Techno-economic analysis of veneers & posts from specialty wood species (durable eucalypts)

Peter Hall and Rosie Sargent

Date: June 2021

Publication No: SWP-T126

TABLE OF CONTENTS

Scion reference number; PAD No. 35052439

Disclaimer

This report has been prepared by Scion for Forest Growers Research Ltd (FGR) subject to the terms and conditions of a research services agreement dated 1 January 2016.

The opinions and information provided in this report have been provided in good faith and on the basis that every endeavour has been made to be accurate and not misleading and to exercise reasonable care, skill and judgement in providing such opinions and information.

Under the terms of the Services Agreement, Scion's liability to FGR in relation to the services provided to produce this report is limited to the value of those services. Neither Scion nor any of its employees, contractors, agents or other persons acting on its behalf or under its control accept any responsibility to any person or organisation in respect of any information or opinion provided in this report in excess of that amount.

supported by forestgrowers commodity levy

EXECUTIVE SUMMARY

This report was commissioned by the Specialty Wood Products Research Partnership and is aimed at assessing the potential for making durable eucalypt posts and veneers from a durable eucalypt crop, *E. globoidea*, using 3 regime options (15, 20 and 25-year rotations).

Making veneers and posts from a crop of durable eucalypt logs appears to be technically and financially viable at a scale suitable for the demand for naturally durable posts.
There are potential markets for both durable posts and high stiffness veneers in the Nelson-Marlborough region.

The market for untreated durable eucalypt posts for organic primary production operations such as vineyards and fruit growing are up to 17,000 m^3 per annum.

Eucalypt veneers could be used to make either a 100% eucalypt LVL or be added to radiata pine LVL to increase the stiffness (GPa rating) and therefore increase the value of the product.

Getting eucalyptus veneer prices was difficult as none are produced in New Zealand at commercial scale, they were estimated to be available from overseas markets at between $440 and $570 per m^3.

The larger processing plants have higher ROCEs' with the plants that would run on crops from longer rotations having ROCEs' of over 20% and, depending on the veneer prices, potentially over 30%. The returns are highly sensitive to the veneer prices.

Overall, the data suggests that the 20-year regime would give better results than the 15-year regime and similar results to the 25-year regime with the benefit of the material being available slightly sooner. The longer rotations (20 to 25 years) gave better yields of veneers.
The area of forest required to service the plant making the posts and veneers was estimated at being between 1,500 and 2,000 hectares, depending on the regime used.

INTRODUCTION

Production of posts for use on organic farms, orchard and vineyards is a topic of interest to the Specialty Wood Products Research Partnership. The potential of growing durable Eucalypt species for this purpose has been covered in previous work (Altenar 2020, Hall 2021). The market for durable eucalypt posts for use in organic ventures has been estimated at between 7,000 and 17,000 m^3 per annum. The volume demand is difficult to assess due to the difficulty in predicting the amount of new vineyard expansion and organic growing operations there will be, hence the wide range in the figures.

One way to grow the required volume is grow and harvest a durable eucalypt crop specifically for producing posts, as described in Hall, 2021. An alternative approach is to grow a crop where the logs that are suitable for producing veneers are first peeled and the core of the log is then used as a durable post.

The assumption here is that there is a demand for the veneers from the eucalyptus logs, as they can be used to make a high stiffness LVL. This could be either as a 100% eucalyptus product or as a blend with pine veneers.

The majority of the LVL made in New Zealand from radiata pine is LVL8 and LVL10 / 11 with a small amount of LVL16. Eucalyptus timber is generally stiffer than radiata pine and LVL made from *Eucalyptus globoidea* (a durable species) would likely have a stiffness of 12 to 14 GPa (making LVL12 or LVL14) with a small amount being up to GPa 20 (Guo and Altaner, 2018). The stiffer veneers make a stiffer LVL, with the correlation being more or less direct. The impact of the blending of two species on the stiffness of the LVL is in direct proportion to the amounts used (Doug Gaunt pers. comm.). That is; LVL made with 50:50 radiata pine veneers with GPa 8 and Eucalyptus veneers at GPa 12 would produce LVL10. Further, according to Guo and Altaner (2018) a mixed LVL with alternating veneers of radiata pine and eucalyptus had better bonding between the plies.

Given that there is a demand for durable but untreated posts for use in organic primary produce ventures and the potential of growing posts directly is still more expensive than the CCA treated radiata pine option (Hall 2021) this analysis is aimed at determining the impact of growing a durable eucalypt product and selling the veneers as a feedstock to an LVL manufacturer where they could be used to produce an LVL product that has a higher stiffness and therefore sells for a higher price than LVL made from radiata pine. The cores from the logs would be sold as naturally durable posts, with the market being organic growers. Further, NZ Winegrowers are aiming for zero waste to landfill by 2050 which implies not using CCA treated posts which are difficult to dispose of otherwise. The species identified as being both durable and suitable to for growing in New Zealand near sites with posts demands is *Eucalyptus globoidea.*

One of the features of this approach is that the less durable sapwood is peeled off the logs leaving the more durable heartwood as the post product.

Objectives

The objectives of this work are to;

- Assess the potential for making durable Eucalypt posts and Veneers from a durable eucalypt crop, using 3 regime options (15, 20- and 25-year rotations).
- Using the Nelson / Marlborough region as a case study estimate the financial viability of making veneers and posts (from peeled cores and upper logs) from the same crop.

METHODS

The crop yields for three growing regimes were derived from a Eucalyptus growth model (van der Colff and Kimberley, 2013). The regimes used were to plant 1111 stems per ha and then thin to 600 s/ha at age 8 with clear-fell at ages 15, 20 and 25.

The costs of producing the log were derived from a number of calculators;

- Growing costs were calculated from a Scion growing cost calculator which includes variables such as land cost ($7,500/ha), interest rates (6%), profit margin (6%), silvicultural costs, tree stocks, labour, pest and disease control, forest management fees and rates etc.
- Logging costs were based on AgriHQ logging costs for 2021 and varied to allow for the increased costs associated with the lower piece size of the shorter rotation.
- Transport costs were derived using Scion's harvesting and transport cost calculator (Riddle 1994, Blackburne 2009).
- Roading costs per m^3 were estimated based off an assumed cost of $50,000 per km of road construction and 16ha of logging per km of road and the yield of logs per ha.

The yield of logs by grade was derived from log grade modelling outputs provided by NZ Dryland Forestry Initiative (Paul Millen, Kevan Buck).

Veneer yields were calculated based on the small end diameters (SED) of the logs by grade from the modelling and the assumptions that the cores used for posts would be 100mm. A ply mill with a chuck or spindle type lathe can typically peel to a core of 83mm diameter. However, this is small in comparison to the majority of posts sold.

The yields of veneers were based on those found in Guo and Altaner 2018. The plies were assumed to be 4mm thick. The volume of a 100mm post at 2.7m length was calculated, and a post / core of this dimension was assumed to be available from each log.

The yields of cores / posts, veneers and residuals (round up, clippings, spurs etc) were calculated for each log grade and then converted to a volume per ha for each regime.

The prices of different products; posts, veneers and LVL were derived from Hall 2021, an online search and industry data respectively.

The techno-economic analysis of making veneers and posts from the eucalypt logs was done using the WoodScape model (Jack et al, 2013). This model has a wide range of wood processing options and can have variants of differing scales added to it. For this study a small veneer plant (20,000 m^3 of product per annum) with eucalypt logs as the feedstock and two products; high stiffness veneers and durable posts was added.

The area of forest crop required to feed a plant of sufficient size to meet the bulk of the organic post demand was estimated from crop and product yield data.

RESULTS

The results from the growth model for an average site (site index 27[1] and 1000 index of 31[2]) are shown in Table 1. The values are for the total recoverable volume of merchantable logs in cubic metres per hectare.

Table 1. Recoverable volumes of merchantable logs by regime

Rotation length (years)	**15**	**20**	**25**
Total recoverable volume (m^3 per ha)	397	600	770

The estimated costs for growing the crops for the 3 regimes are shown in Table 2. The shorter regime has the highest cost per cubic metre. The margin for error on the costs means the 20 and 25-year regimes are effectively the same delivered cost.

Table 2. Total delivered cost, per cubic metre by regime.

Rotation length, years	**15**	**20**	**25**
Growing cost, $/m^3$	$55.49	$57.43	$60.84
Roading cost, $/m^3$	$7.55	$5.21	$3.89
Logging cost, $/m^3$	$38.00	$33.00	$32.00
Transport cost, $/m^3$	$20.00	$19.50	$19.00
Total delivered cost, $/m^3$	**$121**	**$115**	**$116**

The yield of logs by grade is shown in Table 3.

Table 3 – cubic metres per ha of different log sizes (by small end diameter, mm) produced by the different regimes

Age	**300mm**	**250mm**	**200mm**	**150mm**	**130mm**	**Firewood**	**Total**
15	0.0	49.5	71.1	117.0	66.0	93.3	397
20	63.9	132.3	141.6	136.8	55.9	69.4	600
25	177.8	117.6	274.2	111.0	43.8	45.5	770

Based on the volume of the posts of various diameters and lengths of 2.7m the number of posts recoverable by grade were calculated. The yield of veneers will vary with the diameter of the logs.

Table 4 – number of logs per ha by grade by regime

Age	**300mm**	**250mm**	**200mm**	**150mm**	**130mm**	**Firewood**
15	0	374	838	2453	1842	n. a.
20	335	998	1669	2868	1560	n. a.
25	932	887	3233	2327	1223	n. a.

The yields (as percentages) of different products from the peeling of the logs of different diameters are shown in Table 5. Some of these are based on the data presented in Guo and Altaner and some are derived from calculation based on an assumed dimension of the post / core. The minimum post size was assumed to be 100mm diameter. A veneer lathe (with a spindle) can peel down to an 83mm core, spindle-less lathes can go down to around 30mm, but both these diameters are too small to be used as a post.

The small diameter (130mm) logs produce only a small proportion of their volume as veneers.

[1] Site index = mean top height at age 15.
[2] 1000 index = mean annual increment (m^3 per ha per annum) at age 15 for a stand with 1000 stems per ha.

Table 5 – yields of products and residues by log grade.

Log grade	300mm	250mm	200mm	150mm	130mm
Cores / posts	10%	16%	25%	44%	59%
Round-up	5.3%	6.4%	8.0%	10.7%	12.3%
Other loss	9%	8%	6%	5%	4%
Clipping loss	20%	17%	13%	10%	9%
Useable veneers	**56%**	**53%**	**48%**	**31%**	**16%**

The product yields by log grade also need to be combined with the yields of log grade by regime to give an estimate of product yield by regime (Table 6).

Table 6 – products and residues per ha of crop.

Regime	Product	300mm	250mm	200mm	150mm	130mm
15 years	Cores / posts	0	8	18	51	39
15 years	Residuals	0	15	19	29	16
15 years	Veneers	0	26	34	36	11
20 years	Cores / posts	6	21	35	60	33
20 years	Residuals	22	40	39	34	14
20 years	Veneers	36	71	67	42	9
25 years	Cores / posts	18	19	69	49	26
25 years	Residuals	61	36	75	28	11
25 years	Veneers	99	63	131	34	7

The data from Table 6 was converted into an average yield

Table 7 – mean yield of products (%) by regime

	15 years	20 years	25 years
Cores as posts	38	29	25
Veneers	35	42	46
Residuals	27	29	29

Price data

Posts
- 100mm by 2.7 length; \$445 per m^3 ex-mill (retail of \$890 per m^3)

Eucalyptus veneers
- estimated ex-mill price of \$570 per m^3 to be competitive with imported product.

LVL prices vary by the strength of the LVL, expressed as GPa (Table 8).

Table 8 – LVL prices in \$ per m^3; Retail and ex-mill (estimated)

GPa	Retail, \$/m^3	Ex-mill \$/m^3
8	\$ 684	\$400
9	\$ 849	\$492
10	\$ 1,029	\$597
11	\$ 1,225	\$711
12	\$ 1,437	\$833
13	\$ 1,663	\$965
14	\$ 1,905	\$1,105
15	\$ 2,161	\$1,253
16	\$ 2,432	\$1,410

Techno-economic analysis

Data from the WoodScape model on processing costs were used to work back from an ex-mill price for LVL to what could be paid for veneers and still have a financially viable operation.

The estimates of product value (ex-mill) were;
- Durable posts $445 per m^3
- Eucalypt veneers $438 per m^3

The WoodScape model was run using different inputs based on the log costs and the different ratios of products based on the rotation lengths / regimes. The results are shown in Table 9. The size of the plant varied as the differing product ratios affected the volume of posts produced. The target for posts production was kept at 15,000 m^3 per annum.

Table 9 – results for WoodScape modelling

Rotation length	Log in, m^3 p. a.	Products out, m^3 p.a. veneers / posts	ROCE %	IRR %	Payback Years	NPV $/Millions
15	40,000	14,000 / 15,000	10	4.5	8.9	-$4.8M
20	52,381	22,000 / 15,000	27	15.2	3.3	$4.20M
25	60,870	28,000 / 15,000	22	12.4	3.8	$1.45M

Eucalypt veneers are available for purchase from a range of suppliers in China. These veneer prices were averaged and converted (foreign exchange and freight) to an ex-mill price in New Zealand. These prices were higher than those used above. If these higher prices ($570 per m^3) were used, then the financial metrics improve (Table 10).

Table 10 – financial metrices for veneer and postproduction with veneer price at $570 m^3

Regime	ROCE %	IRR %	NPV, $m p.a.
15 years	25	14	$3.0M
20 years	33	17	$7.5M
25 years	36	19	$10.3M

These metrics compare well with the returns from making posts alone (11.8% ROCE, Hall 2021) and for making veneers alone at the low ($438/$m^3$) and high ($570//m^3) veneer prices which gave ROCEs of -10% and 17 % respectively. The veneer mill is highly sensitive to the price of the veneer product.

Area of forest required

In order to feed a plant making both post and veneer products that is making sufficient posts to meet a large proportion (70 or 80%) of the organic post market (up to 17,000 m^3 per annum) on a continuous supply basis an area of dedicated forest is required. This area varies with the regime (rotation length used) (Table 11).

Table 11 – area of annual harvest and total forest of durable eucalypt species estimated to be required rotation (years)

	15 years	20 years	25 years
m^3/ha	397	600	770
Volume (m^3) p.a.	40,000	52,381	60,870
Harvest area required, ha per annum	101	88	80
Total ha of forest	1511	1760	2000

CONCLUSIONS

Eucalypt veneers could be used to make either a 100% eucalypt LVL or be added to Radiata pine LVL to increase the stiffness (GPa rating) and therefore increase the value and market access of the product.

The market for untreated durable eucalypt posts for organic primary production operations is up to 17,000 m^3 per annum.

Making veneers and posts from a crop of durable eucalypt logs appears to be technically and financially viable at a scale suitable for the demand for naturally durable posts.

The longer rotations (20 to 25 years) gave better yields of veneers.

The larger processing plants have higher ROCEs' with the plants that would run on the crops from longer rotations having ROCEs' of over 20% and, depending on the veneer prices over 30%. The returns are highly sensitive to the veneer prices.

Getting eucalyptus veneer prices was difficult as none are produced in New Zealand at commercial scale, they were estimated to be between $440 and $570 per m^3 based on prices in overseas markets adjusted to allow for freight to New Zealand.

The area of forest required to service the plant making the posts and veneers was estimated at being between 1,500 and 2,000 hectares, depending on the regime used.

Overall, the data suggests that the 20-year regime would give results better than the 15-year regime and similar to the 25-year regime with the benefit of the material being available slightly sooner.

ACKNOWLEDGEMENTS

Scion wishes to acknowledge the inputs from the Specialty Wood Products Research Partnership into this report.

REFERENCES

Altaner C. (2020). Wooden posts a review. Specialty wood products Research Partnership Report SWP-T095.

Blackburne M. (2009). Business management for logging. Published by Future Forests Research in Association with the Forest Industry Contractors Association.

Forest Owners Association (NZFOA) (2020). Facts and Figures 2019/20. New Zealand Plantation Forest Industry.

Guo F. and Altaner C. M. (2018). Properties of rotary peeled veneer and laminated veneer lumber (LVL) from New Zealand grown Eucalyptus globoidea. New Zealand Journal of Forestry Science. (2018) 48:3.

Jack M., Hall P., Goodison A. and Barry L. (2013). WoodScape study - regional wood processing options. Scion report for the Wood Council of New Zealand (Woodco). http://woodco.org.nz/images/stories/pdfs/woodscape/woodscaperegionalreportfinal2_web.pdf

Hall P. (2021). Techno-economic analysis of posts from specialty wood species and radiata pine. Scion Contract report for Specialty Wood Products Research Partnership. Scion PAD No. 34081216.

Organics Aotearoa New Zealand (2010). Alternatives to CCA (Copper Chromium Arsenate) treated wood. https://www.bhu.org.nz/future-farming-centre/ffc/information/misc/over_the_fencepost-alternatives_to_cca_treated_timber.pdf

van Bruchem B. (2020). Analysis of the treated wood market for Agricultural and Horticultural uses in New Zealand. Dissertation- Bachelor of Forestry Science. New Zealand School of Forestry, University of Canterbury.

van der Colff M. and Kimberley M. (2013). E. fastigata growth Model (Excel spreadsheet). Future Forest Research.

New Zealand Winegrowers Inc. Annual Report 2018. https://www.nzwine.com/media/9567/nzw-annual-report-2018.pdf

New Zealand Winegrowers Inc. Annual Report 2020. https://www.nzwine.com/en/media/statistics/annual-report/

Riddle A. (1994). Business management for logging. LIRO Handbook.