalypt by-product tonnages from SE processing operations

Sawmill	**Green sawdust (t/yr)**	**Green fines (t/yr)**	**Dry shavings (t/yr)**	
Adams	733	312	Negligible	
Auswest	12,750	4,250	Nil	
Blue Ridge	5,425	2,170	1,628	
Boral	1,900	750	Nil	
Hallmark Oaks	1,600	700	600	
Jamison Bros	1,250	600	Nil	
Mectech	n/a (incinerated)	167+	5	
North Eden	Nil	Nil	570	**Total**
Total	**23,658**	**8,949**	**2,803**	**35,410**

Figure 1. Wood biomass resource from sawmills near the SEFE biomass mill.

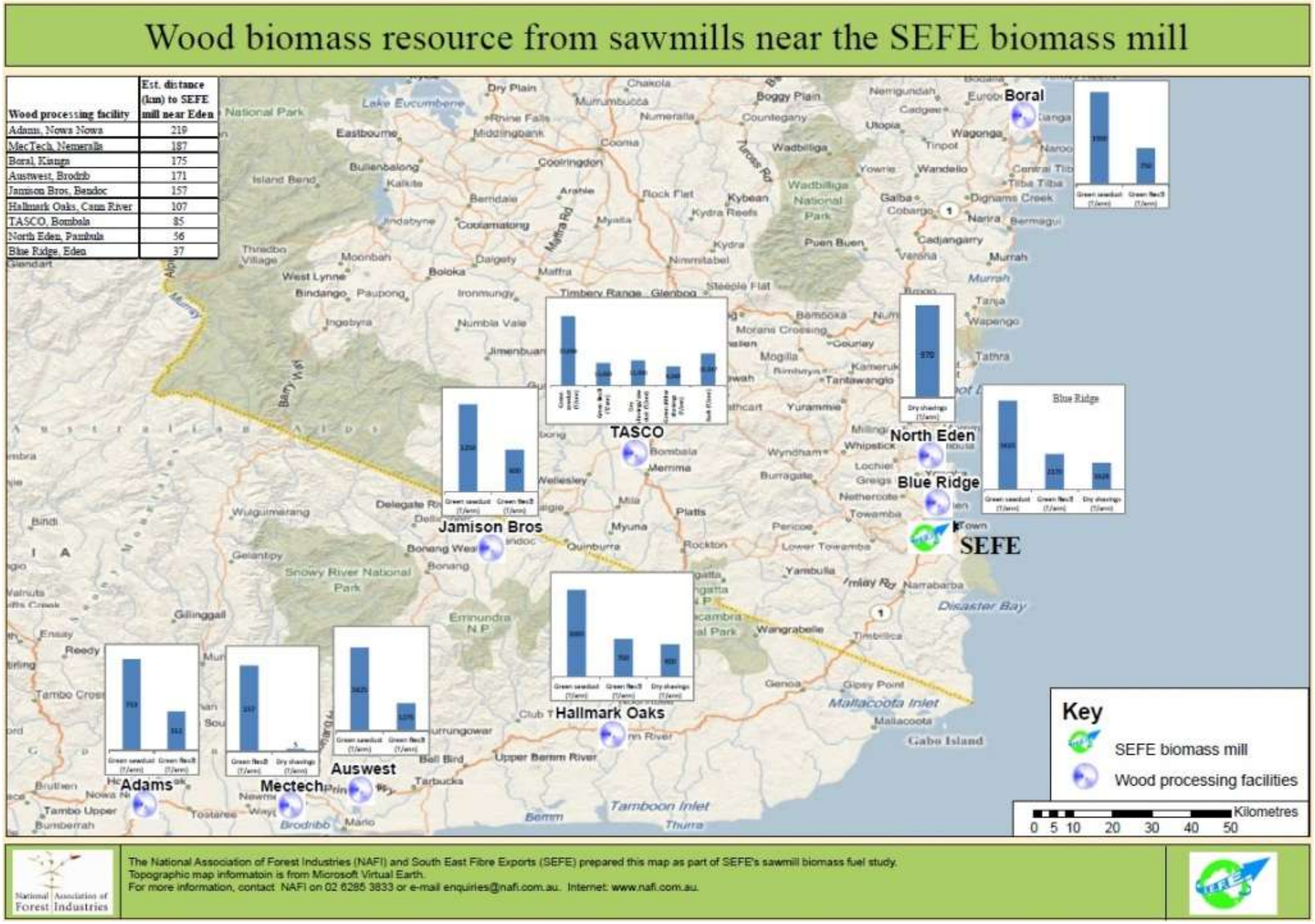

Image 1. Typical hardwood by-products from SE wood processing industry

Table 2. Size and moisture content of eucalypt sawdust from SE wood processing operations

Mill	Moisture content (%)	Oversize <28.6 mm (%)	22.2 mm (%)	9.5 mm (%)	4.8 mm (%)	Fines <4.8 mm (%)	Bark (%)
Blue ridge hardwoods	38.3	0.0	0.0	0.04	2.2	97.77	0.0
Hallmark Oaks	42.0	0.85	0.0	0.23	9.24	89.68	0.0
Auswest	45.0	0.0	0.0	0.37	2.58	97.06	0.0
PW Adams	46.3	0.0	0.0	0.34	3.24	96.42	0.0
Mectec	45.3	0.0	0.0	0.32	5.54	94.14	0.0
Jamieson Bros.	43.7	0.0	0.02	0.31	6.00	93.67	0.0
Boral Narooma	37.7	0.0	0.03	1.17	2.58	96.12	0.0
Average	**42.6**	**0.1**	**0.0**	**0.4**	**4.5**	**95.0**	**0.0**

Table 3. Size and moisture content of eucalypt chip fines from SE wood processing operations

Mill	Moisture content (%)	Oversize <28.6 mm (%)	22.2 mm (%)	9.5 mm (%)	4.8 mm (%)	Fines <4.8 mm (%)	Bark (%)
Blue ridge hardwoods	42.3	0.0	0.07	24.76	56.56	18.6	0.0
Hallmark Oaks	43.3	1.52	0.0	5.93	69.09	23.45	0.0
Auswest	46.0	0.0	0.03	3.3	56.9	39.8	0.0
PW Adams	39.7	0.0	0.0	9.71	69.03	21.26	0.0
Mectec	35.0	0.0	0.0	0.0	24.08	75.92	0.0
Jamieson Bros.	46.3	0.0	0.02	17.61	67.14	15.23	0.0
Boral Narooma	32.7	0.0	0.0	3.41	57.62	39.97	0.0
Average	**40.8**	**0.2**	**0.0**	**9.2**	**57.2**	**33.3**	**0.0**

Table 4. Size and moisture content of eucalypt dry shavings from SE wood processing operations

Mill	Moisture content (%)	Oversize <28.6 mm (%)	22.2 mm (%)	9.5 mm (%)	4.8 mm (%)	Fines <4.8 mm (%)	Bark (%)
Blue ridge hardwoods	11.3	0.0	0.0	0.18	8.19	91.63	0.0
North Eden Timbers	12.7	0.0	0.05	1.84	15.2	82.91	0.0
Hallmark Oaks	14.0	0.0	0.0	5.1	23.3	71.6	0.0
PW Adams	15.7	0.0	0.0	2.21	17.01	80.77	0.0
Mectec	13.3	0.0	0.04	0.49	17.7	71.77	0.0
Average	**13.4**	**0.2**	**0.0**	**2.0**	**16.3**	**81.7**	**0.0**

Summary of SE hardwood solid wood product processing industry

There is a variation in scale of hardwood sawmilling operations in the South East, but similarity in the species utilised and products processed, thereby providing some consistency in wood by-product quality and flow. All the hardwood sawmills are heavily dependent on resources provided by public native forests and managed by Forests NSW or VicForests.

Products include green sawn structural timber, flooring, decking, seasoned building and feature use timbers, as well as lower grade products such as tiling battens. Collectively, the hardwood mills produce a significant volume of woodchip which is supplied to the SEFE chip mill near Eden.

Scale in sawmilling operation varies from around 7,000m^3 to 50,000m^3 annual round log intake. Modernisation also varies with a number of traditional green saws still in operation. Some facilities also have kiln drying and moulding capabilities.

Most green wood by-products from sawmilling and chipping are handled by conveyor to bunkers or deposits. Bunkers for short and longer term storage ranged from concrete to earthen floored, partially walled, to fully walled and roofed.

Image 2. Various by-product storage

By-products are handled with front end loaders into semi-trailers for transport. Bunkers are generally located in close vicinity to loading sites.

Image 3. Loading wood by-products at Auswest Brodribb

Some of the traditional sawmills used conical iron incinerators to burn off sawdust, chip fines, dockings and other residues. All sawmills maintained markets for wood by-products, especially for the garden mulch industry. Incineration was not solely relied on by any one sawmill operation.

Image 4. Conical incinerator at MecTech Hardwood Sawmill

Base of incinerator	Conical iron hood	Emissions
		

Dry shavings from planner and moulding involved exhaust ventilation systems direct to storage. Storage included outdoor bunkers with some measures in place to protect from wind and rain, to contained hoppers.

Image 5. Dry shavings handled with exhaust ventilation system to hopper at North Eden Hardwoods

Summary of TASCO Softwood processing by-product flows

Table 5. TASCO softwood by-product tonnages

Residue	Est. Ann tonnage
Green sawdust	33,899
Green fines	11,000
Dry shavings/sawdust	12,300
Green slither shavings	9,348
Bark	15,547
Total	**82,094**

Table 6. Size and moisture content of *Pinus* radiata wood by-products from TASCO Bombala operations

Mill	Moisture content (%)	Oversize <28.6 mm (%)	22.2 mm (%)	9.5 mm (%)	4.8 mm (%)	Fines <4.8 mm (%)	Bark (%)
Sawdust	47.0	0.0	0.0	0.5	18.5	81.0	0.0
Woodchip	53.3	10.7	18.2	63.4	7.2	0.1	0.4
Bark	36.7	44.4	15.4	29.1	6.9	4.3	0.0
Planer shavings	47.7	0.2	0.8	16.1	27.5	55.3	0.0
Pole shavings	55.0	10.1	6.9	49.7	31.2	2.1	0.0
Fines	52.0	0.0	0.1	0.7	51.7	47.5	0.0

Image 6. Additional TASCO wood by-product

TASCO sawmill in Bombala involves an integrated softwood processing operation producing a range of timber products, especially treated pine for outdoor structural use, sleepers and peeled post and poles. The operation includes kiln drying, dressing and chemical preservation treatment, giving it the capacity to process pine logs into various value-added wood products ready for market.

The facility is under proposal for upgrade in 2014. Wood residue handling will utilise a bunker system, involving concrete pads with 3-sided concrete walled cells for immediate storage of bark, chips, fines and slither shavings. Only the cell for the fines is planned to be roofed to prevent spread in high wind conditions. Bunkers will be fed by an overhead conveyor with trap doors above bunkers. Bunkers will be situated adjacent to a concrete pad area enabling direct loading into semi-trailers.

Dry shavings will be stored in $75m^3$ walk-in-floor semi-trailer containers on-site. The shavings extraction method is a closed system, using exhaust ventilation system to draw solid matter from the planer and collection into containers. This will enable storage of wood residue on-site without risk of contamination or significant changes to moisture content.

Residues will be removed from sites regularly throughout each day's operation.

Image 7. TASCO softwood processing operation produces large volumes of wood by-products

Individual mill reports

A more detailed description of individual mill operations and wood biomass resources potentially available for renewable bioenergy production is provided below.

P.R. Adams Pty Ltd

Nowa Nowa Vic

Adams Hardwood operation involves a traditional hardwood sawmilling operation with 10 staff and an annual round log intake of around 10,000 m^3. Adams wood residue flows are:

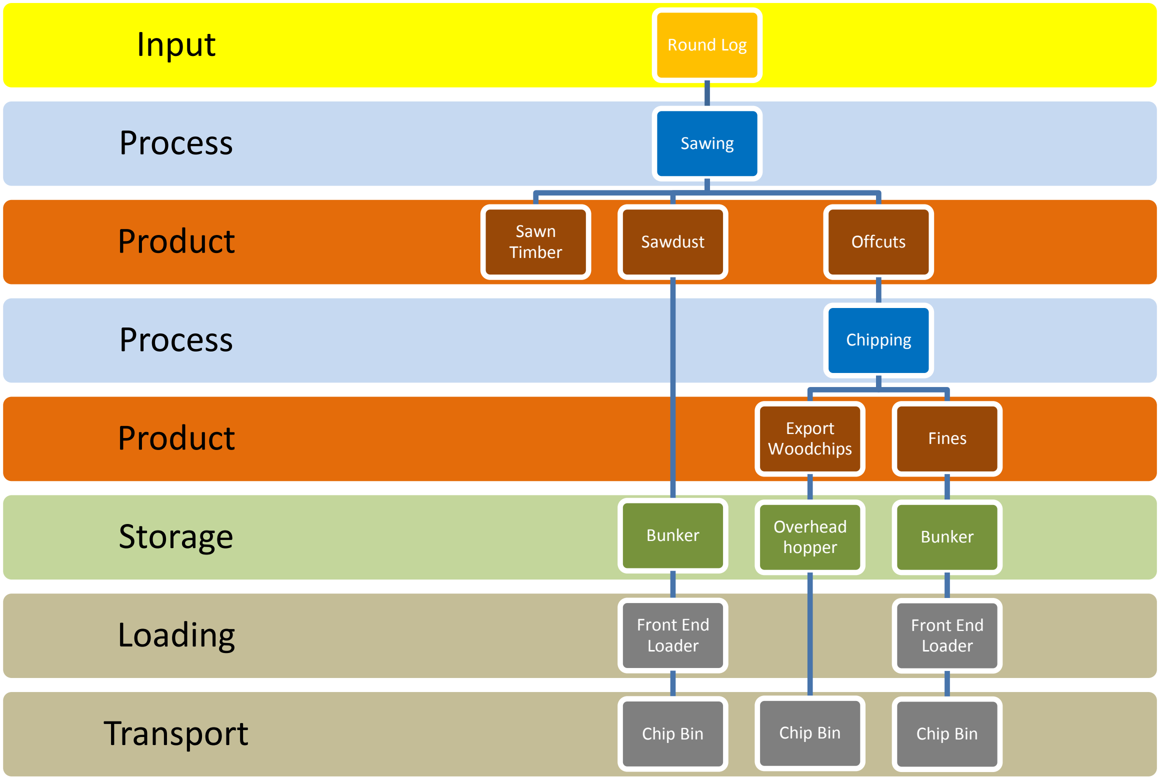

Table 7. Adams wood by-product tonnage

Residue	Est. Ann tonnage
Green sawdust	733
Green fines	312
Dry shavings	Negligible

Table 8. PW Adams, eucalypt wood by-product size and moisture results as percentage

Product	Moisture content (%)	Oversize >28.6 mm (%)	22.2 mm (%)	9.5 mm (%)	4.8 mm (%)	Fines <4.8 mm (%)	Bark (%)
Sawdust	46.3	0.0	0.0	0.34	3.24	96.42	0.0
Dry shavings	15.7	0.0	0.0	2.21	17.01	80.77	0.0
Fines	39.7	0.0	0.0	9.71	69.03	21.26	0.0

Description of wood residue flows and volumes at the Adams sawmill operation are detailed in Appendix 1.

Auswest Sawmill

Brodribb Vic

Auswest Brodrib operation involves a significant green saw hardwood operation, including 42 staff and has a current annual round log intake of around 52,000 m^3. Current Auswest wood residue flows are:

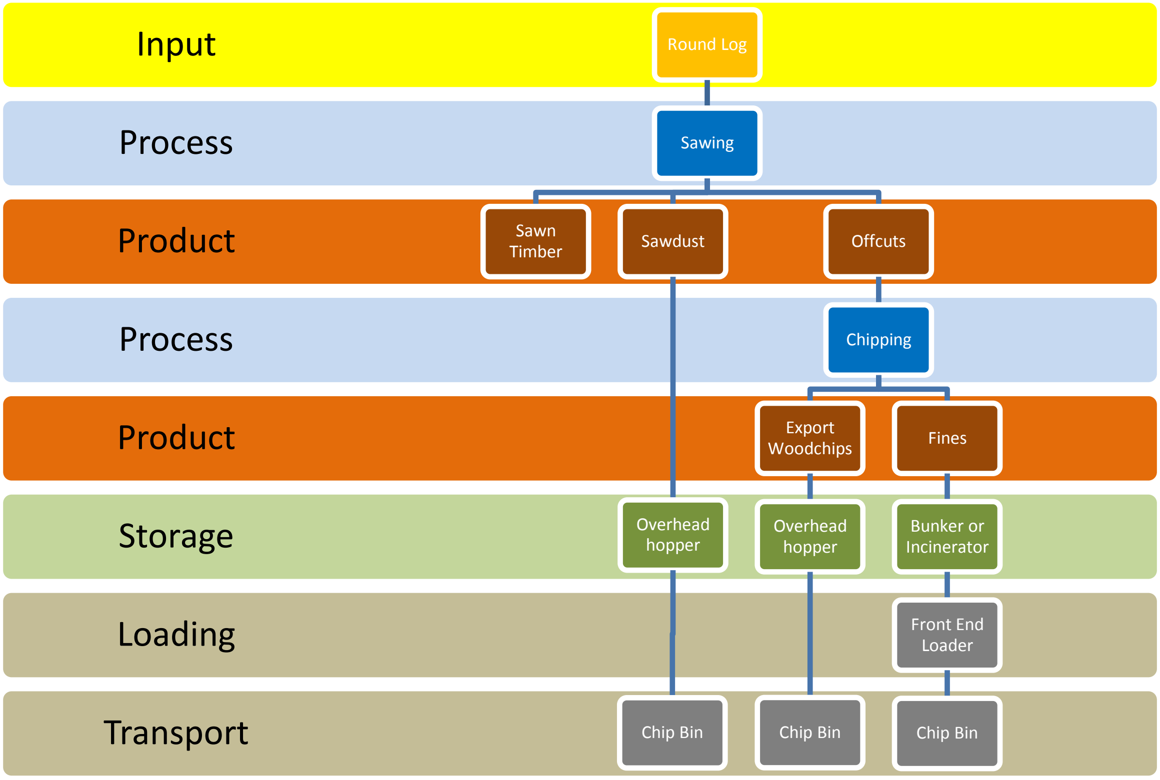

Table 9. Auswest wood by-product tonnage

Residue	Est. Ann tonnage
Green sawdust	12,750
Green fines	4,250

Table 10. Auswest, eucalypt wood by-product size and moisture results as percentage

Product	Moisture content (%)	Oversize >28.6 mm (%)	22.2 mm (%)	9.5 mm (%)	4.8 mm (%)	Fines <4.8 mm (%)	Bark (%)
Sawdust	46.0	0.0	0.03	3.3	56.9	39.8	0.0
Fines	14.3	0.0	0.0	0.37	2.58	97.06	0.0

Description of wood by-product flows and volumes at the Auswest sawmill operation are detailed in Appendix 1.

Blue Ridge Hardwoods

Eden NSW

The Blue Ridge operation involves quite a significant hardwood sawmilling and solid wood product processing operation, including 55 staff and has an annual round log intake of around 38,000 m^3. Blue Ridge wood residue flows are:

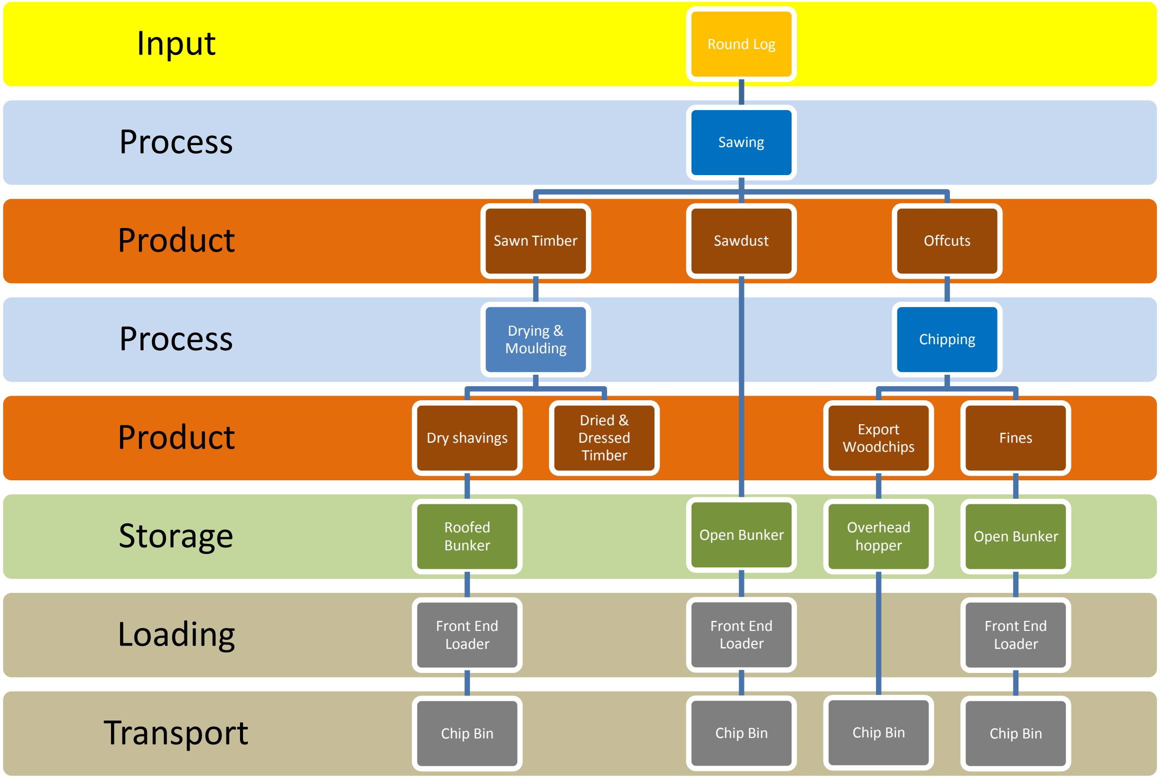

Table 11. Blue Ridge wood by-product tonnages

Residue	Est. Ann tonnage
Green sawdust	5,425
Green fines	2,170
Dry shavings	1,628

Table 12. Blue Ridge, eucalypt wood by-product size and moisture results as percentage

Product	Moisture content (%)	Oversize >28.6 mm (%)	22.2 mm (%)	9.5 mm (%)	4.8 mm (%)	Fines <4.8 mm (%)	Bark (%)
Fines	42.3	0.0	0.07	24.76	56.56	18.60	0.0
Sawdust	38.3	0.0	0.0	0.04	2.2	97.77	0.0
Dry shavings	11.3	0.0	0.0	0.18	8.19	91.63	0.0

Description of wood residue flows and volumes at the Blue Ridge sawmill operation are detailed in Appendix 1.

Boral Sawmill

Narooma NSW

The Boral Narooma operation involves a green saw hardwood operation, involving 22 staff and an annual round log intake of around 18,000 m^3. Boral wood residue flows are:

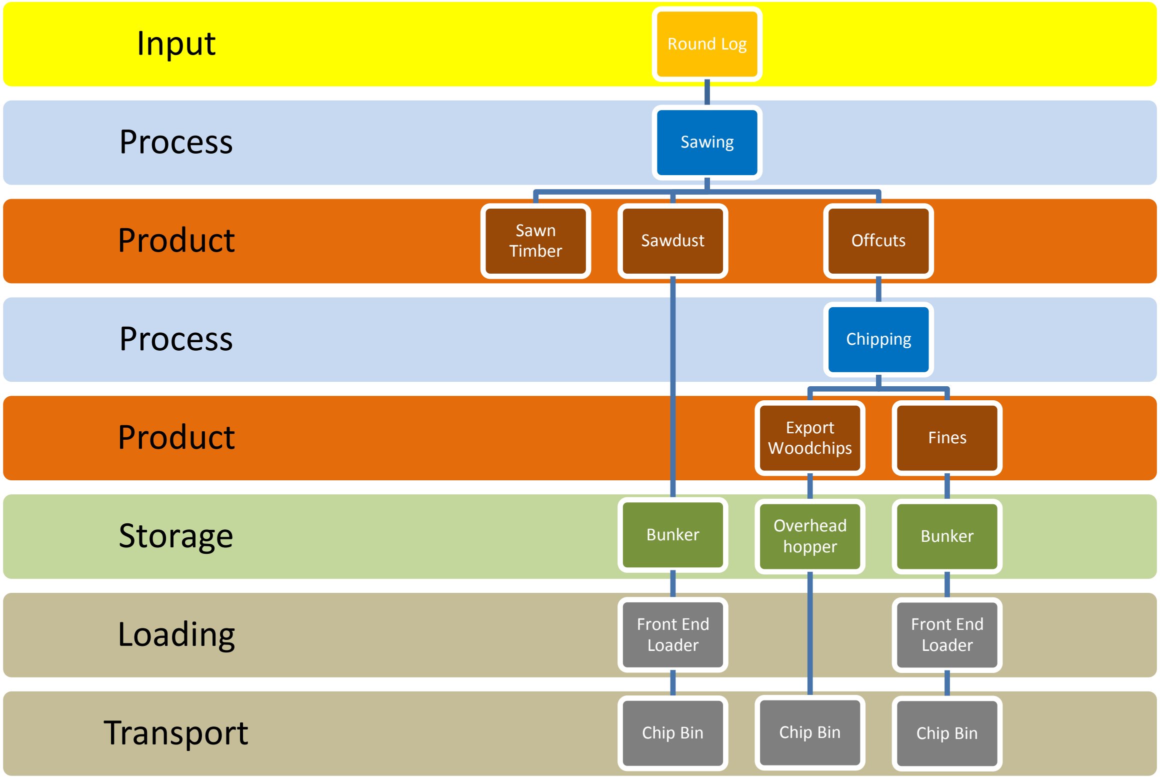

Table 13. Boral wood by-product tonnages

Residue	Est. Ann tonnage
Green sawdust	1,900
Green fines	750

Table 14. Boral Narooma, eucalypt wood by-product size and moisture content results as percentage

Product	Moisture content (%)	Oversize >28.6 mm (%)	22.2 mm (%)	9.5 mm (%)	4.8 mm (%)	Fines <4.8 mm (%)	Bark (%)
Fines	32.7	0.0	0.0	3.41	57.62	38.97	0.0
Sawdust	37.7	0.03	0.11	1.17	2.58	96.12	0.0

Descriptions of wood residue flows and volumes at the Boral sawmill operation are detailed in Appendix 1.

Hallmark Oaks

Cann River Vic

The Hallmark Oaks operation involves a traditional hardwood sawmilling operation with dressing and kiln drying infrastructure, including 13 staff and has an annual round log intake of around 11,500 m^3. Hallmark Oaks wood residue flows are:

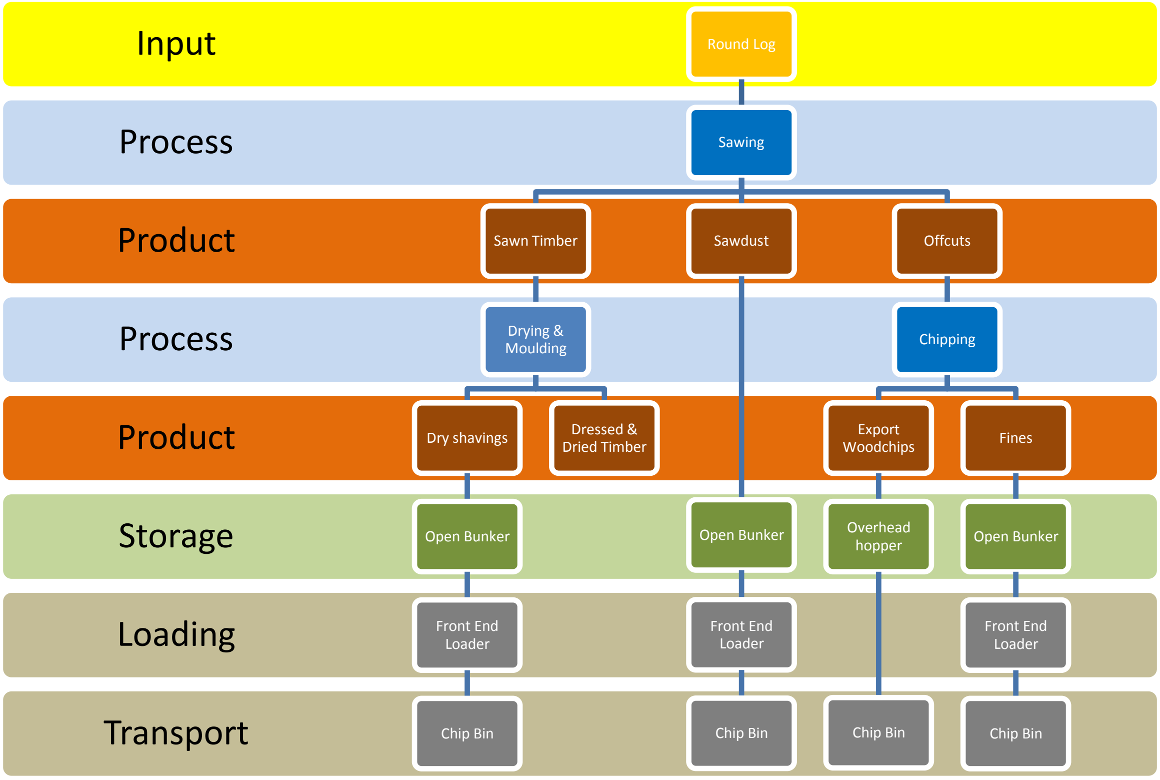

Table 15. Hallmark Oaks wood by-product tonnages

Residue	Est. Ann tonnage
Green sawdust	1,600
Green fines	700
Dry shavings	600

Table 16. Hallmark Oaks, eucalypt wood by-product size and moisture content results as percentage

Product	Moisture content (%)	Oversize >28.6 mm (%)	22.2 mm (%)	9.5 mm (%)	4.8 mm (%)	Fines <4.8 mm (%)	Bark (%)
Planer shavings	14.0	0.0	0.0	5.1	23.3	71.6	0.0
Dry sawdust	14.3	0.0	0.0	1.71	12.9	85.39	0.0
Greensawdust	42.0	0.85	0.0	0.23	9.24	89.68	0.0
Fines	43.3	1.52	0.0	5.93	69.09	23.45	0.0

Description of wood residue flows and volumes at the Hallmark Oaks sawmill operation are detailed in Appendix 1.

Jameson Bros Sawmill

Bendoc Vic

The Jameson Bros operation involves a traditional hardwood sawmilling operation, including 10 staff and has an annual round log intake of around 7,000 m^3. Jamison Bros wood residue flows are:

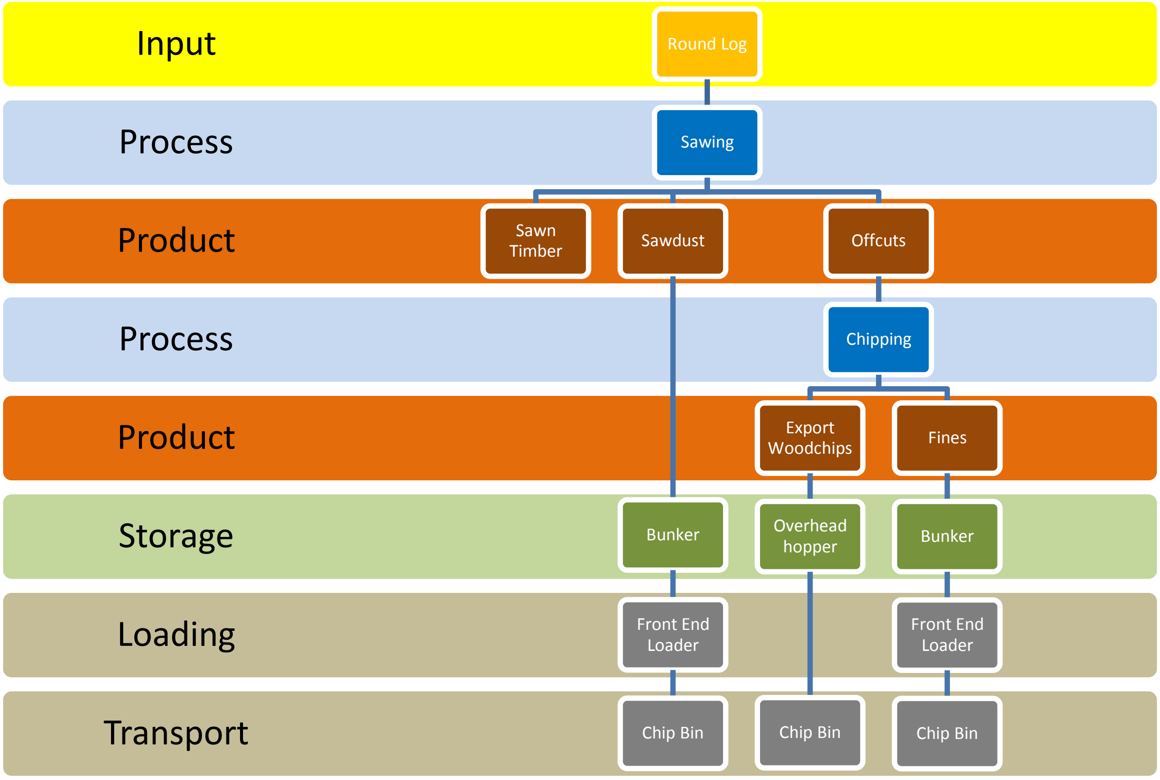

Table 17. Jamison Bros wood by-product tonnages

Residue	Est. Ann tonnage
Green sawdust	1,250
Green fines	600

Table 18. Jamieson Bros, eucalypt wood by-product size and moisture results as percentage

Product	Moisture content (%)	Oversize (>28.6)	22.2mm	9.5mm	4.8mm	Fines (<4.8mm)	Bark
fines	46.3	0.0	0.02	17.61	67.14	15.23	0.0
sawdust	43.7	0.0	0.02	0.31	6.0	93.67	0.0

Detail of wood residue flows and volumes at the Jamison Bros sawmill operation are detailed in Appendix 1.

Mectech Sawmill

Newmeralla Vic

The Mectech operation involves a traditional hardwood sawmilling operation, including 10 staff and has an annual round log intake of around 7,500 m^3. Mectech wood residue flows are:

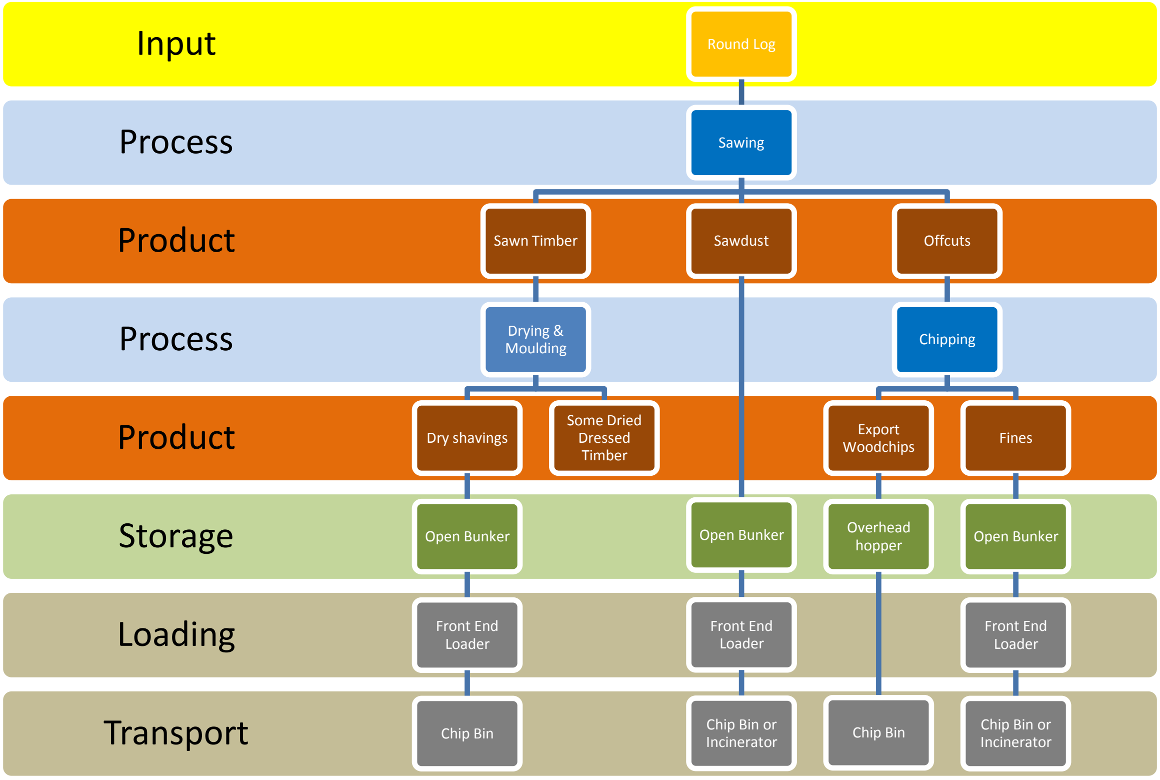

Table 19. Mectech wood by-product tonnages

Residue	Est. Ann tonnage
Green sawdust	?
Green fines	167
Dry shavings	5

Table 20. Mectech, Eucalypt wood by-product size and moisture results as percentage

Product	Moisture content (%)	Oversize >28.6 (%)	22.2mm (%)	9.5mm (%)	4.8mm (%)	Fines <4.8mm (%)	Bark (%)
dry shavings	13.3	0.0	0.04	0.49	17.7	81.77	0.0
fines	35.0	0.0	0.0	0.0	24.08	75.92	0.0
sawdust	45.3	0.0	0.0	0.32	5.54	94.14	0.0

Detail of wood residue flows and volumes at the Mectech sawmill operation are detailed in Appendix 1.

North Eden Timber

Pambula NSW

The North Eden Timber operation involves purchasing green sawn hardwood and processing it through dressing and kiln drying into solid wood products for outdoor and indoor use. The operating involves 13 staff. North Eden wood residue flow is:

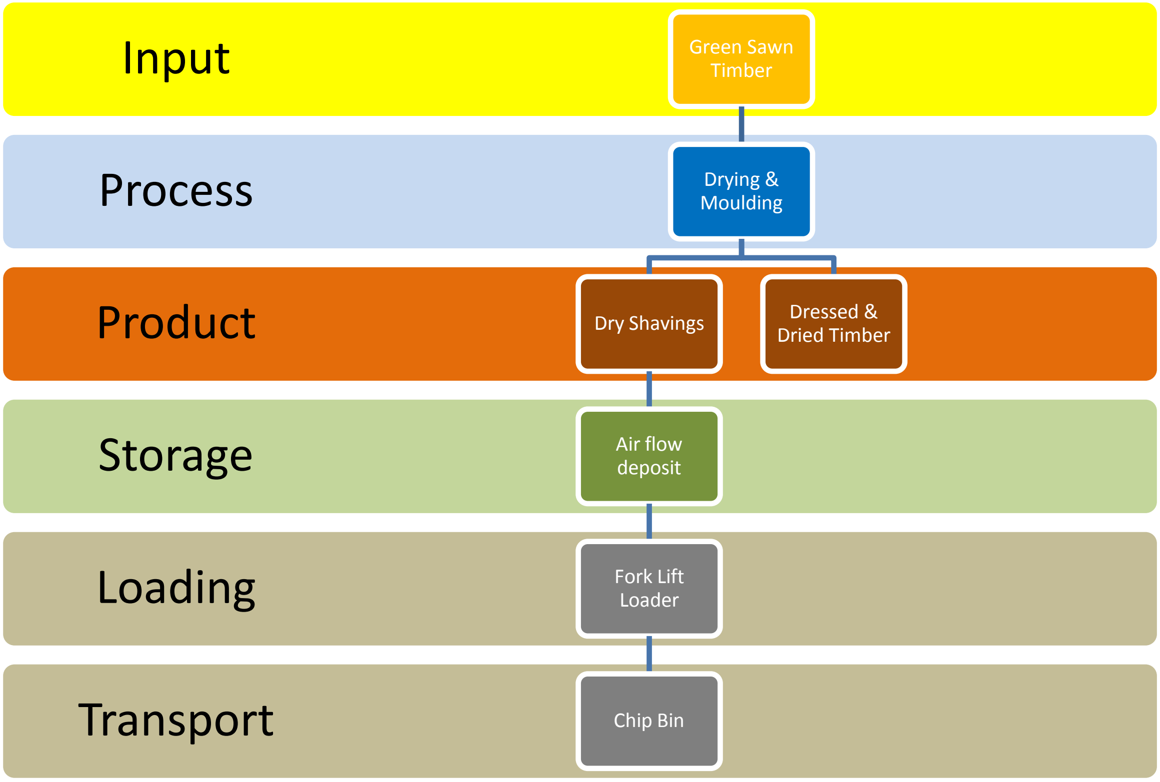

Table 21. North Eden wood by-product tonnage

Residue	Est. annual tonnage
Dry shavings	570

Table 22. North Eden Timber, Eucalypt wood by-product size and moisture results as percentage

Product	Moisture content (%)	Oversize >28.6 (%)	22.2mm (%)	9.5mm (%)	4.8mm (%)	Fines <4.8mm (%)	Bark (%)
dry shavings	12.7	0.0	0.05	1.84	15.2	82.91	0.0

Detail of wood residue flows and volumes at the North Eden sawmill operation are detailed in Appendix 1.

TASCO Softwood Mill

Bombala NSW

The TASCO operation in Bombala involves an integrated softwood sawmilling process producing a range of timber products, especially treated pine for outdoor structural use, sleepers and peeled post and poles. TASCO currently has an intake of 106,000 tonnesper annum of plantation round wood. Production at Tasco is planned to significantly increase with a new expansion infrastructure set to be fully operational by 2014. Tasco wood residue flows in 2014 will be:

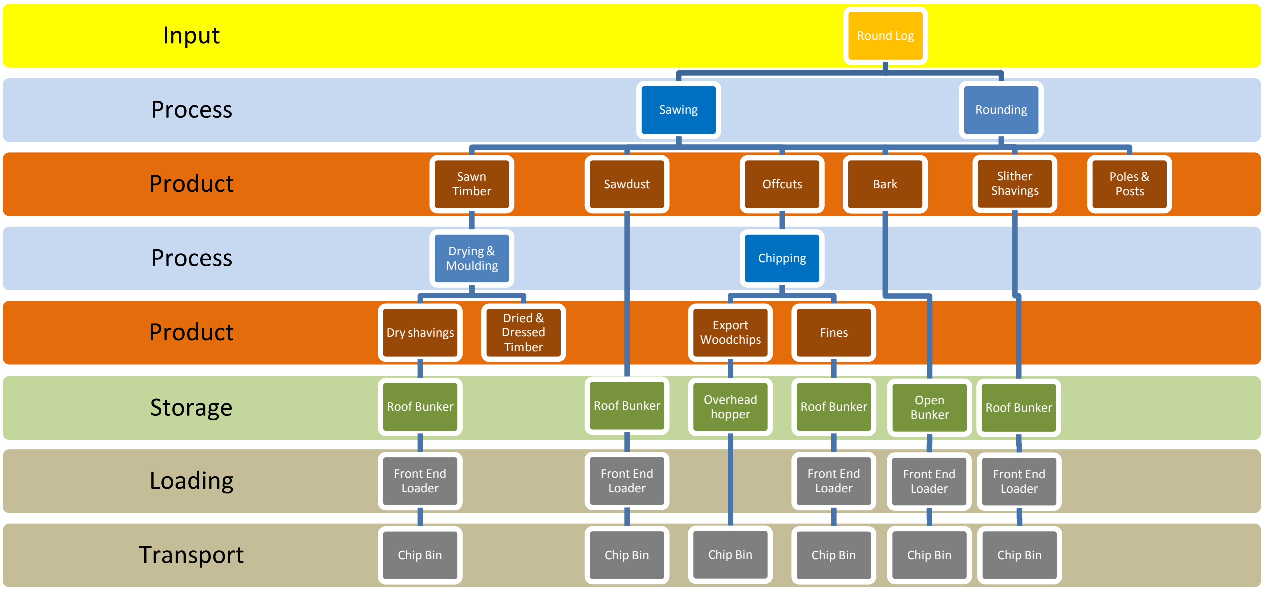

Table 23. TASCO wood by-product tonnages from 2014

Residue	Est. Ann tonnage
Green sawdust	33,899
Green fines	11,000
Dry shavings/sawdust	12,300
Green slither shavings	9,348
Bark	15,547

Table 24. TASCO Bombala mill, *Pinus radiata* wood by-product size and moisture results as percentage

Product	Moisture content (%)	Oversize >28.6 (%)	22.2mm (%)	9.5mm (%)	4.8mm (%)	Fines <4.8mm (%)	Bark (%)
sawdust	47.0	0.0	0.0	0.5	18.5	81.0	0.0
woodchip	53.3	10.7	18.2	63.4	7.2	0.1	0.4
bark	36.7	44.4	15.4	29.1	6.9	4.3	0.0
planer shavings	47.7	0.2	0.8	16.1	27.5	55.3	0.0
pole shavings	55.0	10.1	6.9	49.7	31.2	2.1	0.0
fines	52.0	0.0	0.1	0.7	51.7	47.5	0.0

Description of wood residue flows and volumes at the Tasco sawmill operation are detailed in Appendix 1.

WOOD FUEL COST MODEL – SAWMILL BIOMASS FUEL PROJECT

Model description

Purpose of the model

This model has been developed to calculate the cost of landing wood by-products, suitable for use in bioenergy generation, from sawmills and wood processing facilities to a suitable bioenergy facility (i.e. market). Presently, the SEFE Chip Mill near Eden in NSW is the site for a proposed wood-to-bioenergy production facility and is used as a realistic example in the excel-based spreadsheet model. SEFE is planning to utilise wood by-products generated by the SEFE woodchip mill as well as the surrounding wood processing industry for feedstock to its proposed bioenergy facility.

The model is relevant to the costs associated with the handling and transport of wood by-products from wood processing facilities into a bioenergy plant, in a state ready for use as fuel.

Application of the wood fuel price table

The wood fuel price table in the model is provided where there may be a range of different wood by-products and prices generated through timber processing. Typically, costs could be given to potential wood fuels depending on calorific value. Dry wood shavings for instance may have a higher calorific value in bioenergy production than for instance green sawdust, and therefore the price paid to the supplier may vary accordingly. Particle size of wood by-products is also a potentially important variable when determining the price of wood by-products for use as feedstock for bioenergy. Some wood by-product may require further processing to be suitable as fuel, therefore costs associated with on-site grinding or processing are included in the model.

Wood fuel prices paid to the supplier at the mill gate will also need to take into account the costs associated with handling wood by-products on-site. In many circumstances, sawmill operations will need to be adapted to handle wood by-products in a manner suitable for marketing as fuel for bioenergy generation. There will be costs associated with the handling of wood by-products and loading into trucks.

Inputs to the wood fuel cost model

The mill door price paid to suppliers of wood by-products, haulage and handling costs are included in the biomass fuel cost model.

Haulage is exclusively by road. A simple cost per kilometre rate to cart wood by-products can be used in the model in the absence of mill specific contracts for delivery.

On-site handling includes grading, blending, storage and feeding into the bioenergy plant.

Energy cost per tonne refers to the use of diesel (or other energy inputs) for operating equipment, such as forwarders and loaders.

Processing cost per tonne refers to grinding or processing fuel to reduce particle size. This may or may not be required and will depend on the particle size of wood by-products supplied.

Drying cost per tonne refers to the energy requirement for on-site wood by-product drying. This may or may not be required and will depend on the moisture content of wood by-products.

The individual cost items are aggregated into a total cost function for the collection and delivery of wood by-products to a suitable facility for use as a suitable feedstock for bioenergy.

This generic model could similarly be applied to other potential bioenergy sites.

Table 25. Wood fuel cost model inputs and parameters

Wood fuel cost model	
Wood fuel supplier	*Sawmiller or wood processor*
A. Volume of consignment	(t)
B. % wood fuel type (as decimal)	
B_1 Green sawdust	0.5
B_2 Green chip fines	0.25
B_3 Green dry shavings	0.25
Costs	
SEFE door wood fuel cost	
C. Value per tonne	($)
D. Total cost to SEFE gate	**D = (A * C) * B_n**
Haulage cost	
E. Value per km	($)
F. Haulage distance	(km)
G. Total haulage cost	**G = (E * F) * B**
On-site handling	
H. Labour cost per tonne	($)
I. Energy cost per tonne	($)
J. Processing cost per tonne	($)
K. Drying cost per tonne	($)
L. Volume of consignment adjusted (t_{adj})	(A * B)
M. Handling cost	**M = (H + I + J + K) *L**
N. Totals	**N = (D + G+ M)**

LITERATURE REVIEW

Wood by-product processes and handling for use as biomass fuel relevant to Sawmills in South East Australia

In brief

Wood by-products generated from the processing of solid wood products, such as through sawmilling, can be utilised for the generation of renewable energy. The handling of this wood by-product resource is important when considering supply of wood biomass from sawmills and other wood processing facilities for bioenergy markets.

This Literature Review is a summary of readily available information relevant to wood by-product handling processes and technologies utilised in sawmilling, wood chipping and other timber product processing operations. The scope is limited to realistic options for potential adoption by the sawmilling and processing industry in the study region, being South East NSW and North East Gippsland in Victoria, although many aspects will be relevant to the wider industry.

Overview

The sustainable use of bioenergy is a major opportunity to address climate change[1] and the potential for bioenergy in Australia is large and diverse. Unused biomass residues and wastes are documented as being a significantly under-exploited resource[2], yet the use of bioenergy is a renewable energy option with an already established technological base. Notwithstanding the current renewable energy policy environment, systems are available for far greater adoption and investment of wood-to-bioenergy technologies in Australia.

South East Fibre Exports (SEFE) has a proposal to install a 5MW bioenergy facility at its wood chip plant near Eden, on the NSW South Coast. This bioenergy plant is planned to be fed on wood by-products from the SEFE wood chipping operation, and also from wood by-products generated by the sawmilling and wood processing industry in the nearby region.

As identified by the assessment of sawmill by-products in the region, there is potential for supply of around 23,500 tonnes of hardwood biomass per year from nearby operations[3]. This is in addition to the potential of the on-site chip operations to produce biomass feedstock from wood by-products, which is estimated at around 118,500 tonnes per year[4]. Nor does it include the softwood by-products generated from the TASCO sawmill at Bombala, which is estimated to produce around 82,000 tonnes by 2014[3].

The traditional-design sawmills in the region vary in scale from an annual log intake of 7,000m^3 to 50,000m^3 annually[5]. With the exception of the TASCO softwood processing operation at Bombala, sawmills are relatively small therefore technologies explored in this literature review are relevant to these traditional and relatively modest scale operations. Further detail of the timber processing

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[1] Berndes, G. et al. 2010. Bioenergy, Landuse Change and Climate Change Mitigation. IEA Bioenergy.

[2] ABARE 2011. Australian Energy Resource Assessment. Chapter 12 Bioenergy.

[3] South East Region Wood By-product Summary. 2010. South East Fibre Exports. Prepared as part of the SEFE Biomass Handling Project, funded by the Australian Government Department of Agriculture, Fisheries and Forestry.

[4] Schuck. S. 2007. Biomass Energy Study. Prepared for South East Fibre Exports.

[5] South East Region Sawmill By-product Report. 2010. South East Fibre Exports. Prepared as part of the SEFE Biomass Handling Project, funded by the Australian Government Department of Agriculture, Fisheries and Forestry.

industry within a 200km radius of the Eden area is provided in the South East Region Sawmill By-product Report, prepared as part of the SEFE Sawmill Biomass Fuel Project, funded by the Australian Government Department of Agriculture, Fisheries and Forestry, through the Forest Industries Climate Change Research Fund.

Scope of literature review

Findings of the literature review are specific to technologies in wood by-product handling. The review covers issues of biomass hygiene and moisture management through to specific wood by-product handling equipment that can be practically applied to timber saw millers and processors in the study region.

Wood by-product recovery

Available wood by-products suitable for bioenergy

Sawdust

Sawing is generally conducted on comparatively recently harvested logs. Therefore sawdust wood by-product will be mostly green, reflecting the moisture content of the log entering the mill.

Chip fines

Chipping is generally conducted on comparatively recently harvested logs. Therefore chip wood by-product will be mostly green, reflecting the moisture content of the log entering the mill.

Shavings

Moulding of sawn timber is generally conducted on seasoned product. Therefore sawdust is mostly dry, reflecting the seasoning process of timber prior to entering moulding and planning machinery for final dressing.

Considerations for handling

Sawdust, wood shavings and chip fines have generally a desirable calorific value, dimension and moisture content for immediate use as feedstock for bioenergy generation.

Other wood by-products

Other wood by-products include bark and oversize chip.

Bark will be often green and reflect the moisture content of the harvested log and the time since harvesting. For hardwood logs from multiple use public forests in South East Australia, debarking is generally conducted at harvest sites, whereas softwood, as in the case of the TASCO sawmill in Bombala, debarking is conducted at the processing facility.

Oversize chip produced from the chipping process is often only available in small volumes and requires additional processing into a smaller section size to be marketable as a biomass feedstock.

Further grinding and processing is required before large section size wood by-products like bark and oversize chip is ready as a feedstock for a wood-to-bioenergy facility. Either at the wood processing facility (point of wood by-product generation) or at the wood-to-bioenergy facility itself, large wood pieces will require re-processing to reduce section size suitable for bioenergy generation.

Managing moisture content

Moisture management requires consideration of the energy balance of wood by-products. Energy balance requires careful consideration of local conditions such as ambient air temperature and seasonal conditions[6].

It will be generally unfeasible for South East Australia sawmills to consider kiln drying green wood by-products to achieve optimum calorific value for use as biomass fuel. Managing wood fuel moisture will be best conducted adjacent to the biomass energy facility, where wood fuel is handled and fed into the boiler.

At the biomass facility wood fuels can be mixed and sorted to enable a consistent flow of optimum calorific value wood fuel into the boiler. The design of the proposed biomass facility for the SEFE site does not require bone dry wood for optimum energy production, but rather a fuel moisture content of around 40%[7]. Mixing fuels at the facility, such as dry sawdust with green chip fines for instance, will be important in maintaining a consistent quality of fuel into the boiler.

At the sawmill synergies with other fuel supplies need not be a consideration. Due to economies of scale, passive moisture management practices and segregation of by-products will be a feasible option for sawmills in the South East.

Passive moisture management in wood by-product deposits at sawmills will rely on air drying and in some cases sheltering from rain. The on-site storage of wood by-products is discussed further below.

Segregation of wood by-products, as part of sawmill operations, will enable consistencies in supply. Mixed loads will vary in moisture content whereas segregated loads enable more predictability in supply.

Wood-to-bioenergy facilities will generally source wood biomass in a section size suitable for feedstock. This means wood pieces mostly finer, but no greater than 40mm diameter.

Depending on cost and equipment requirements it may not be economically justifiable to mechanically reduce section size of large wood pieces for use as biomass fuel.

Strategies for moisture management

Protection against moisture ingress through rain is important for maintaining a consistent quality of biomass product.

Storing biomass to protect against moisture ingress will be best achieved through sealed containerisation, such as overhead hoppers.

Bunker storage systems, at the very least, need to be rooved to protect against rain.

Managing contamination

Contamination of wood by-product is problematic and causes significant wear and tear and mechanical failures to biomass facilities. The source of contamination generally occurs in the collection and storage of wood by-product biomass. Managing contamination is important and will ultimately impact the value of the wood by-product as a bioenergy feedstock. The higher the hygiene

[6] Smith, D. 2010. Strategic Material Handling Systems for Biomass Energy Facilities. Bruks presentation. USA

[7] Schuck. S. 2007. Biomass Energy Study. Prepared for South East Fibre Exports.

standards and protection of by-product against contamination, the higher the value the product can expect to receive for bioenergy production[8].

Contaminated product impacts the efficiency of a biomass energy facility. Contaminated product will correlate with down time in bioenergy production. Contamination from stones and steel will cause breakdowns and abnormal wear and tear within the biomass facility. From these problems it can be expected an increase in stoppages for maintenance and to replace parts. In the boiler component of a biomass energy facility 'glazing' can occur from steel and stone contaminants, causing reduced boiler performance[8].

Combustion of wood waste contaminated with metal fragments will also negatively impact emissions. Higher concentrations of arsenic, chromium, zinc, nickel, lead, mercury and cadmium, amongst other possible heavy metal can be expected with emissions from bioenergy wood furnaces where wood feedstock is contaminated with metal[9].

Contamination can be managed where proper procedures are put in place at the sawmill and the bioenergy facility to maintain wood by-product hygiene. Avoided contamination can be gained through good housekeeping, good loader driver practice and sealed areas for wood by-product storage and handling.

Strategies to manage contamination

Good hygiene practices are imperative to protecting wood biomass from contamination.

Concrete floors in biomass storage areas can be effective in protecting against rock and soil contaminants.

Conveyor systems require careful design to maintain biomass hygiene.

Outdoor storage and earthen floored areas expose biomass to contamination.

Sorting, screening and biomass segregation

Screening describes the process during which material is passed over a physical barrier that selectively allows a fraction of the waste stream to pass through or over this barrier on the basis of particle size. Screening technologies are commonly used to remove rock and grit, metals, and other foreign materials from waste streams, and subsequently to screen fibres into suitable size fractions for re-use[10].

Considerations for segregation

Screen shakers that segregate particle size is a common feature in sorting woodchips from wood by-products amongst traditional hardwood sawmills in the South-East region[11]. Flat or inclined vibratory screen screens (or sieves) involve a mesh grid with a certain passing size.

Materials are placed on top of the screens. These screens are then mechanically vibrated. Smaller sized particles fall through under gravitational force.

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[8] Smith, D. 2010. Strategic Material Handling Systems for Biomass Energy Facilities. Bruks presentation. USA

[9] J. Krook et al (2002) Metal contamination in recovered waste wood used as energy source in Sweden

[10] Warnken, M. .2001. Utilisation Options for Wood Waste: A Review of European Technologies and Practices. J.W. Gottstein Memorial Trust Fund.

[11] South East Region Wood By-product Summary. 2010. South East Fibre Exports. Prepared as part of the SEFE Biomass Handling Project, funded by the Australian Government Department of Agriculture, Fisheries and Forestry.

Screening and separating different residue types will be important in maintaining consistency and reliability in supply of biomass into wood-to-bioenergy markets.

An effective screening and conveying system will transport biomass to storage points efficiently whilst protecting biomass from contamination.

The system will need to integrated into the biomass storage system, as well as to the existing sawmill or wood processing operation.

Conveyor systems for moving biomass on-site

Various low friction techniques for moving conveyor belts are available, from the typical roller system to more modern air cushioning systems.

Conveyor systems are already common practice for handling wood chips, as well as for handling wood by-products amongst the wood processing industry in the regionl[11].

Closed air flow or exhaust ventilation systems

Another method for moving biomass on-site is with local exhaust ventilation (LEV) systems or otherwise known as closed air flow systems. LEV removes dust at or near the dust source and systems can often be integrated with machine guards to improve safety and operation. Exhaust hoods of a LEV should be located as close as possible to the dust emission source (i.e. on the woodworking machinery itself or nearby), and must incorporate an efficient air and filter cleaning device[12].

LEV systems move by-products directly from the point of generation to storage points. An LEV system of this construct is in operation at North Eden Timber[11].

LEV systems require specific complementary biomass storage systems. Rather than bunker systems, direct biomass injection into bins or containers is required.

Design will also need to consider loading into haulage vehicle systems, and should aid efficient loading systems, such as bin emptying directly to haulage vehicle.

Excellent hygiene standards can be expected from these systems.

Storing biomass on-site

Overhead hopper systems

There is potential to apply the same overhead hopper systems for sawdust, chip fines and shavings, which are common practice from storing woodchips amongst the wood processing industry in the study region[13].

These systems will require integration into screening and conveyor systems. Overhead hopper systems adapt well to conveyor systems, where biomass can be moved to significant heights.

Good hygiene standards can be maintained using overhead hopper systems, especially protection from moisture ingress.

Overhead hopper systems aids very efficient loading of haulage vehicles. Transport systems are already equipped for loading from overhead hopper systems.

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[12] Forest & Wood Products Australia. 2008. Wood Recovery and Recycling: A source book for Australia.

[13] South East Region Wood By-product Summary. 2010. South East Fibre Exports. Prepared as part of the SEFE Biomass Handling Project, funded by the Australian Government Department of Agriculture, Fisheries and Forestry.

Bunker systems

It is important that bunker systems for storing biomass provide protection from rain and contaminants. Bunker systems of varying quality are utilised amongst the wood processing industry in the regionl[13].

Moisture ingress can make the biomass too wet as well as initiate decomposition. Both will reduce calorific value and therefore energy generation potential.

Bunker systems that include rooves and at least three walls can be adapted to screening and conveyor handling systems.

Design will also need to consider loading to haulage vehicle which will generally be done by front end loader.

Overhead conveyors directly feed bunker systems.

Concrete based bunkers provide good hygiene standards, protecting against rock and soil contamination.

Bunkers are best applied where biomass is stored for only short periods.

For best efficiency, haulage vehicles must have clear and manoeuvrable access to bunkers.

Wood by-product transport

The logistics and hence costs associated with the collection and transport of wood by-products present significant challenges, with factors such as scale, geography and system optimisation being key determinants[14].

Front end loading will be suitable for modest operations with relatively small volumes of generated wood by-products. Front end loading is common practice for loading wood chips into haulage vehicles[13].

Ramps to aid loading to haulage vehicles can be incorporated to improve loading efficiency.

Caution needs to be taken to avoid contamination when loading, through soil and stones collected by the loader bucket.

Knowledge gaps

Occupational Health and Safety

OH&S issues were difficult to assess as part of this review. The information gathered was fragmented and in almost all circumstances did not provide detail as to OH&S issues related to biomass handling systems per se.

International experiences

While many publications covered international experiences in bioenergy technologies and investment very little of this information was specific to biomass handling systems. No manuals or strategy document specific to biomass handling were identified as part of this review.

Strategies for biomass handling at the source point

There are significant publications available that discuss the handling of biomass at the biomass facility, but little in relation to handling at the source. For instance, no publications discussed handling sawmill by-products at the source in any more than general terms.

[14] Forest & Wood Products Australia. 2008. Wood Recovery and Recycling: A source book for Australia.

Costs of biomass handling systems

While cost information was attainable from individual engineers and product suppliers, such as suppliers of conveyor belt systems, cost information for generic biomass handling systems was not available. It was considered not a useful exercise to attempt to cost a new handling system, as wood processors are more likely to adapt current systems, such as adjustments to existing conveyor systems as well as the acquisition of, in some instances, second hand components.

APPENDIX 1

A guide to handling wood by-products for use in bioenergy

APPENDIX 2.

Stakeholder engagement findings

Adams Hardwood Sawmill

Date of meeting: 5th Aug 2010

Attendance:

- Peter Adams (Owner/Manager)
- James Gray (Project resource officer)

Mill name: P.R. Adams Pty Ltd

Location: Nowa Nowa Vic

Distance to SEFE: 219km

Interest in supplying wood residue for SEFE bioenergy generation: P.R. Adams Pty Ltd provided a positive response to the concept of biomass to renewable energy generation supply to the proposed SEFE facility, although distance could be a significant challenge. Adams has been successful at finding markets for some of the wood residues.

Summary of current operation

The current Adams Hardwood operation involves a traditional hardwood sawmilling operation. Resource accessed from VicForests mountain and coastal forest areas in NE Gippsland. Products and markets include green sawn solid timber, for decking and other outdoor use and some kiln dried, dressed products. The operation involves 10 staff and has an annual round log intake of around 10,000 m^3. Developed markets are established for wood residues. There is no incineration-to-waste conducted on-site.

Species composition

Species	% of intake	% of recover (solid wood products)
Mixed: Alpine & Mt Ash, Messmate, Brown Barrel, Grey Gum	100	n/a

Basic stats of operation

Total log input: 10,000 m^3/yr

Total solid wood product output: n/a

Types and volume of residues generated

Sawdust (wet & dry): 2,200m^3/yr

Chip (wet): 10,850 m^3/yr

Fines (wet): 935 m^3/yr

Dockings, solid off-cuts, hearts: Not measured in this project.

Residue production

Type of Residue	Output (t/yr)	Compaction (vol:wt)	Output (m^3/yr)	Explanation of Residue
Sawdust	733	3:1	2,200	Green saw sawdust and planner shavings mixed
Chip		?:1	10,850	SEFE Chips
Fines	312	3:1	935	Fines off chips

Categorisation of Residue Products

Attributes table: wood waste

Type of Residue(X)	Purity	Storage 2013/14	Handling 2013/14	Current market	Transport to Market
Sawdust (wet and dry)	Clean	Outdoor storage	Blower, conveyor	Yes	Semi-trailer
Chip (wet)	Clean	Direct to hopper – weekly empty	Conveyor to hopper	SEFE	Semi-trailer
Fines (wet)	Clean	Outdoor storage	Conveyor under chip shaker	Yes	Semi-trailer

Storage	• Sawdust off the green saw is heaped outdoors via conveyor. Pile is adjacent to sawmill on a soil floor. Pile is removed infrequently to market. Area allows some longer term storage. Some purity issues with soil and oil. • Chip from screen shaker is stored in double-hoppers. • Fines from chipping are heaped outdoors via conveyor. Pile is adjacent to chipper on a soil floor. Pile is removed infrequently to market. Area allows some longer term storage. Some purity issues with soil and oil. • Duration of time for on-site storage: - Sawdust (wet): Hauled off-site infrequently to weekly (Semi-trailers) - Chip (wet): Hauled off-site weekly to twice weekly (Semi-trailers) - Fines (wet): Hauled off-site infrequently to weekly (Semi-trailers)
Handling	• Sawdust is moved from integrated green saw operation via conveyor. Full exposure to weather. • Chip is shaken onto conveyor direct to twin hopper. Trap doors drop chip directly into semi-trailers below. • Fines are handled by conveyor to outdoor deposit. Full exposure to weather.
Haulage considerations	• Sawdust is hauled off-site to customer. Loading is conducted on-site by front end loader directly into truck containers, adjacent to wood residue storage. • Chips are transport by semi-trailer to SEFE. Gravity from hopper to containers. • Fines are marketed as mulch. Loading is conducted on-site by front end loader directly into truck containers, adjacent to wood residue storage.

Auswest Timber Brodrib

Date of meeting: 5th Aug 2010

Attendance:

- Jack Light (Mill Manager)
- James Gray (Project resource officer)

Mill name: Auswest Timber Brodribb

Location: Brodrib Vic

Distance to SEFE: 171km

Interest in supplying wood residue for SEFE bioenergy generation: Auswest Timber provided a positive response to the concept of biomass to renewable energy generation supply to the proposed SEFE facility, although distance could be a significant challenge. Auswest have been successful at finding markets for some of the wood residues.

Summary of current operation

The current Auswest Brodrib operation involves a significant green saw hardwood operation. Resource accessed from VicForests mountain and coastal forest areas in NE Gippsland. Products include green sawn solid timber, for decking and other outdoor use, the majorityt of which is value added further before market from the Auswest Bairnsdale operation. Some air drying is conducted on-site. The Brodrib operation involves 42 staff and has an annual round log intake of around 52,000 m^3.. Developed markets are established for wood residues. As of recently, there is no longer incineration-to-waste conducted on-site.

Species composition

Species	% of intake	% of recover (solid wood products)
Messmate and Brown Barrel	65	34
Grey Gum, Shining Gum, Silvertop Ash, Stringy, Manna, etc	35	34

Basic stats of operation

Total log input: 52,000 m^3/pa

Total solid wood product output: n/a

Total wood residue (wet): 40,900 t/pa (residue suitable for bioenergy)

Types and volume of residues generated

Sawdust (wet): 12,750 t/pa

Chip (wet): 23,900 t/pa

Fines (wet): 4,250 t/pa

Dockings, solid off-cuts, hearts: Not measured in this project

Residue production

Type of Residue	Output (t/yr)	Compaction (conversion)	Output (m^3/yr)	Explanation of Residue
Sawdust	12,750	3:1	38,250	Green-saw sawdust and planner shavings mixed
Chip	23,900	2.55:1	60,945	SEFE Chips
Fines	4,250	3:1	12,750	Fines off chips

Categorisation of Residue Products

Attributes table: wood waste

Type of Residue(X)	Purity	Storage 2013/14	Handling 2013/14	Current market	Transport to Market
Sawdust (wet and dry)	Clean	Outdoor bunker (no roof)	Blower, conveyor and FEL	Yes	Semi-trailer 2-3 times per day
Chip (wet)	Clean	Direct to hopper	Conveyor to hopper	SEFE	Semi-trailer daily
Fines (wet)	Clean	Outdoor bunker (no roof)	Conveyor under chip shaker and FEL	Yes	Semi-trailer 2-3 times per day

Storage	• Sawdust off the green saw is heaped in concrete floored outdoors bunkers via conveyor. Pile is removed throughout the day. No long term storage is conducted on-site. Site is clean and should maintain good purity. • Chip from screen shaker is stored in double-hoppers. • Fines from chipping are heaped in concrete floored outdoors bunkers via conveyor. Pile is removed throughout the day. No long term storage is conducted on-site. Site is clean and should maintain good purity. • Duration of time for on-site storage: - Sawdust (wet): Hauled off-site daily (Semi-trailers) - Chip (wet): Hauled off-site daily (Semi-trailers) - Fines (wet): Hauled off-site daily(Semi-trailers)
Handling	• Sawdust is moved from integrated green saw operation via conveyor. Some exposure to weather, but regularly loaded into trucks. • Chip is shaken onto conveyor direct to twin hopper. Trap doors drop chip directly into semi-trailers below on a daily basis. • Sawdust is moved from integrated green saw operation via conveyor. Some exposure to weather, but regularly loaded into trucks.
Haulage considerations	• Sawdust is hauled off-site to the customer. Loading is conducted on-site by front end loader directly into truck containers, adjacent to wood residue bunkers. Other garden markets are also accessed for this product. • Chips are transport by semi-trailer to SEFE. Gravity from hopper to containers. • Fines are hauled off-site to the customer. Loading is conducted on-site by front end loader directly into truck containers, adjacent to wood residue bunkers.

Blue Ridge Hardwood

Date of meeting: 4/08/10

Attendance:

- Noel Hall (Green mill Manager)
- James Gray (Project resource officer)

Mill name: Blue Ridge Hardwood

Location: Eden NSW

Distance to SEFE: 37km

Interest in supplying wood residue for SEFE bioenergy generation: Blue Ridge Hardwoods provided a positive response to the concept of biomass to renewable energy generation supply to the proposed SEFE facility could be a significant challenge. Blue Ridge has been successful at finding markets for some of the wood residues, and has looked at on-site bioenergy options in the past.

Summary of current operation

The current Blue Ridge operation involves a significant hardwood sawmilling and solid wood product processing operation. Resource accessed from VicForests and Forests NSW mountain and coastal forest areas in the SE region. Products and markets are shifting and include green sawn and kiln dried solid timber, for wide application from structural to flooring. The operation involves 55 staff and has an annual round log intake of around 38,000 m^3. Developed markets are established for some wood residues. Some of the green sawdust and dry shavings are used on site as fuel for heating the kilns. There is no incineration-to-waste conducted on-site.

Species composition

Species	% of intake	% of recover (solid wood
Mountain Spp. Messmate, Brown Barrel, mixed gum	60	n/a
Coastal Spp. Silvertop Ash, Stringybark, etc	40	n/a

Basic stats of operation

Total log input: 38,000 m^3/yr

Total solid wood product output: n/a

Total wood residue:

Types and volume of residues generated

Sawdust (wet): 16,275m^3/yr

Chip (wet): See SEFE chip data

Fines (wet): 6,510 m^3/yr

Shavings (dry): 16,275m^3/yr

Dockings, solid off-cuts, hearts: Not measured in this project

Residue production

Type of Residue	Output (t/yr)	Compaction (vol:wt)	Output (m3/yr)	Explanation of Residue
Sawdust	5,425	3:1	16,275	Green saw sawdust
Chip	n/a	n/a	n/a	SEFE Chips
Fines	2,170	3:1	6,510	Fines off chips
Shavings (dry)	1,628	10:1	16,275	Planner shavings after kiln drying

Categorisation of Residue Products

Attributes table: wood waste

Type of Residue(X)	Purity	Storage 2013/14	Handling 2013/14	Current market	Transport to Market
Sawdust (wet)	Clean	Three sided shed (roof) – daily empty	Blower, conveyor	Yes + on-site use (kilns)	Semi-trailer
Chip (wet)	Clean	Direct to hopper – daily empty	Conveyor to hopper	SEFE	Semi-trailer
Fines (wet)	Clean	Bunker (roof) –weekly empty	Conveyor under chip shaker	Yes	Semi-trailer
Shavings(dry)	Clean	Soil bunker (sealed roof)	Conveyor	Yes + on-site use (kilns)	Semi-trailer

Storage	• Sawdust off the green saw is heaped via overhead conveyor in a three-sided shed with roof. Storage is only enough for daily handling and haulage off-site (some on-site use – kilns). There are no longer term storage facilities. • Chip from screen shaker is stored in double-hoppers with a 150 m^3 total capacity. • Fines from chipping are heaped via overhead conveyor in a three side area without roof. Pile is adjacent to chipper on a soil floor. Pile is removed around twice weekly to market. Area is limited and without longer term storage. • Shavings are heaped via overhead conveyor in a three-sided shed with roof. Storage is only enough for daily handling and haulage off-site (some on-site use – kilns). There are no longer term storage facilities. • Duration of time for on-site storage: • Sawdust (wet): Hauled off-site daily (Semi-trailers) - Chip (wet): Hauled off-site daily (Semi-trailers) - Fines (wet): Hauled off-site weekly (Semi-trailers) - Shavings (dry): Hauled off-site daily (Semi-trailers)
Handling	• Sawdust is moved from integrated green saw operation via overhead conveyor. Good purity observed. • Chip is shaken onto conveyor direct to twin hopper. Trap doors drop chip directly into semi-trailers below. Good purity observed. • Fines are handled by overhead conveyor to short term deposit. Good purity observed. • Sawdust is moved by air-blower/suction and overhead conveyor. Good purity observed.
Haulage considerations	• Sawdust is hauled off-site daily to the customer. Some use on-site (kilns). Loading is conducted on-site by front end loader directly into truck containers, adjacent to wood residue storage. • Chips are transport by semi-trailer to SEFE. Gravity from hopper to containers. • Fines are marketed as mulch. Loading is conducted on-site by front end loader directly into truck containers, adjacent to wood residue storage. • Sawdust is hauled off-site daily to the customer. Some use on-site (kilns). Loading is conducted on-site by front end loader directly into truck containers, adjacent to wood residue storage.

Boral Timber

Date of meeting: 25th Aug 2010

Attendance:

- Brett Longstaff (Plant Manager)
- James Gray (Project resource officer)
- Mick Stephens (NAFI and Project Steering Committee)

Mill name: Davis and Herbert Boral Sawmill

Location: Narooma NSW

Distance to SEFE: 175km

Interest in supplying wood residue for SEFE bioenergy generation: Brett provided a positive response to the concept of better utilisation of waste. Boral have been successful at finding markets for some of the wood residues.

Summary of current operation

The current Boral Narooma operation involves a green saw hardwood operation. Resource accessed from Forests NSW mountain and coastal forest areas in SE NSW. A very small proportion of resource is accessed from private land. Products include green sawn solid timber, for flooring, pallets and bridge building, the most of which is value added further before market from other Boral operations. The operation involves about 22 staff and has an annual round log intake of around 25,000 m^3. Developed markets are established for wood residues. There is some incineration-to-waste conducted on-site.

Species composition

Species	% of intake	% of recover (solid wood products)
Spotted gum, Yellow stringybark, Black butt, Brown barrel, Silvertop Ash, Peppermint	100	n/a

Basic stats of operation

Total log input: 18,000 m^3/pa

Total solid wood product output: n/a

Types and volume of residues generated

Sawdust (wet): 1,900 t/pa

Fines (wet): 750 t/pa

Dockings, solid off-cuts, hearts: Not measured in this project

Residue production

Type of Residue	Output pa (t/yr)	Compaction (vol:wt)	Output pa (m^3/yr)	Explanation of Residue

Sawdust	1,900	3:1	5,700	Green saw sawdust
Chip	0	2.55:1	0	SEFE Chips
Fines	750	3:1	2,250	Fines off chips

Categorisation of Residue Products

<u>Attributes table: wood waste</u>

Type of Residue(X)	**Purity**	**Storage 2013/14**	**Handling 2013/14**	**Current market**	**Transport to Market**
Sawdust (wet and dry)	Clean	Outdoor bunker (no roof)	Conveyor to indoor deposit	Yes	Semi-trailer 2-4 times per week
Chip (wet)	Clean	Direct to hopper	Conveyor to hopper	SEFE	
Fines (wet)	Clean	Outdoor bunker (no roof)	Conveyor to hopper	Yes	Semi-trailer 1-2 times per week

Storage	• Overhead hopper and should maintain good purity. If not hauled, long term outdoor storage on-site plus incineration. • Chip from screen shaker is stored in double-hoppers. • Sawdust off the green saw is heaped in concrete floored indoors. Pile is removed throughout the day. Site is clean and should maintain good purity. If not hauled, long term outdoor storage on-site plus incineration. • Duration of time for on-site storage: - Sawdust (wet): Hauled off-site weekly if possible (Semi-trailers) - Chip (wet): Hauled off-site weekly (Semi-trailers) - Fines (wet): Hauled off-site weekly if possible (Semi-trailers)
Handling	• Sawdust is moved from green saw operation via conveyor deposited in overhead hopper. Needing replacement. • Chip is shaken onto conveyor direct to twin hopper. Trap doors drop chip directly into semi-trailers below regularly. • Sawdust is moved from green saw operation via conveyor deposited indoors initially.
Haulage considerations	• Sawdust is hauled off-site to the Bega Cheese Factory via Merimbula. Loading is conducted on-site by trap overhead door. Other garden markets are also accessed for this product. • Chips are transport by semi-trailer to SEFE. Gravity from hopper to containers. • Fines are hauled off-site to the local garden market. Loading is conducted on-site by front end loader directly into truck containers, adjacent to wood residue deposit.

Hallmark Oaks

Date of meeting: 5th Aug 2010

Attendance:

- Bob Humphries (Mill Owner/Manager)
- James Gray (Project resource officer)

Mill name: Hallmark Oaks Hardwood Mill

Location: Cann River Vic

Distance to SEFE: 107km

Interest in supplying wood residue for SEFE bioenergy generation: Bob provided a positive response to the concept of biomass to renewable energy generation supply to the proposed SEFE facility, and has been involved in biomass handling assessment work with SEFE in the past. Hallmark Oaks have been successful at finding markets for some of the wood residues.

Summary of current operation

The current Hallmark Oaks operation involves a traditional hardwood sawmilling operation with dressing and kiln drying infrastructure. Resource accessed from VicForests mountain and coastal forest areas in NE Gippsland. Products include green sawn and value added solid timber, for decking and other outdoor use. The operation involves 13 staff and has an annual round log intake of around 11,500 m^3. Developed markets are established for wood residues. There is incineration-to-waste conducted on-site.

Species composition

Species	% of intake	% of recover (solid wood products)
Messmate, Brown Barrel, Grey Gum, Shining Gum, Silvertop Ash, Stringy, Manna, etc	100	40

Basic stats of operation

Total log input: 11,500 m^3/yr

Total solid wood product output: n/a

Types and volume of residues generated

Sawdust (wet): 12,750 t/yr

Chip (wet): 23,900 t/yr

Fines (wet): 4,250 t/yr

Shavings (dry): 600 t/yr

Dockings, solid off-cuts, hearts: Not measured in this project

Residue production

Type of Residue	Output (t/yr)	Compaction (conversion)	Output (m3/yr)	Explanation of Residue
Sawdust	1,600	3:1	38,250	Green saw
Chip		2.55:1		SEFE Chips
Fines	700	3:1	2,100	Fines off chips
Shavings (dry)	600	10:1	6,000	Dry shavings and sawdust

Categorisation of Residue Products

Attributes table: wood waste

Type of Residue(X)	**Purity**	**Storage 2013/14**	**Handling 2013/14**	**Current market**	**Transport to Market**
Sawdust (wet)	Clean	Outdoor deposit (no roof)	conveyor to deposit	Yes	Semi-trailer 2-3 times per day
Chip (wet)	Clean	Direct to hopper	Conveyor to hopper	SEFE	Semi-trailer daily
Fines (wet)	Clean	Outdoor deposit (no roof)	Conveyor to deposit	Yes	Semi-trailer 2-3 times per day
Shavings (dry)	Clean	Outdoor deposit (no roof)	Blower/load to deposit	Yes	Semi-trailer

Storage	• Sawdust off the green saw is heaped in concrete floored outdoors bunkers via conveyor. Pile is removed throughout the day. No long term storage is conducted on-site. Site is clean and should maintain good purity. • Chip from screen shaker is stored in double-hoppers. • Fines from chipping are heaped in concrete floored outdoors bunkers via conveyor. Pile is removed throughout the day. No long term storage is conducted on-site. Site is clean and should maintain good purity. • Dry shavings are stored on a soil floored surface and removed periodically. • Duration of time for on-site storage: • Sawdust (wet): Hauled off-site daily (Semi-trailers) - Chip (wet): Hauled off-site daily (Semi-trailers) - Fines (wet): Hauled off-site daily(Semi-trailers) - Dry shavings (dry): Hauled off-site periodically (Semi-trailers)
Handling	• Sawdust is moved from integrated green saw operation via conveyor. Some exposure to weather, but regularly loaded into trucks. • Chip is shaken onto conveyor direct to twin hopper. Trap doors drop chip directly into semi-trailers below on a daily basis. • Fines are handled by conveyor system and front end loader. • Dry shavings by air flow system and front end loader.
Haulage considerations	• Sawdust and dry shavings hauled off-site to the customer. Loading is conducted on-site by front end loader directly into truck containers, adjacent to wood residue bunkers. Other garden markets are also accessed for this product. • Chips are transport by semi-trailer to SEFE. Gravity from hopper to containers. • Fines are hauled off-site to the customer. Loading is conducted on-site by front end loader directly into truck containers, adjacent to wood residue bunkers. • Dry shavings are hauled off-site to the customer periodically.

Jameson Bros

Date of meeting: 24/07/10

Attendance:

- Ray Jameson (Owner/Manager)
- James Gray (Project resource officer)

Mill name: Jameson Bros – Hardwood sawmill

Location: Bendock NSW

Distance to SEFE: 157km

Interest in supplying wood residue for SEFE bioenergy generation: Jameson Bros provided a positive response to the concept of supplying woody resource for biomass renewable energy generation at the proposed SEFE facility. Ray has been successful at finding markets for the wood residue but would consider supply to SEFE on economic grounds.

Summary of current operation

The current Jameson Bros operation involves a traditional hardwood sawmilling operation. 100% of resource accessed from VicForests mountain areas in North East Gippsland. Products include green sawn structural timber, flooring, decking, etc. The operation involves 10 full time staff and has an annual round log intake of around 7,000 m^3. The average recovery into solid wood products is 39%. Developed markets are established for wood residues, although stockpiling is conducted for sawdust and mulch. 70% of log intake is c-grade and 30% d-grade.

Species composition

Species	% of intake	% of recover (solid wood products)
Messmate	80	39
Mixed gum (Manna, Shinning, etc)	20	39

Summary of projected operation from 2013/14

Total log input: 7,000 m^3/yr

Total solid wood product output: n/a

Types and volume of residues generated

Sawdust (wet): 1,250 t/yr

Fines (wet): 600 t/yr

Residue production

Type of Residue	Output (t/yr)	Compaction (vol:wt)	Output (m3/yr)	Explanation of Residue
Sawdust	1,250	3:1	3,750	Green saw shavings
Chip	3,600	n/a		SEFE Chips
Fines	600	3:1	1,800	Fines off chips

Categorisation of Residue Products

Attributes table: wood waste

Type of Residue(X)	**Purity**	**Storage 2013/14**	**Handling 2013/14**	**Current market**	**Transport to Market**
Sawdust (wet)	Clean	Shed (roof)	Blower, belt under saw	YES	B-double and semi-trailer
Chip (wet)	Clean	Concrete bunker (no roof)	Conveyor to hopper	SEFE	B-double and semi-trailer
Fines (wet)	Clean	Concrete bunker (sealed roof)	Conveyor under chip shaker	YES	B-double and semi-trailer

Storage 2013/14	• Sawdust is stored in-shed with soil floor. Shed situated away from green saw via conveyor. • Chip from screen shaker is stored in 2*30 tonne hoppers via conveyor. • Fines falling through screen shaker are deposited in a pile outdoors via conveyor. Pile is adjacent to chipper on a soil floor. Moved daily to heaps further from operation for longer term storage. • Duration of time for on-site storage: - Sawdust (wet): Hauled off-site on non-regular intervals when markets emerge - Chip (wet): Hauled off-site weekly (Semi-trailers) - Fines (wet): Stored on-site for potentially months as hauled off-site as markets emerge
Handling 2013/14	• Sawdust is moved from green saw to conveyor through air blower/suction system. Conveyor moves sawdust to storage shed. • Chip is shaken onto conveyor direct to twin hopper. Trap doors drop chip directly into semi-trailers below. Good purity. • Fines are handled by conveyor to daily deposit then moved by front end loader to longer term outdoor storage area. Mud, oil and debris can is some part impacts purity.
Haulage considerations 2013/14	• Sawdust, chips and fines: • Transport of residue conducted with semi-trailer to market • Loading chip is direct gravity from hopper to container • Loading sawdust and fines is conducted on-site by front end loader directly into containers, adjacent to wood residue storage

Mectech

Date of meeting: 24/07/10

Attendance:

- Clinton Mekken (Resource Manager)
- James Gray (Project resource officer)

Mill name: Mectech – Hardwood sawmill

Location: Newmeralla Vic

Distance to SEFE: 187km

Interest in supplying wood residue for SEFE bioenergy generation: Mectech provided a positive response to the concept of biomass to renewable energy generation, although noted the feasibility of transport to the proposed SEFE facility could be a significant challenge. Clinton has been successful at finding markets for some of the wood residues, and has looked at on-site bioenergy options in the past.

Summary of current operation

The current Mectech operation involves a traditional hardwood sawmilling operation. 100% of resource accessed from VicForests mountain and coastal forest areas in North East Gippsland. Products include green sawn structural timber, flooring, decking as well as dressed, kiln dried solid wood products. Mecteck are planning to up-grade the dressing/moulder infrastructure in the near future which will increase the volume. The operation involves 10 full time staff and has an annual round log intake of around 7,500 m^3. Developed markets are established for some wood residues, although much is incinerated on-site. Data is largely not available for true residue generation potential due to the reliance on incineration.

Species composition

Species	% of intake	% of recover (solid wood products)
Messmate	50	35
Mixed gum, Silvertop Ash, Brown barrel, etc	50	39

Basic stats of operation

Total log input: 7,500 m^3/yr

Total solid wood product output: n/a

Types and volume of residues generated

Sawdust (wet): Unknown (direct to incinerator)

Chip (wet): 4,015 t/yr

Fines (wet): ~500 m^3/yr

Shavings (dry): ~50 m^3/yr

Dockings, solid off-cuts, hearts: Not measured in this project

Residue production

Type of Residue (Jameson)	Output (t/yr)	Compaction (vol:wt)	Output (m^3/yr)	Explanation of Residue
Sawdust	n/a	3:1	n/a	Green saw shavings
Chip	4 015	n/a	12,045	SEFE Chips
Fines	167	3:1	500	Fines off chips
Shavings (dry)	5	10:1	50	Moulder shavings after kiln drying

Categorisation of Residue Products

Attributes table: wood waste

Type of Residue(X)	Purity	Storage 2013/14	Handling 2013/14	Current market	Transport to Market
Sawdust (wet)	Clean	Shed (roof)	Blower, belt under saw	YES	B-double and semi-trailer
Chip (wet)	Clean	Concrete bunker (no roof)	Conveyor to hopper	SEFE	B-double and semi-trailer
Mulch (wet)	Clean	Concrete bunker (sealed roof)	Conveyor under chip shaker	YES	B-double and semi-trailer

Storage 2013/14	• Sawdust off the green saw is incinerated on-site. • Chip from screen shaker is stored in double-hoppers with a 53 tonne total capacity. • Fines falling through screen shaker are deposited in a pile outdoors. Pile is adjacent to chipper on a soil floor. Moved daily to heaps further from operation for longer term storage, although area is limited. Fines can also be incinerated. • Shavings are stored in a semi-sealed shed/lean-to adjacent to moulder. Roof and walls – some walls impervious. Soil floor. This storage will be up graded in line with new moulder/planner infrastructure. • Duration of time for on-site storage: • Sawdust (wet): direct to incinerator -Chip (wet): Hauled off-site every two days on average (Semi-trailers) - Fines (wet): Stored on-site for short periods of time then hauled off-site as markets emerge some incineration - Shavings (dry): Stored on-site and loaded into small vehicles to a small secure market
Handling 2013/14	• Sawdust is moved from green saw via conveyor direct to incinerator. • Chip is shaken onto conveyor direct to twin hopper. Trap doors drop chip directly into semi-trailers below. Good purity. • Fines are handled by conveyor to daily deposit then moved by front end loader to longer term outdoor storage area. Mud, oil and debris can impact purity. Fines can also be moved direct to incinerator or incinerated after some time of outdoor storage. • Sawdust is moved by air-blower/suction directly to a rough shed extension, providing some weather protection. Dry shavings are from kiln dried, dressed timber. It would be expected that wet weather conditions would moisten the residue through partial exposure.
Haulage considerations 2013/14	• Chips are transport by semi-trailer to SEFE. • Fines are marketed as Euc Mulch. Loading is conducted on-site by front end loader directly into containers, adjacent to wood residue storage. • Small vehicles/trailers have access to current dry shavings storage. Front end loader access.

North Eden Timber

Date of meeting: 4-08-10

Attendance:

- Mick Loudon (Owner/Manager)
- James Gray (Project resource officer)

Mill name: North Eden Timber

Location: Pambula NSW

Distance to SEFE: 56km

Interest in supplying wood residue for SEFE bioenergy generation: North Eden Timbers provided a positive response to the concept of supplying woody resource for biomass renewable energy generation at the proposed SEFE facility. Mick disclosed that it costs the business a significant amount annually to dispose of the wood waste stream (dry shavings only), and that any option to reduce this cost, including making the shavings available to bioenergy production, would be keenly looked at.

Summary of current operation

The current North Eden Timber operation involves purchasing green sawn hardwood and processing it through dressing and kiln drying into solid wood products for outdoor and indoor use, such as flooring, decking and parquetry. The volume of green sawn input and value added product output varies greatly from year to year, but would be in the order of thousands of m^3 annual through put. Wood products are processed to order (on-spec) and purchasing often involves salvaging of stacked sawn timber from local sawmill yards and the like. Markets for wood products include architects and direct for retail/home application. The operation uses 6 solar kilns and two planers to produce a variety of boards in tongue and groove or other joining specification. 14 staff are employed on site.

Species composition

Species (mixed hardwoods)	% of intake	% of recover (solid wood products)
Ironbarks	n/a	n/a
Blackbutt	n/a	n/a
Silvertop Ash	n/a	n/a
Spotted Gums	n/a	n/a
Stringybarks	n/a	n/a
White Cypress	n/a	n/a

Summary of input/output

Total green/rough sawn input: n/a

Total solid wood product output: n/a

Total wood residue (dry sawdust only): 5,700 m^3/yr

Types and volume of residues expected to be generated

Shavings (dry): 5,700m^3/yr

Residue production

Product	Type of Residue (TASCO)	Output (t/yr)	Compaction (vol:wt)	Output (m^3/yr)	Type of Residue (SEFE)
Dressed hardwood	Kiln dried shavings	570	10:1	5,700	Dry shavings

Categorisation of Residue Products

Attributes table: wood waste

Type of Residue(X)	Purity	Storage 2013/14	Handling 2013/14	Moisture Content (%)	Current market	Transport to Market
Shavings (dry)	Clean	30m^3 containers (sometimes sealed)	Closed air system direct to hopper. Hopper fork lifted to container	8-18 depending on product	YES	Semi-trailer

Storage	• Dry shavings are removed directly from planning equipment via a sealed air flow system. Shavings flow to a 9m^3 hopper. This hopper is emptied daily by a forklift, which empties to a 30m^3 truck container via a loading ramp. Hinges on the hopper allow its emptying. • Duration of time for on-site storage: • Shavings (dry): Hauled off-site 3-4 times per week, but can vary widely
Handling	• Rubber wheeled front end loader/forklift for loading dry shavings from hopper to container. Loading conducted on soil ramp. Once loaded into the 30m^3 truck container, it is ready for direct linkage to truck.
Haulage considerations	• Dry shavings: • Pre-loaded into containers using air system and ready for attachment to haulage vehicle • Loading is in close vicinity to planer.

TASCO

Date of meeting: **14-07-10**

Attendance:

- Peter Haintz (TASCO Operations Manager)
- James Gray (Project resource officer)
- Peter Mitchell (Project steering committee - SEFE)

Mill name: TASCO Pty Ltd – Bombala softwood sawmill

Location: Bombala NSW

Distance to SEFE: 85km

Interest in supplying wood residue for SEFE bioenergy generation: The TASCO Operations Manager provided a positive response to the concept of supplying woody resource for biomass renewable energy generation at the proposed SEFE facility. Peter indicated that operational viability is important, and looking into the future, this could include arrangements between TASCO and SEFE for woody residues supply.

Summary of current operation

The current TASCO operation in Bombala involves an integrated softwood sawmilling process producing a range of timber products, especially treated pine for outdoor structural use, sleepers and peeled post and poles. The operation includes kiln drying, dressing and chemical preservation treatment, giving it the capacity to process pine logs into various value-added wood products ready for market. TASCO currently has an intake of 106,000 t/yr of plantation round wood and produces 40,000t/yr of solid wood products. The annual volume of pulp grade wood chip production is around 40,000 t/yr. The average recovery into solid wood products is 56%, although TASCO has a regular market for the chip and bark, as well as a range of small and seasonal markets for the sawdust and fines residues. Only as small volume of wood residues are incinerated to waste on-site.

Summary of planned operation beginning 2013/14

The current operation is planned to be significantly up-graded in a timeframe beginning in 18 months or beyond. When the up-grade commences TASCO plans to begin a phased development process over 3-years to build up to full processing capacity. The following residue generation projections are shown over the 3 planned phases of development;

Species composition

Species	% of intake	% of recover (solid wood products)
Pinus radiata (Radiata Pine)	100	56

Summary of projected operation from 2013/14

Total log input:	250,000 t/yr
Total solid wood product output:	133,604 t/yr
Total wood residue (inc. chip/bark):	116,396 t/yr
Total wood residue (exc. Bark/chip):	58,051 t/yr

Types and volume of residues expected to be generated from 2013/14

Bark (wet): 46,641m^3/yr

Chip (wet): 241,458m^3/yr

Fines (wet): 101,697m^3/yr

Course shavings (wet): 35,448 m^3/yr

Shavings (dry): 123,000 m^3/yr

Residue production

Year 1 residue production

Product	Type of Residue (TASCO)	Output (t/yr)	Compaction (vol:wt)	Output (m^3/yr)	Type of Residue (Handling)
Pole (wet)	Pole waste	9,024	3:1	27,072	Coarse shavings
Sawn (wet)	Sawdust	20,967	3:1	62,901	Fines
Pole/salvage (wet)	Sawdust	2,792	3:1	8,376	Coarse shavings
Log prep (wet)	Chip	44,000	3:1	132,000	Chip
Pole/salvage (wet)	Chip	9,348	3:1	28,044	Chip
De-barking (wet)	Bark	10,342	3:1	31,026	Bark
Planer (dry)	Shavings	7,600	10:1	76,000	Shavings

Year 2 residue production

Product	Type of Residue (TASCO)	Output (t/yr)	Compaction (vol:wt)	Output (m^3/yr)	Type of Residue (Handling)
Pole (wet)	Pole waste	9,024	3:1	27,072	Coarse shavings
Sawn (wet)	Sawdust	26,994	3:1	80,982	Fines
Pole/salvage (wet)	Sawdust	2,792	3:1	8,376	Coarse shavings
Log prep (wet)	Chip	56,647	3:1	169,941	Chip
Pole/salvage (wet)	Chip	9,348	3:1	28,044	Chip
De-barking (wet)	Bark	12,768	3:1	38,304	Bark
Planer (dry)	Shavings	9,800	10:1	98,000	Shavings

Year 3 residue production

Product	Type of Residue (TASCO)	Output (t/yr)	Compaction (vol:wt)	Output (m^3/yr)	Type of Residue (Handling)
Pole (wet)	Pole waste	9,024	3:1	27,072	Coarse shavings
Sawn (wet)	Sawdust	33,899	3:1	101,697	Fines
Pole/salvage (wet)	Sawdust	2,792	3:1	8,376	Coarse shavings
Log prep (wet)	Chip	71,138	3:1	213,414	Chip
Pole/salvage (wet)	Chip	9,348	3:1	28,044	Chip
De-barking (wet)	Bark	15,547	3:1	46,641	Bark
Planer (dry)	Shavings	12,300	10:1	123,000	Shavings

Categorisation of Residue Products

Type of Residue(X)	Purity	Storage 2013/14	Handling 2013/14	Current market	Transport to Market
Bark (wet)	Clean	Concrete bunker (no roof)	Loaded into container on-truck	YES	B-double and semi-trailer
Chip (wet)	Clean	Concrete bunker (no roof)	Loaded into container on-truck	YES	B-double and semi-trailer
Fines (wet)	Clean	Concrete bunker (sealed roof)	Loaded into container on-truck	YES	B-double and semi-trailer
Course shavings (wet)	Clean	Concrete bunker (no roof)	Loaded into container on-truck	YES	B-double and semi-trailer
Shavings (dry)	Clean	$75m^3$ containers (sealed)	Closed air system direct to container	YES	Semi-trailer only

Storage 2013/14	• Bunker system involving concrete pads with 3-sided concrete walled (cells) for bark, chips, fines and coarse shavings. Only the cell for the fines is planned to be roofed to prevent spread in high wind conditions. Bunkers are fed by an overhead conveyor with trap doors above bunkers. Bunkers are situated adjacent to a concrete pad. • Dry shavings will be stored in $75m^3$ walk-in-floor semi-trailer containers on-site. The shavings extraction method is a closed system, using air flow to draw solid matter from the planer and collection into containers. This will enable storage of wood residue on-site without risk of contamination or significant changes to moisture content. • Duration of time for on-site storage: -Bark (wet): Hauled off-site daily -Chip (wet): Hauled off-site daily -Fines (wet): Potentially daily haulage or medium-term storage on-site (outdoor heaps) -Course shavings (wet): Hauled off-site daily -Shavings (dry): Hauled off-site daily/regularly (limited by sealed air-flow container system)
Handling 2013/14	• Rubber wheeled front end loader with extension bucket for handling/loading bark, chip, fines and coarse shavings. Loading conducted on concrete pad directly into trucks from bunkers. • Dry shavings from the planer operation, which is directly loaded into containers through the sealed air flow system, are ready to fit for semi-trailers. Containers, as they are fitted with air-flow system features, are rotated and will need to be hauled off-site regularly.
Haulage considerations 2013/14	• Bark, chips, fines and coarse shavings: • Transport by B-double trucks with walk-in-floor containers ($115m^3$ capacity) and semi-trailer trucks with walk-in-floor containers ($75m^3$ capacity) • Loading on-site by front end loader directly into containers, adjacent to wood residue bunkers. • Dry shavings: • Pre-loaded into containers using air system and ready for attachment to haulage vehicle • Loaded adjacent to planer infrastructure

Result Sheet

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Analysis of four biomass samples

1 Samples

Four biomass samples were submitted for analysis by Don Olsen from South East Fibre Exports. The samples were submitted for proximate, ultimate, chlorine, oxygen, calorific value, ash composition, ash fusion temperatures and particle size analysis.

The sample descriptions and the HRL sample identifications are presented in Table 1.

2 Sample Preparation

Before the samples were dried the particle size analysis was performed on the "as received" samples, as was requested

Signed:..
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Analytical Chemist

Approved:.....................................
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Business Unit Manager

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The remainder of each sample was dried at 40˚C over night and weight loss was determined as part of the total moisture determination. The dried samples were then passed through a knife mill, then passed through a Raymond mill to a nominal size of 500 microns in readiness for all other analysis..

Table 1 – Sample Description and HRL Sample Identifications.

HRL Sample ID	Sample Description
CMM/09/0316-01	Mill Waste
CMM/09/0316-02	Wilmott Waste
CMM/09/0316-03	Pine Bark Waste
CMM/09/0316-04	Mill Fines Waste

3 Analysis Methods

Moisture and ash were determined using a Leco MAC Analyser, according to HRL Method 1.6. Total moisture was calculated from the weight loss on air-drying and the determined analysis sample moisture.

Volatile matter (and fixed carbon) was determined according to AS 2434.2

Carbon, hydrogen and nitrogen were determined according to HRL Method 1.4, using a Leco CHN Analyser.

Sulphur was determined according to AS 1038.6.3.1, with measurement by ICP-OES.

Chlorine was determined according to AS 1038.8.1, with measurement by ICP-OES.

Oxygen content was determined by difference (ie O=100 – C – H –N – S – Ash, all dry basis).

Gross dry calorific value was determined on a Leco AC350 calorimeter, according to AS1038.5. Gross wet and net wet calorific values were calculated from the gross dry result, using determined moisture and hydrogen values as required.

Ash composition (ten elements) was determined by ICP-OES, following borate fusion and acid dissolution of ash. As part of ash composition analysis, chlorine content was determined by ICP-OES, following dilute nitric acid extraction. Also carbonate content of the ash was determined on the Leco CHN Analyser and this is expressed in the ash composition result as CO2. The ash was produced by combustion of samples up to 600°C.

Ash fusion temperatures were determined according to I.S. CEN/TS 15370-1:2006.

Particle size analysis was performed on the “as received” samples, with a range sieves selected to suite each sample.

4 Results

The results for moisture, ash, volatile matter (fixed carbon), carbon, hydrogen, nitrogen, sulphur, chlorine, oxygen and calorific value are presented in Table 2.

Ash composition results are presented in Table 3.

Ash fusion temperatures results are present in Table 4.

Particle size results of the sample identified as Mill Waste are presented in Table 5.

Particle size results of the sample identified as Wilmott Waste are presented in Table 6.

Particle size results of the sample identified as Pine Bark Waste are presented in Table 7.

Particle size results of the sample identified as Mill Fines Waste are presented in Table 8.

TABLE 2 - Proximate, Ultimate, Chlorine, Oxygen and Calorific Value Results

HRL Sample ID CMM/09/0316 No.	Sample Description	Moisture (ar%)	Ash Yield (db%) 600˚C	Volatile matter (db%)	Fixed Carbon (db%)	C (db%)	H (db%)	N (db%)	Cl (db%)	S (db%)	O (db%)	Gross Dry Calorific Value (MJ/kg)	Gross Wet Calorific Value (MJ/kg)	Net Wet Calorific Value (MJ/kg)
1	Mill Waste	22.2	1.3	76.8	21.9	49.7	5.9	0.15	0.06	0.03	42.9	19.7	15.3	13.9
2	Wilmott Waste	25.3	0.6	80.0	19.5	50.3	6.2	<0.01	0.01	0.01	42.9	20.2	15.1	13.5
3	Pine Bark Waste	25.8	6.4	62.3	31.2	52.5	5.2	0.10	0.02	0.02	35.8	20.9	15.5	14.1
4	Mill Fines Waste	45.0	0.5	77.3	22.2	50.1	5.9	0.02	0.01	0.01	43.5	19.8	10.9	9.2

TABLE 3 – Ash Composition Results (%)

HRL Sample ID CMM/09/0316 No.	Sample Description	SiO2	Al2O3	Fe2O3	TiO2	K2O	MgO	Na2O	CaO	SO3	P2O5	CO2	Cl	less O equiv to Cl	Total
1	Mill Waste	14.8	5.4	2.8	0.23	13.34	5.8	7.1	27.1	4.5	2.39	15.4	1.8	- 0.41	101.4
2	Wilmott Waste	33.0	7.4	2.9	0.29	20.05	8.0	0.5	15.9	1.4	1.9	7.8	0.3	- 0.07	100.9
3	Pine Bark Waste	59.6	14.8	5.0	0.31	7.5	2.0	0.1	5.7	0.2	0.71	2.4	0.04	- 0.01	99.0
4	Mill Fines Waste	43.9	8.4	3.6	0.40	10.4	5.6	3.8	15.1	2.8	2.41	3.2	0.15	- 0.03	100.4

TABLE 4 – Ash Fusion Temperature Results (Irish Standard, under reducing conditions °C)

HRL Sample ID CMM/09/0316 No.	Sample Description	Shrinking Starting Temp °C	Deformation Temp °C	Hemisphere Temp °C	Flow Temp °C
1	Mill Waste	1200	1270	1300	1380
2	Wilmott Waste	1140	1170	1190	1210
3	Pine Bark Waste	1180	1230	1270	1310
4	Mill Fines Waste	1150	1180	1190	1210

TABLE 5 – Particle Size Results of Mill Waste Sample (%)

HRL Sample ID CMM/09/0316 No.	Sample Description	>25.0 mm	19.0-25.0 mm	12.5-19.0 mm	6.3-12.5 mm	4.75-6.3 mm	<4.75 mm
1	Mill Waste	21	3	19*	24	11	22

*Note: Much stringy bark retained on sieve

TABLE 6 – Particle Size Results of Wilmott Waste Sample (%)

HRL Sample ID CMM/09/0316 No.	Sample Description	> 37.5 mm	25.0-3705 mm	19.0-25.0 mm	12.5-19.0 mm	6.3-12.5 mm	4.75-6.3 mm	< 4.75 mm
2	Mill Waste	0	13	8	9	38	13	19

TABLE 7 – Particle Size Results of Pine Bark Waste Sample (%)

HRL Sample ID CMM/09/0316 No.	Sample Description	> 37.5	25.0-37.5 mm	19.0-25.0 mm	12.5-19.0 mm	6.3-12.5 mm	< 6.3 mm
3	Pine Bark Waste	2	17	44	25	9	3

TABLE 8 – Particle Size Results of Mill Fanes Waste Sample (%)

HRL Sample ID CMM/09/0316 No.	Sample Description	> 12.5 mm	6.3-12.5 mm	4.75-6.3 mm	3.35-4.75 mm	2.36-3.35 mm	1.18-2.36 mm	< 1.18 mm
4	Mill Fines Waste	0	5	18	12	15	29	21