



Report into the potential for additional wood flow resulting from participation in evolving carbon markets in the Green Triangle Region: A quantification of economic benefits.

This report was commissioned by the Green Triangle Regional Forest Industries Hub with funding from the Australian Government, Department of Agriculture, Fisheries and Forestry.

The analysis, undertaken by ERC, examines how the Green Triangle Area could benefit economically from growing its forestry sector under two carbon pricing scenarios at \$40 and \$80 an Australian Carbon Credit Unit (ACCU).

From the analysis, the economy of the Green Triangle could grow by 4%, or \$290m pa of direct growth and \$543m pa with indirect effects and a net increase in employment of 2750 jobs.

At a carbon price of \$80 per tonne, the yearly net economic impact could be more than \$2.3 billion, increasing the region's income by 19% and creating about 11400 new jobs.

The analysis has a wide range of assumptions, one being that the current ratio of exports and local processing would continue. The Hub is involved with other projects that are testing the opportunity for increased local processing opportunities from wood fibre that is traditionally exported.

As our knowledge and technology continue to develop, it is expected that the opportunity for increased local processing of wood fibre could result in increased value chain capture within our region, which would, in turn, amplify the economic benefits modelled in this paper.

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The potential for additional wood flow resulting from participation in evolving carbon markets in the Green Triangle Region: A quantification of economic benefits

**Report prepared for
the Green Triangle
Forest Industries
Hub**

Final Report

19th October 2023



This report provides a modelling based assessment of the potential impact of investing in additional forestry in the Green Triangle region of Australia, in response to the likelihood of increase carbon prices. It is estimated that prices of \$40-80 per metric ton of carbon dioxide emitted are needed to keep global warming within a 2-point degree, as provided by the Paris agreement. Even higher prices will be required to achieve global emission targets. However current prices as identified in carbon taxes or carbon trading schemes are well below that level. A critical factor in policy frameworks will be achieving the higher levels of price and a pertinent issue in this context is the recent announcement by the Prime Minister in Germany of Australia becoming a member of the Carbon Club (who have an agenda around carbon prices).

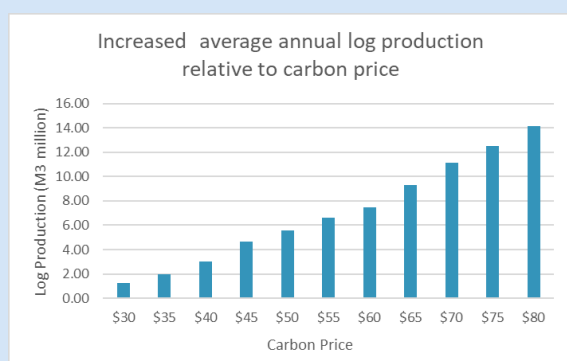
Due to the role that forests and trees play in decarbonization, increasing carbon prices are likely to result in increased plantations with respect to forest plantations. While the carbon trading aspect will underpin the investment in forests, the plantations themselves will result in increases in employment, and in processing and development opportunities.

Based on modelling undertaken by the University of South Australia, and assumptions in this modelling as to the nature of the wood harvesting the potential average annual increase in woodflow that an increased carbon price would generate would vary depending on the price. The ranges under the Paris agreement would suggest:

- **At \$40 – the potential for an increase in average annual log production of some 2.19 million cubic metres** – which represents of the order of a 39% increase in annual production from current levels.
- **At \$80 – the potential for an increase in average annual log production of some 6.59 million cubic metres** – or a doubling of production .

These outcomes depend on a number of economic factors and should be considered a maximum possibility.

Figure 1



Based on these forecast wood flows – the implications in an economic context are modelled through a regional economic model that has been prepared for this study. This is an updated version of the model used for the June 2022 study undertaken on the economic contribution re the SA Forestry industry (and includes supply side constraints). Based on the woodflows, the outcomes are summarised in Table 1 for a carbon price at \$40 per tonne. The modelling suggests that the woodflows will produce an average yearly direct economic value added in the region (contribution to gross regional product) of \$290 million, while investment activity, supply chains and further induced impacts add a further \$253 million – for a total contribution to the regional economy of \$543 million. This supports over 2,750 additional jobs a year in the region. This represents a 4% increase over the size of the current regional economy.

Table 1: Modelled economic impact of increased woodflow resulting from carbon price of \$40 – average annual per year

	Value Added (\$m)	Compensation of Employees	Employment (FTEs)
Direct Impact			
Forestry and Logging	\$177.98	\$66.00	398
Sawmill product manufacturing	\$106.12	\$55.24	646
Other wood product manufacturing	\$26.25	\$16.51	163
Pulp, paper and paperboard manufacturing	\$3.10	\$1.69	11
Paper stationery and other converted paper product manufacturing	\$21.60	\$13.65	149
Transport	\$12.59	\$7.23	98
Other agriculture	-\$57.24	-\$12.13	-391
Total Direct Impact	\$290.40	\$148.19	1,075
Induced Impact			
Other agriculture and mining	\$102.88	\$31.56	404
Other Manufacturing	-\$24.78	-\$10.35	-140
Construction	\$16.08	\$7.83	134
Utilities	\$6.55	\$1.79	16
Trade and Hospitality	\$52.02	\$33.51	474
Transport	\$35.70	\$19.17	212
Business, Professional and Property Services	\$33.09	\$19.17	180
Ownership of Dwellings	\$0.00	\$0.00	0
Public administration, education and health	\$19.92	\$17.69	149
Other	\$11.19	\$8.98	164
Total Induced Impact	\$252.64	\$129.34	1,593
Total Impact	\$543.04	\$277.53	2,668

The development of plantations represents a long term investment and production stimulus, and over the longer term of 50-100 years the impact in terms of contribution to the regional economy is modelled at \$5-\$5.5 billion in value added (or contribution to regional incomes) and a contribution to wage and salary incomes in the region of \$2.6 - \$2.8 billion in present value terms.

As indicated in Figure 1, the expected diversion of land to forestry will increase with a higher estimated carbon price. As such Table 2 shows the expected outcomes should a carbon price of \$80 per tonne be realised. The annual impact is modelled as high as over \$2.3 billion per year, which represents a 19% increase on the current level of regional income. It would mean an extra 11,400 full time equivalent jobs in the region.

Table 3 shows the impacts as estimated for varying carbon prices based on the aggregate woodflow estimates as indicated in Figure 1. The relationship as modelled is fairly linear – but it should be noted that as the volume of forestry activity steps up in the region – then other structural aspects can change. The modelling is based on maintaining the current relationships between log production, and activity in sawmill and other processing. A substantial amount of product is therefore assumed to be exported. It is possible that at higher prices and forestry investment levels, the ratios could change, attracting higher levels of processing investment.

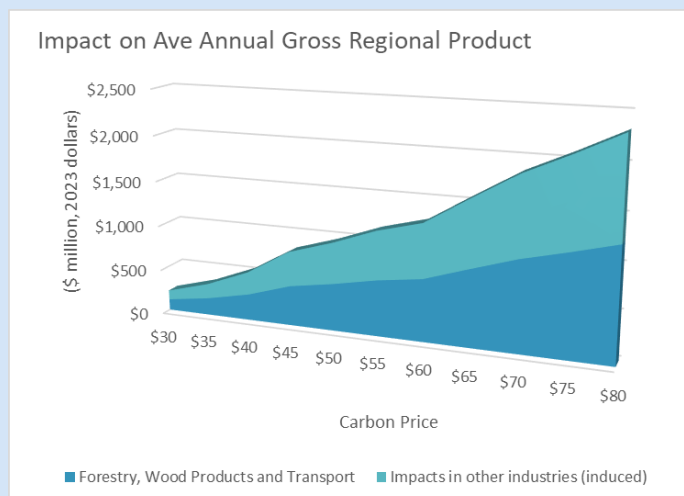
Table 2: Modelled economic impact of increased woodflow resulting from carbon price of \$80 per tonne – average annual per year

	Value Added (\$m)	Compensation of Employees	Employment (FTEs)
Direct Impact			
Forestry and Logging	\$760.2	\$281.9	1,692
Sawmill product manufacturing	\$453.3	\$236.0	2,747
Other wood product manufacturing	\$112.1	\$70.5	694
Pulp, paper and paperboard manufacturing	\$13.3	\$7.2	47
Paper stationery and other converted paper product manufacturing	\$92.3	\$58.3	633
Transport	\$54.0	\$31.0	419
Other agriculture	-\$239.5	-\$50.8	-1,630
Total Direct Impact	\$1,245.6	\$634.2	4,603
Induced Impact			
Other agriculture and mining	\$438.1	\$134.1	1,712
Other Manufacturing	-\$106.9	-\$44.8	-603
Construction	\$68.7	\$33.5	569
Utilities	\$28.1	\$7.7	70
Trade and Hospitality	\$222.5	\$143.4	2,019
Transport	\$152.5	\$81.9	900
Business, Professional and Property Services	\$141.7	\$82.0	767
Ownership of Dwellings	\$0.0	\$0.0	0
Public administration, education and health	\$85.1	\$75.6	634
Other	\$47.8	\$38.4	698
Total Induced Impact	\$1,077.8	\$551.7	6,765
Total Impact	\$2,323.4	\$1,185.9	11,369

Table 3: Modelled economic impact of increased woodflow based on carbon price per tonne– average annual per year

	Carbon Price										
	\$30	\$35	\$40	\$45	\$50	\$55	\$60	\$65	\$70	\$75	\$80
Value Added (\$ million)											
Forestry, Wood Products and Transport	\$120.0	\$189.8	\$290.4	\$440.2	\$519.6	\$614.5	\$682.5	\$842.5	\$996.6	\$1,116.9	\$1,245.6
Impacts in other industries (induced)	\$104.6	\$165.3	\$252.6	\$382.6	\$451.4	\$533.8	\$592.5	\$730.8	\$863.7	\$967.0	\$1,077.8
Total	\$224.7	\$355.0	\$543.0	\$822.8	\$971.0	\$1,148.3	\$1,275.0	\$1,573.2	\$1,860.4	\$2,083.9	\$2,323.4
Compensation of Employees (\$ million)											
Forestry, Wood Products and Transport	\$61.5	\$97.2	\$148.2	\$224.3	\$265.0	\$313.8	\$349.0	\$430.2	\$508.3	\$568.3	\$634.2
Impacts in other industries (induced)	\$53.6	\$84.6	\$129.3	\$195.9	\$231.1	\$273.3	\$303.3	\$374.1	\$442.2	\$495.0	\$551.7
Total	\$115.1	\$181.8	\$277.5	\$420.1	\$496.1	\$587.1	\$652.3	\$804.3	\$950.4	\$1,063.4	\$1,185.9
Employment (FTEs)											
Forestry, Wood Products and Transport	442	699	1,075	1,632	1,922	2,267	2,512	3,105	3,679	4,134	4,603
Impacts in other industries (induced)	661	1,043	1,593	2,411	2,844	3,362	3,731	4,598	5,430	6,073	6,765
Total	1,103	1,743	2,668	4,043	4,766	5,629	6,242	7,703	9,108	10,207	11,369

Figure 2



Economic benefits in the Green Triangle Region from additional wood flow due to evolving carbon markets

PROJECT OVERVIEW AND OBJECTIVES

Objectives

The primary objective of this study is to provide an assessment of the economic contribution of the forestry industry to economic activity in the Green Triangle region in south east South Australian and south west Victoria arising from additional forestry investment that is likely to accompany higher world carbon prices. Due to the role that forests and trees play in decarbonization, increasing carbon prices are likely to result in increased plantations with respect to forest plantations.

An economic contribution evaluation involves a review of the jobs and incomes benefit of an industry or a project – and how it fits within the region's economic structure. Some of these benefits will be within the industry directly but there will be both downstream and upstream (i.e., supply chain) issues to be included in the assessment. Impacts across the broader Green Triangle region (including SW Victoria) are also considered. The objective of the study is therefore to quantify the whole of economy and additional benefits from an increase in both plantation area and consequent additional wood flow within the Green Triangle region in terms of:

- Value of additional timber
- Additional capital investment
- Tourism and amenity values
- Additional value-added processing
- Jobs created, incomes earned, and tax revenues generated as a result of the above activities at the regional level

Background

The process for modelling the economic outcomes associated with

- The estimated value of additional timber produced, mapped by area within the Green Triangle. There is a timeline component of this, in that while the new areas that are opened will not produce marketable timber for some years. Therefore, there needs to be a timeline of hectares developed, wood harvested, and proportion that is harvested as logs and proportion that is processed through local sawmills. However, the impact will be smoothed somewhat as it provides more flexibility into the whole production system.
- A description of current uses of the land where the extra plantation areas will be developed.
- Additional capital investment - capital investment that will be generated in both establishing the plantations, and in providing underlying infrastructure (road improvement, water), within the transport firms, and lastly in providing extra sawmill capacity.
- An assumption as to whether the technologies associated with the new areas and other investments are likely to lead to labour productivity improvements relative to current operations.
- Additional value-added processing – there needs to be consideration as to whether the extra volume and/or future strategies will lead to increased levels of upline processing of sawmill outputs – and what investments that might entail

In addition, there are also aspects such as the potential for recreational use of the new areas as they develop. It is expected that such outcomes would need to be a result of strategic initiatives to provide recreational services with the plantations.

Lastly there needs to be considerations of economic outcomes in terms of implications for supply chains for industries in South Australia, Victoria and Australia that depend heavily on timber (e.g. construction), and the impact of new areas developed in this context..

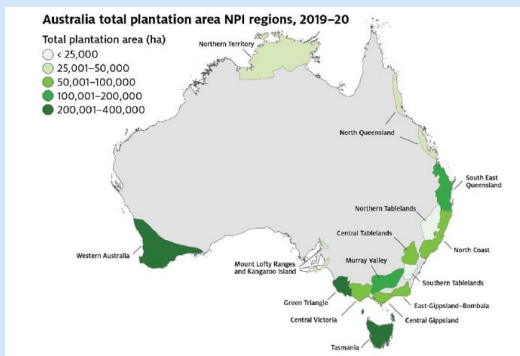


Study Background: - Forestry in Australia – Production Levels

To set the context for the evaluation the following provides a summary of the size and impact of the forestry sector in Australia is active across all States and Territories, focused around the coastline. The key characteristics of production are summarised as follows:

- The total area under forestry plantation in Australia in 2019-20 was 1.78 million hectares.
- Almost 60% of this was in softwood, with 97.5% of the softwood area managed for sawlogs, and 2.5% for pulplog
- The remaining 40% are hardwood plantations, and are managed for 86% pulplog and 14% sawlog
- The hardwood plantation area has fallen by 22% since 2014-15, while softwood plantations have been relatively stable. There have been minimal new establishment since 2012. Bushfires and flooding impact on the production capacity of the plantation areas.
- Softwood plantation areas in 2019–20 are concentrated in New South Wales, Victoria and Queensland, hardwood plantation areas are concentrated in Western Australia and Tasmania. South Australia has 9.6% of the plantation area, mainly in softwood.
- The plantations have forecast availability for 2020-24
 - 15.3 million m³ softwood logs per year, a reduction from 17 million m³ in 2015-19 caused by the impact of bushfires - before increasing in the years beyond that (primarily post 2035)
 - 9.7 million m³ hardwood logs – remaining steady

Figure 3: Geographic distribution– Forestry Production in Australia



Source: Australian plantation statistics and log availability report 2021, ABARES

Figure 4: Plantation Areas - Australia

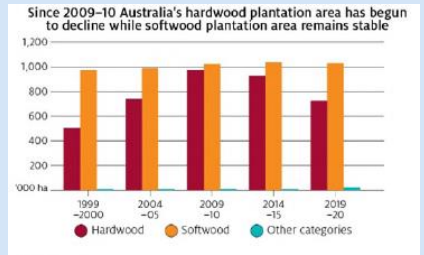


Figure 5: Forecasts of softwood log availability

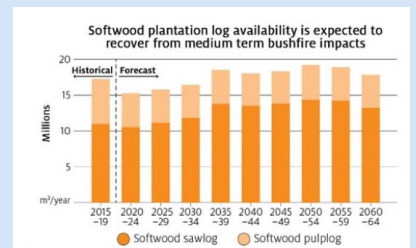
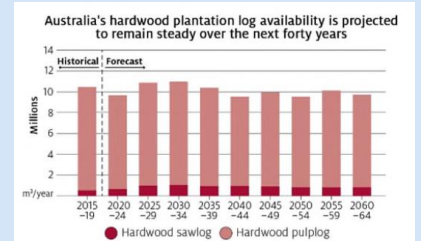


Figure 6: Forecasts of hardwood log availability



Study Background: – Wood Processing in Australia – Production Levels

While the previous pages summarises production levels as published in October 2021, the latest data for sawmills (which gives more detail of the nature of production output) is for 2016-17 (the last ABARES survey):

- Associated with the forestry plantation areas there a were total of 299 mills operated in 2016–17, comprising 182 hardwood sawmills, 58 softwood sawmills, 23 wood-based panel mills, 19 post and pole mills and 17 cypress pine sawmills.
- The number of sawmills declined between 2006–07 and 2012-13 (hardwood sawmills decreasing by 64 per cent and softwood sawmills by 31 per cent) along with 38 percent decline in the volume of hardwood and softwood sawlogs harvested for domestic processing. Sawmill numbers have since stabilised while sawlog processing volumes have increased.
- A total of 10.63 million cubic metres of sawlogs was processed in Australian sawmills - 1.91 million cubic metres of hardwood sawlogs, 8.58 million cubic metres of softwood sawlogs. This resulted in 4.71 million cubic metres of sawnwood (742,000 cubic metres of hardwood sawnwood, 3.91 million cubic metres of softwood sawnwood) and an estimated 280,000 cubic metres of posts and poles and 1.79 million cubic metres of wood-based panels was produced.
- A total of 5.49 million cubic metres of sawlog residues (primarily woodchip) was produced comprising 1.09 million cubic metres of hardwood residues and 4.40 million cubic metres of softwood residues.
- 27 per cent of hardwood sawnwood production was dry appearance-grade products, followed by green structural (24 per cent) and green other (24 per cent). 52 per cent of total softwood sawnwood production was dry structural-grade timber, followed by green other (23 per cent) and dry other (18 per cent).
- An estimated \$2.48 billion of revenue was generated in 2016–17 from the sale of sawnwood processed in Australia, comprising \$930 million from hardwood sawnwood sales and \$1.55 billion from softwood sawnwood sales.

Figure 7: Geographic distribution of sawmills

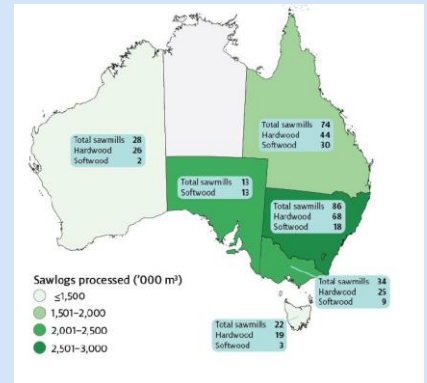
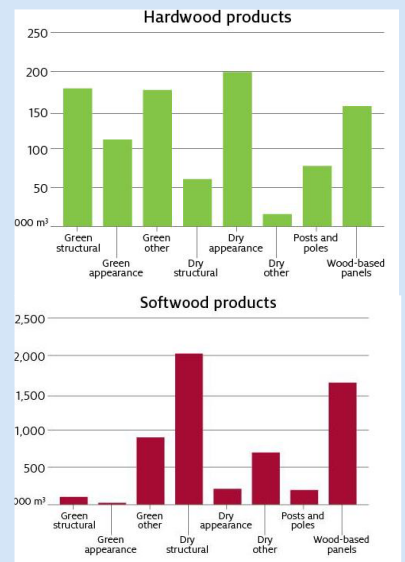


Figure 8: Sawnwood Product Profiles



Source: ABARES National Wood Processing Survey 2016–17

Study Background: - Forestry in Australia – Economic Footprint

Summary of Economic Footprint

To understand the interaction between financial flows, the 2020/21 national input output table produced by the ABS (indicatively adjusted to 2023) provides a perspective of the backward and forward supply chain linkages for the industry at the national level. This therefore indicates that the economic footprint of the forestry and wood products industry is as presented in Table 4 with key points summarized as:

- Total turnover of the Wood and Paper products in 2022/23 is estimated at \$30.4 billion.
- Total exports were around \$2.6 billion.
- The sector employed of the order of 65,000 people (61,000 FTEs). Employment has been falling steadily over several years as labour productivity has been increased.
- Other than internal transfers, the majority of wood product is used within Australia in construction activity.

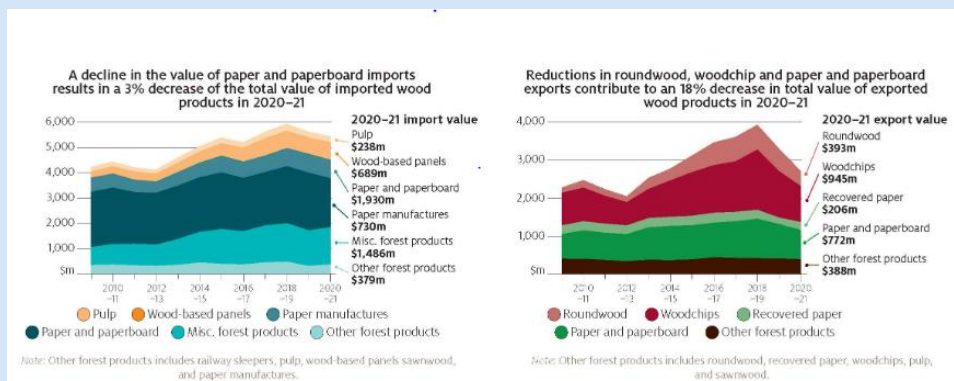
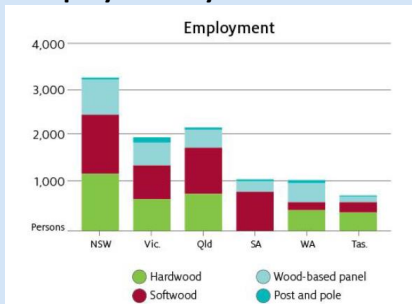
These estimates are supported in terms of orders of magnitude by ABARES data from their 2021 report as discussed earlier, including that presented in Figures 9 and 10.

Table 4: Economic Mapping, Forestry Industry in Australia, 2022-23

	Forestry and Logging	Sawmill product manufacturing	Other wood product manufacturing	Pulp, paper and paperboard manufacturing	Paper stationery and other converted paper product manufacturing	Total Wood and Paper	Printing (including the Reproduction of Recorded Media)	Furniture manufacturing	Total
Annual Turnover (\$m)	\$4,039.8	\$5,401.8	\$10,581.8	\$3,133.8	\$7,264.3	\$30,421.4	\$6,113.0	\$5,900.2	\$42,434.6
Compensation of Employees (\$m)	\$853.4	\$835.5	\$2,494.2	\$459.2	\$1,389.9	\$6,032.3	\$2,167.2	\$1,498.6	\$9,698.1
Employment (FTEs)	5,601	10,617	26,778	2,983	15,170	61,150	25,343	49,282	135,775
Employment (Jobs)	5,970	11,334	28,585	3,145	15,992	65,025	29,217	53,350	147,592
Gross Operating Surplus (\$m)	\$1,326.1	\$753.8	\$1,745.0	\$357.3	\$790.7	\$4,972.8	\$968.8	\$1,160.3	\$7,101.9
Direct Taxes (\$m)	\$122.0	\$15.8	-\$275.2	\$25.2	\$18.4	-\$93.7	-\$415.4	-\$248.0	-\$757.1
Inputs from within the region by sector									
Wood and Wood products sector	4.9%	38.6%	18.1%	19.2%	6.9%	17.4%	7.6%	12.0%	15.2%
Other agriculture and mining	20.7%	0.6%	1.1%	5.2%	2.9%	4.5%	0.8%	0.8%	3.4%
Other manufacturing	4.3%	1.3%	5.5%	4.5%	3.9%	4.1%	4.2%	9.2%	4.8%
Utilities	0.1%	1.2%	2.1%	10.6%	3.6%	2.9%	1.1%	1.7%	2.5%
Construction	0.1%	6.7%	4.7%	0.7%	1.1%	3.2%	1.4%	2.8%	2.9%
Trade	1.4%	2.5%	3.3%	2.6%	3.1%	2.8%	3.0%	4.0%	3.0%
Transport - inputs	1.4%	10.9%	5.9%	3.3%	2.8%	5.2%	1.5%	2.6%	4.3%
Transport - outputs	0.0%	1.6%	0.4%	0.3%	0.1%	0.5%	0.1%	0.9%	0.5%
Other Services	0.5%	4.7%	12.0%	14.7%	22.2%	11.9%	18.5%	6.6%	12.1%
Total	33.5%	67.9%	52.9%	61.1%	46.9%	52.4%	38.0%	40.6%	48.7%
Sales of Output									
Wood and wood products sector	73.4%	30.9%	6.6%	17.8%	4.0%	20.3%	4.1%	0.6%	15.2%
Construction	0.3%	44.9%	74.5%	6.1%	6.5%	36.1%	6.4%	23.9%	30.1%
Other intermediate demand	8.6%	5.1%	8.5%	55.4%	52.2%	23.2%	78.0%	14.8%	29.9%
Households final demand	1.9%	1.0%	3.2%	5.1%	28.6%	8.9%	4.8%	33.7%	11.8%
Gov and investment final demand	5.4%	-0.1%	5.9%	0.6%	0.8%	3.0%	22.6%	5.7%	5.7%
Exports - Other Aust regions	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Exports - Overseas	10.2%	18.3%	1.3%	15.0%	7.9%	8.5%	3.7%	4.3%	7.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Figure 10: Trends in International Trade – Forestry and Wood Products

Figure 9: Wood Products Employment by State



Source of figures <https://www.awe.gov.au/abares/research-topics/forests/forest-economics/forest-wood-products-statistics> 2021

Study Background:– Forestry in the Green Triangle

As per Figures 3 and 7 the Green Triangle region is a major contributor to the national forestry industry. However, the plantation area has declined since 2009-10 due to contractions in the hardwood estate while the softwood estate has been stable.

Green triangle hardwood and softwood supply is forecast to remain stable over the next few decades (Table 5).

The Green Triangle region has a well-established wood processing industry that sources its logs from plantations. Most of the softwood plantations in the Green Triangle region are radiata pine (*P. radiata*) and Tasmanian blue gum (*E. globulus*) is the main hardwood species. These provide a steady supply of sawlogs and pulplog to large-scale integrated processing industries at Mount Gambier, Tarpeena, Myamin, Colac and other locations. These industries produce sawn timber, laminated veneer lumber, particleboard, treated posts and poles. Small round wood and woodchips are exported from Portland.

Figure 11: Geographic Mapping of Forestry Areas in the Green Triangle

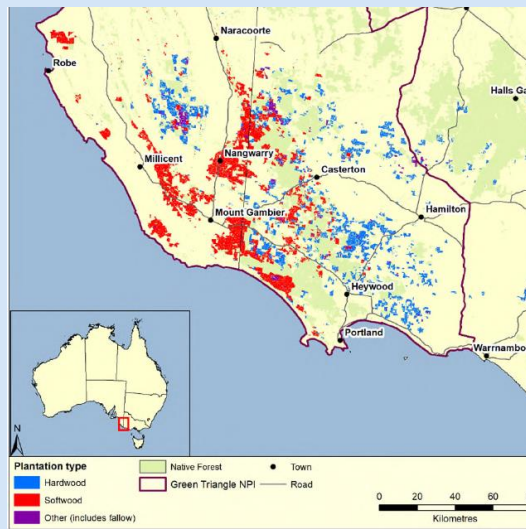


Table 5: Forecasts of Log Availability – Green Triangle

	2020-24	2025-29	2030-34	2035-39	2040-44	2045-49	2050-54	2055-59	2060-64
Hardwood pulplog	1,709	2,047	2,124	1,734	1,541	1,536	1,554	1,720	1,557
Hardwood sawlog	0	0	0	0	0	0	0	0	0
Softwood pulplog	907	872	868	856	797	828	835	809	910
Softwood sawlog	3,033	3,189	3,179	3,490	3,747	3,948	3,866	3,759	3,453
Grand Total	5,649	6,108	6,171	6,081	6,085	6,312	6,255	6,287	5,920

Source: Australian plantation statistics and log availability report 2021, ABARES

Study Background: Green Triangle Forestry

The Green Triangle region Freight Action Plan Update (June 2016) summarised a case for improved freight infrastructure, with the main driving factor being growth in the forestry transport task.

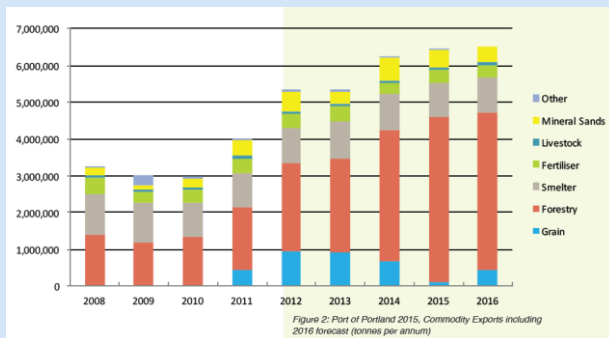
The major recommendations coming out of the Freight Action Plan including the need for:

1. Updating the evidence base for transport
2. New investment for priority freight corridors, with required investment of \$179 million over 10 years (with BCR) of 1.74. These priority freight routes are;
 1. Princes Highway (a) Warrnambool to Heywood, (b) Heywood to South Australia Border
 2. Portland-Casterton Road
 3. Portland-Nelson Road
 4. Henty Highway a) Ring Road to Port b) Condah to Portland
3. A new user-pays framework for the region's road network

The Freight Action Plan summarises the economic characteristics of the forestry and transport sector (*note the transport task includes more than just forestry as can be seen in Figure 10*)

- Largest plantation forestry area in Australia (355,000 hectares and 18 per cent of the national plantation estate)
- More than 150 separate businesses in the region rely on the forest industry
- More than 3,400 direct forest industry jobs with more than 550 additional jobs expected by end of 2016
- Over 18,000 jobs created by the region's forestry and transport sectors
- Six globally significant plantation companies operating
- More than 145,000 truck trips annually to the Port of Portland (2015)
- Forestry and transport combined output exceeding \$790m per annum
- Combined value added exceeding \$397m per annum
- Exports in raw timber and timber products, mineral sands, and grains, expected to grow over next five to 10 years
- The Port of Portland is currently the largest hardwood chip export in the world

Figure 12: Freight Out from Port of Portland



The report “Building the Nation: Growing the Green Triangle’s Contribution to Australia’s Future” (Green Triangle Forestry Industry Hub, 2021) indicates that the Green Triangle contributes more wood products into domestic markets than any other region producing:

- 35% of Australia’s locally produced house framing and interior sawnwood
- 25% of the nation’s particleboard
- 48% of the packaging and industrial grade timber
- 60% of the poles, posts, fencing and similar products, used in the agriculture, horticulture and external environments.

However, the report notes that over 40% of forestry output leaves the region unprocessed, and therefore the report, and the accompanying strategic plan also sets targets for the region to increase the extent of local production – rather than exporting log and residue. The report outlines strategies that focus on increasing the extent of local processing and presents the following targets.

Figure 13: GTFIH Strategic Targets -1

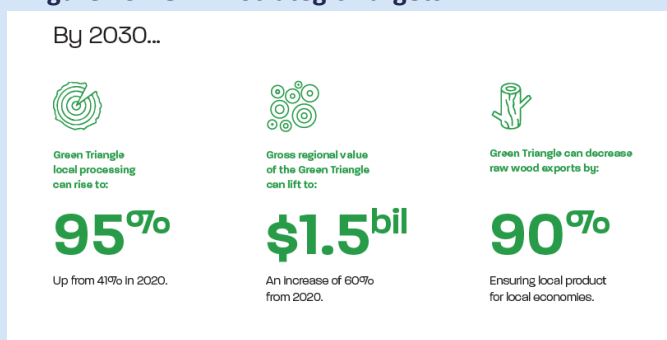
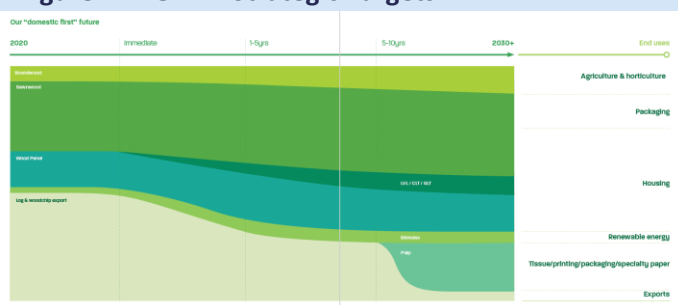


Figure 14: GTFIH Strategic Targets -2



Source: “Building the Nation: Growing the Green Triangle’s Contribution to Australia’s Future”

Study Background: - Forestry in the Green Triangle – Economic Footprint

Summary of Economic Footprint

To develop a picture of the economic structure of the forestry industry in the Green Triangle region an economic model of the region for 2022-23 has been developed. The methodology and detail of the modelling framework are contained in Appendix 1. The conclusion of the modelling is that in 2022-23 the overall structure of the industry in the Green Triangle included:

- Total turnover of the Wood and Paper products was \$2.04 billion.
- 50% of the output of the forestry and logging sector is used as inputs for next level activity (sawmilling, other wood products, pulp, paper and paperboard manufacturing).
- Total out of region exports were around \$1.5 billion, of which \$0.2 billion was directly overseas and the rest interstate exports.
- The sector supports directly of the order of 6.5% of the gross regional product of the Green Triangle region.
- The sector employed of the order of 3,600 people (3,400 FTEs) or 4.1% of employment in the region.

Table 6: Economic Mapping, Forestry Industry in the Green Triangle, 2022-23

	Forestry and Logging	Sawmill product manufacturing	Other wood product manufacturing	Pulp, paper and paperboard manufacturing	Paper stationery and other converted paper product manufacturing	Total Wood and Paper	Printing (including the Reproduction of Recorded Media)	Furniture manufacturing	Total
Annual Turnover (\$m)	\$776.1	\$887.3	\$174.1	\$28.7	\$177.3	\$2,043.5	\$18.0	\$8.4	\$2,069.9
Compensation of Employees (\$m)	\$164.0	\$137.2	\$41.0	\$4.2	\$33.9	\$380.4	\$6.4	\$2.1	\$388.9
Employment (FTEs)	978	1,586	400	27	370	3,362	75	97	3,533
Employment (Jobs)	1,043	1,693	427	29	390	3,582	86	129	3,797
Gross Operating Surplus (\$m)	\$254.8	\$123.8	\$28.7	\$3.3	\$19.3	\$429.9	\$2.9	\$1.7	\$434.4
Direct Taxes (\$m)	\$23.4	\$2.6	-\$4.5	\$0.2	\$0.4	\$22.2	-\$1.2	-\$0.4	\$20.6
Inputs from within the region by sector									
Wood and Wood products sector	4.9%	38.5%	17.9%	17.8%	4.4%	20.7%	4.0%	11.6%	20.6%
Other agriculture and mining	20.7%	0.3%	0.3%	1.3%	0.8%	8.1%	0.2%	0.5%	8.0%
Other manufacturing	4.3%	1.3%	5.5%	4.5%	3.9%	3.1%	4.2%	9.2%	3.1%
Utilities	0.1%	0.8%	1.3%	6.9%	2.4%	0.8%	0.7%	1.0%	0.8%
Construction	0.1%	6.4%	4.5%	0.7%	1.0%	3.3%	1.2%	2.7%	3.3%
Trade	1.4%	2.5%	3.1%	2.3%	2.9%	2.1%	2.8%	3.9%	2.1%
Transport - inputs	1.3%	10.7%	5.8%	3.2%	2.7%	5.9%	1.5%	2.6%	5.9%
Transport - outputs	0.1%	8.0%	2.3%	0.9%	0.4%	3.8%	0.2%	0.9%	3.7%
Other Services	0.3%	2.7%	6.5%	7.2%	10.8%	2.9%	8.6%	3.3%	2.9%
Total	33.2%	71.1%	47.2%	44.8%	29.4%	50.7%	23.3%	35.7%	50.4%
Sales of Output									
Woods and woods products sector	48.5%	3.5%	4.6%	14.4%	2.7%	20.8%	4.3%	0.8%	20.6%
Construction	0.0%	1.9%	29.8%	2.1%	1.7%	3.6%	4.3%	19.7%	3.6%
Other Intermediate demand	0.8%	0.3%	4.7%	24.6%	19.7%	2.9%	64.6%	15.3%	3.5%
Households final demand	0.1%	0.0%	1.1%	1.6%	6.0%	0.7%	2.9%	25.3%	0.8%
Govt and investment final demand	0.1%	0.0%	1.8%	0.1%	0.2%	0.2%	6.3%	1.4%	0.3%
Exports - Other Aust regions	42.3%	79.6%	56.9%	49.3%	63.5%	61.7%	13.9%	33.2%	61.1%
Exports - Overseas	8.2%	14.6%	1.0%	7.8%	6.3%	10.2%	3.7%	4.3%	10.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

The impact of increased carbon prices on wood production

The High Level Commission on Carbon Prices—drafted by the UN Framework Convention on Climate Change estimated that prices of \$40–80 per metric ton of carbon dioxide emitted were needed by 2020 to keep global warming within a 2-point degree, (the target in the Paris agreement). While some regions (particularly Europe) have trading schemes operating at these prices, the world average is still somewhat less than what is required. Higher prices again will be required to achieve global emission targets. However current prices as identified in carbon taxes or carbon trading schemes are well below that level. A critical factor in policy frameworks will be achieving the higher levels of price and a pertinent issue in this context is the July 2023 announcement by the Prime Minister in Germany of Australia becoming a member of the Carbon Club (who have an agenda around carbon prices).

Due to the role that forests and trees play in decarbonization, increasing carbon prices are likely to result in increased plantations with respect to forest plantations. While the carbon trading aspect will underpin the investment in forests, the plantations themselves will result in increases in employment, and in processing and development opportunities.

The modelling of the woodflows that could be expected in response to various carbon prices has been undertaken by Dr Courtney Regan, Research Fellow – Centre for Markets Values and Inclusions, the University of South Australia, and are summarised in Tables 7 and 8, with more detail provided the softwoods modelling in Appendix 2. There are three core presumptions in these estimates. Firstly, they assume the land is available for sale. This will be a major constraining factor but really was not tackled in the GTFIH work. Secondly, they assume 100% of any parcel is developed. Thirdly, the threshold prices are sensitive to agricultural land prices and is the major driving factor. In total therefore is that the estimates present as absolute upper bound of available additional wood flow – whether this potential will be reached depend on the factors above.

Table 7 presents the estimated additional woodflow for hardwood generated at ACCU prices of \$0 to \$80/t CO₂e in both cubic metres and green metric tonnes, and the hectares of land required. The results assume that any parcel having a classified land use of mixed agriculture, broadacre cropping or extensive livestock grazing 10ha or greater in size in the 600mm or above rainfall zone is eligible for forestry development. The prices should be read as less than or equal to. i.e. \$35 should be interpreted as all additional woodflow available at ACCU prices less than or equal to \$35. The results assume a 15 year rotation and that 100% of the eligible area of each property is converted plantation forestry net of remnant vegetation, water courses, existing plantations. In order High Level Commission on Carbon Prices—drafted by the UN Framework Convention on Climate Change to constrain land availability these data can be multiplied by the proportion of the parcel available for development.

As with the hardwood data, Table 8 presents the additional woodflows estimated at or below each ACCU price listed for each of the four harvesting operation associated with a softwood rotation in the Green Triangle National Plantation Inventory Region, along with the hectares required. The production involves 3 thinning operations followed by a final clearfell harvest operation. Thin 1 is assumed to occur at year 13, Thin 2 at year 20, Thin 3 at year 27 and the clearfell at year 32. All woodflow values are in M3 and as with hardwood assume that 100% of each eligible parcel is converted to softwood plantation net of native vegetation, water courses, roads etc. Tables provided in the appendix - provide estimates of additional woodflow by log class and final product. The data in table 7 displays additional woodflow at each price point of below (i.e.. \$40/THIN1 would expect 4,054,208 m3 additional woodflow at ACCU prices of \$40/ t CO₂e and below (so all price points up to and including \$40).

Table 7: Potential Hardwood WoodFlow with Increased Carbon Price

ACCU PRICE	ADDITIONAL TIMBER VOLUME		Area (Hectares)
	Volume (M3)	Green Metric Tonnes	
\$30	20,657,571	18,591,814	71,908
\$35	28,784,212	25,905,791	102,514
\$40	36,494,039	32,844,635	132,052
\$45	46,624,187	41,961,768	171,201
\$50	55,553,198	49,997,878	205,671
\$55	67,534,742	60,781,268	251,640
\$60	76,594,279	68,934,851	287,405
\$65	89,645,371	80,680,834	337,855
\$70	97,791,088	88,011,979	370,818
\$75	103,775,116	93,397,605	394,815
\$80	109,880,289	98,892,260	419,933

Table 8: Potential Softwood WoodFlow with Increased Carbon Price

ACCU PRICE	ADDITIONAL VOLUME (M3)				Area (Hectares)
	THIN 1	THIN 2	THIN 3	CLEARFELL	
\$30	0	0	0	0	0
\$35	1,196,484	1,111,018	1,032,676	4,965,686	11,331
\$40	4,054,208	3,776,941	3,514,927	16,916,484	38,113
\$45	8,556,031	8,128,180	7,634,751	37,036,503	84,907
\$50	10,225,302	9,742,926	9,165,213	44,520,022	103,380
\$55	11,958,304	11,406,064	10,737,510	52,196,025	122,838
\$60	13,286,755	12,667,071	11,923,239	57,958,052	138,401
\$65	18,282,551	17,321,296	16,257,355	78,835,848	186,237
\$70	24,451,542	23,115,745	21,673,280	105,004,633	247,091
\$75	29,511,716	27,856,216	26,098,724	126,365,887	288,941
\$80	35,157,148	33,313,684	31,269,148	151,637,924	355,702

Source for Tables 7 and 8: Centre for Markets Values and Inclusions, the University of South Australia Modelling

Modelling the impact of increased carbon prices on economic activity - assumptions

The 2022 report “Economic Contribution Study of the SA Forestry Industry” illustrates the importance of the forestry industry to the Green Triangle region, and the additional plantations that would be generated by an increased carbon price has the potential to substantially expand that going forward, and as noted this is updated to 2023 in Table 5.

To provide an indicative modelled outcome of the economic implications of the increased wood flow the following additional assumptions are applied (data below is provided for a carbon price of \$40 per tonne):

- The transformation of general farming land is assumed to take a 5 year period, and involve an investment of \$2,803 per hectare (as estimated by Green Triangle Forest Industries Hub)
- The general farming land used to develop the new plantations is assumed to produce outputs (missed farming) worth \$855 per hectare per annum (<https://www.agriculture.gov.au/abares/research-topics/surveys/measuring-austalian-broadcare-farmland-value>, Wheat for Grain - 2021/22 (ABS Cat Agricultural Commodities and Agricultural Commodities and Value of Agricultural Commodities)).
- The basic value per cubic metre of log produced is assumed to be \$105. This is the underling value as indicated by the value of forestry and logging industry output estimated in the Green Triangle region input output table prepared for 2022-23 for this study (and used to produce the information in Table 5).
- Table 9 shows the distribution of sales by each industry sector as estimated/modelled for 2022-23 for the Green Triangle region. It is assumed that these distributions will be maintained with the expansion of activity. The implication of this assumption is that increased logging results in increased sawmill production (42% of forestry logs produced by value are sent to local sawmills, while a little over 50% are exported ((to other states/regions or overseas).

Table 9: Estimates of Production value and sales by wood production sector – Green Triangle region, 2022-23

Value	\$million	Percentage sales to								
		Logging	Sawmill Product	Other wood product	Pulp, paper	Paper, stationary	Other	Exports Interstate	Exports Overseas	Total
Logging	776.1	4.85%	42.01%	1.66%	0.00%	0.00%	0.94%	42.33%	8.20%	100.0%
Sawmill Product	887.3	0.0%	1.3%	1.6%	0.5%	0.0%	2.3%	79.6%	14.6%	100.0%
Other wood product	174.1	0.0%	2.2%	2.0%	0.0%	0.0%	38.0%	56.8%	1.0%	100.0%
Pulp, paper	28.7	0.0%	0.2%	0.3%	1.1%	11.7%	28.9%	49.9%	7.8%	100.0%
Paper, stationary	177.3	0.0%	0.1%	0.1%	0.1%	2.2%	27.2%	64.0%	6.3%	100.0%

- The turnover generated in sawmills, other wood products etc. is assumed to be linked to the ratio of inputs from the other wood products sector within the production function.
- The average turnover per industry sector calculated as above is assumed to be generated in the year of harvesting for all sectors but Forestry and Logging. For the Forestry and Logging sector, it is assumed that the expenditure is distributed more evenly than turnover in terms of planation care and activity in non harvesting years. This evens out the spread of activity somewhat, but the direct outcomes as modelled are cyclical, depending heavily on harvesting cycles. It should be noted that in reality the outcomes are likely be more evenly spread than as modelled, in that the extra plantations provide greater flexibility across the whole area for harvesting and production activity with the cycles more likely to have greater variability than as modelled.
- The expenditure estimates by the wood production sector, along with the estimated production value loss from the agriculture sector where land has been converted to forestry plantation are distributed as final demand changes for across the 35 industry sectors of the economic model. In addition to the final demand for the forestry sector (which as noted above is estimated in basic values (which is aligned with the concept of price at the farm gate), a margin turnover figure is added for transport and trade sector as it relates to wood production and lost value of agriculture (3.5% for road transport, 0.5% for other transport and 0.2% for wholesale trade). Plantation investment spend is allocated across the forestry sector, construction services, and professional, scientific and technical services. Investment in sawmills, other wood products etc. are distributed across the non-residential construction services, engineering construction, and professional, scientific and technical services.
- These final demand estimates are then input as final demand shocks by year, into the economic model to calculate:
 - **Direct impact** – the increase in economic activity in the directly impacted sectors of forestry and logging and wood production, transport and agriculture in terms of Value Added (payments for labour and returns on capital consistent with national accounts definitions), Compensation of Employees and Employment (in full time equivalent terms).
 - **Indirect impact** – the impacts throughout the rest of economy for the above measures of economic activity, made up of first round impact (suppliers of goods and services to the forestry and wood production industries), industry induced impacts (the supply chain outcomes of business to business transactions, and the consumption induced impacts of the spend of wages).

Modelling the impact of increased carbon prices on economic activity - results

Based on the assumptions and modelling framework applied, the core results of the analysis are presented in Tables 1, 2 and 3 in the executive summary. In summary:

- At a carbon price of \$40:
 - There will be an additional 3.0 million cubic metres of log production out of the Green Triangle region on average per year.
 - This will result in increased turnover in the forestry and wood manufacturing sector of \$844 million per annum on average, with wages and salaries incomes generated of \$148 million and total Gross Regional Product of \$290 million. 1,075 new full time equivalent jobs will be supported in the forestry and wood manufacturing sector.
 - However, this will result in some loss of activity in general agriculture as a consequence of the transfer of land from general agriculture to forestry.
 - It will create activity through supply chain and consumption effects, though due to underlying supply side constraints will squeeze out some investment in other areas (in net terms investment in other manufacturing will be the most affected).
 - With all of these impacts considered in a combined context, the average annual increment to Gross Regional Product is estimated at \$543 million, to wage and salary income at \$277 million and the creation of 2,700 full time equivalent jobs in the region.
 - This represents an estimated 4% increase in the size of the Green Triangle economy over and above what it would otherwise be.
- At a carbon price of \$80:
 - There will be an additional 14.3 million cubic metres of log production out of the Green Triangle region on average per year.
 - This will result in increased turnover in the forestry and wood manufacturing sector of \$3.9 billion per annum on average, with wages and salaries incomes generated of \$630 million and total Gross Regional Product of \$1.2 billion. 4,600 new full time equivalent jobs will be supported in the forestry and wood manufacturing sector.
 - Again this will result in some loss of activity in general agriculture as a consequence of the transfer of land from general agriculture to forestry but on the other hand it will create activity through supply chain and consumption effects
 - With all of these impacts considered in a combined context, the average annual increment to Gross Regional Product is estimated at \$2.3 billion, to wage and salary income at \$1.2 billion and the creation of 11,400 full time equivalent jobs in the region.
- This is a long term impact. The outcomes in present value terms (real discount rate of 6%) over 100 years are indicated in Table 10 for a \$40 carbon price and Table 11 for an \$80 carbon price - showing the extensive impact that would be generated should these woodflow volumes be achieved. An evaluation over a 50 year time frame would see these estimates come down by approximately 10%.

Table 10: 100 year Present Value of Economic Outcomes
ACCU of \$40

	Value Added (\$m)	Compensation of Employees (\$m)
Direct Impact		
Forestry and Logging	\$2,102	\$779
Sawmill product manufacturing	\$992	\$516
Other wood product manufacturing	\$245	\$154
Pulp, paper and paperboard manufacturing	\$29	\$16
Paper stationery and other converted paper product manufacturing	\$202	\$128
Transport	\$103	\$59
Other agriculture	-\$866	-\$184
Total Direct Impact	\$2,807	\$1,469
Induced Impact		
Other agriculture and mining	\$1,123	\$347
Other Manufacturing	-\$219	-\$88
Construction	\$174	\$85
Utilities	\$58	\$16
Trade and Hospitality	\$512	\$330
Transport	\$335	\$180
Business, Professional and Property	\$372	\$223
Ownership of Dwellings	\$0	\$0
Public administration, education and Other	\$201	\$179
	\$111	\$89
Total Induced Impact	\$2,668	\$1,361
Total Impact	\$5,474	\$2,830

Table 11: 100 year Present Value of Economic Outcomes
ACCU of \$80

	Value Added (\$m)	Compensation of Employees (\$m)
Direct Impact		
Forestry and Logging	\$8,736	\$3,240
Sawmill product manufacturing	\$3,957	\$2,060
Other wood product manufacturing	\$979	\$616
Pulp, paper and paperboard manufacturing	\$116	\$63
Paper stationery and other converted paper product manufacturing	\$806	\$509
Transport	\$403	\$231
Other agriculture	-\$3,625	-\$768
Total Direct Impact	\$11,371	\$5,950
Induced Impact		
Other agriculture and mining	\$4,532	\$1,397
Other Manufacturing	-\$878	-\$353
Construction	\$693	\$338
Utilities	\$231	\$63
Trade and Hospitality	\$2,055	\$1,325
Transport	\$1,333	\$718
Business, Professional and Property	\$1,495	\$896
Ownership of Dwellings	\$0	\$0
Public administration, education and Other	\$810	\$720
	\$443	\$356
Total Induced Impact	\$10,714	\$5,459
Total Impact	\$22,085	\$11,409

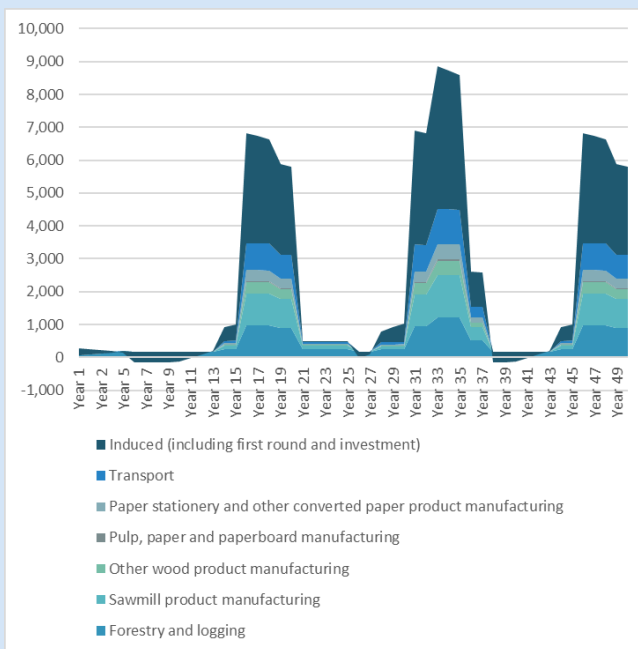
Modelling the impact of increased carbon prices on economic activity - results

Figure 15 shows the modelled outcomes by year for 50 years. It shows the cycles (and over that period there are 3) associated with the assumptions re harvesting/rotations, and the economic consequences given the modelling assumptions. However as noted earlier, the actual economic outcomes are unlikely to be subject to that level of variation. In effect the new areas allocated to forestry will have some natural variation around the assumed rotations and harvesting time frames and also interact with existing plantations – and would even out this perspective to some degree with production cycles being optimized.

The modelling focusses on the tangible effects of the increased forestry activity. It is further noted that with a further 170,000 hectares of land allocated to forestry activity at a carbon price of \$40, and 775,000 hectares of land allocated to forestry activity at a carbon price of \$80 appropriate planning and investment considerations will see enhanced outcomes for recreational and tourist attracting activities. The potential benefit in this context has not been quantified in that there is no primary information on which to do so.

Further it is noted that the assumption that the current ratios of local processing that have been assumed are likely to be somewhat conservative. The increase in activity at a carbon price of \$40 represents of the order of a 40% increase in the underlying scope of activity, while at \$80 forestry activity is tripled. This substantial change in structure is highly likely to lead to increased processing within the region and further enhance the outcomes.

Figure 15: Modelled Employment Outcomes by Year



Appendix 1: Context of Modelling and Summary of Economic Mapping Methodology

Without a full survey/audit of the companies involved in an industry there is limited data with respect to the economic structure of that industry at the regional level. In the main this is restricted to employment data and at sub-state level that in turn is limited to census data. It is clear from comparing ABS Labour Force data and Census data at the national and state level that census data substantially understates employment outcomes in the region.

At the national level, the best picture of an industry and how it is structured is available in an input output table prepared by the ABS, and the outcomes for the Forestry sector is summarised in Slide 6 above. To assess the contribution of the sector by region, with a focus on South Australia, the following steps have been undertaken:

- The last available national IO table at the beginning of this analysis (2020/21) has been updated to 2022/23 (mainly for inflation). Employment data by industry has been sourced from the labour force survey. The table has been structured at a 35-sector level, focussing on the industries of and linked to the forestry sector.
- A state table for SA for 2022/23 has been prepared using a mathematical process (location quotient method) applied to the 2020/21 national table, involving State Labour Force data of employment by industry and adjusting for data on wages and salaries (compensation of employees), gross operating surplus and direct taxes from State Accounts data. Adjustment of jobs to FTEs is based on the ratios in the national IO tables. It has then been updated to 2022/23 (mainly for inflation).
- A regional table for the Green Triangle region has been prepared also using the location quotient method (applied to the underlying state table), based on census data for the region (and adjusted upwards for under-enumeration in census employment data (as evidenced from the labour force data at the state level)).

This process provides a picture of the regional economy. It should be cautioned that it is not an audited/full survey approach – and as such should be understood to be indicative. Further it is noted this an economic contribution perspective – and it should be noted that it cannot be concluded that a region would decline by the levels estimated (proportionally) should the industry somehow shrink. Should this happen, there would potentially be some offsetting macroeconomic responses or in the medium to longer term the evolution of replacement industries (e.g., forestry areas taken over by alternative agriculture) that would offset. Therefore, the model has been adjusted in its application to the expansion of the area to include assumptions regarding supply side constraints. However these assumptions reflect to the research that indicates the extent of supply side constraint at the regional level mainly relate to availability of land for specific purposes and in the long term other constraints are minimal.

The Industry sectors that are mapped include: Forestry and Logging, Sawmill product manufacturing, Other wood product manufacturing, Pulp, paper and paperboard manufacturing, Paper stationery and other converted paper product manufacturing as the focus, but also as they are inter-related include Printing (including the Reproduction of Recorded Media) and Furniture manufacturing. The forestry regions tend to have increased focus on the first two and to some extent the third sector, and output from those sectors is “exported from the region” to other regions of the state to be used in the other sectors (and construction as discussed further on), to other states and overseas.

Tables 5 presents the mapping outcomes based on this methodology for the Green Triangle areas (located in South Australia and Victoria). The mapping focusses first on identifying the direct turnover, employment, compensation of employees (gross) and gross operating surplus (returns to capital) and taxes. It reviews the linkages within the economy and provides an estimate of where outputs of each sector are “sold”. The estimates are in basic values and exclude margins.

National accounting conventions measure activity in terms of value added (compensation of employees + gross operating surplus + taxes) and employment. Therefore, the turnover in each sector is then applied to the economic model to provide estimates of direct and induced value added and employment outcomes. Induced outcomes are the flow on effects created by the business-to-business flows (i.e., the forestry and wood products sector buys from other industries) and the spend of wages generated. The modelling allows for flows that occur within the sector to avoid double counting.

Appendix 2: Assumptions re Softwood Production Induced by Increased Carbon Price

Table 12 provides the assumptions with respect to the log sizes for softwood production for the various harvesting activities and were developed from Forestry SA data with the aid of Dr Jim O'Hehir. Forestry SA class log sizes on a scale of 0-10. TO make programming more tractable, the 10 log sizes were simplified into small - large. i.e. 0-2 (small), 3-5 (intermediate), 6-8 (medium), 9-10 (large).

Table 12: Assumed distribution of log sizes per trim/clearfell

	Proportion Log sizes			
	SMALL	TERMEDIA	MEDIUM	LARGE
T1	1	0	0	0
T2	0.77	0.23	0	0
T3	0.31	0.55	0.14	0
CF	0.05	0.17	0.61	0.17

Table 13 - 16 Shows additional woodflow (m3) estimated at \$5 increments. The results show the additional woodflow at that price point including all prices below the price listed in the tables . i.e. Volume at each price up to and including that price.

Table 13: Woodflow estimates for Trim 1

THIN 1				
ADDITIONAL VOLUME (M3)				
ACCU PRICE	SMALL	INTERMEDIATE	MEDIUM	LARGE
\$30	0	0	0	0
\$35	1,196,484	0	0	0
\$40	4,054,208	0	0	0
\$45	8,556,031	0	0	0
\$50	10,225,302	0	0	0
\$55	11,958,304	0	0	0
\$60	13,286,755	0	0	0
\$65	18,282,551	0	0	0
\$70	24,451,542	0	0	0
\$75	29,511,716	0	0	0
\$80	35,157,148	0	0	0

Table 14: Woodflow estimates for Trim 2

THIN 2				
ADDITIONAL VOLUME (M3)				
ACCU PRICE	SMALL	INTERMEDIATE	MEDIUM	LARGE
\$30	0	0	0	0
\$35	855,484	255,534	0	0
\$40	2,908,245	868,697	0	0
\$45	6,258,699	1,869,481	0	0
\$50	7,502,053	2,240,873	0	0
\$55	8,782,669	2,623,395	0	0
\$60	9,753,645	2,913,426	0	0
\$65	13,337,398	3,983,898	0	0
\$70	17,799,123	5,316,621	0	0
\$75	21,449,287	6,406,930	0	0
\$80	25,651,537	7,662,147	0	0

Table 15: Woodflow estimates for Trim 3

THIN 3				
ADDITIONAL VOLUME (M3)				
ACCU PRICE	SMALL	INTERMEDIATE	MEDIUM	LARGE
\$30	0	0	0	0
\$35	320,130	567,972	144,575	0
\$40	1,089,627	1,933,210	492,090	0
\$45	2,366,773	4,199,113	1,068,865	0
\$50	2,841,216	5,040,867	1,283,130	0
\$55	3,328,628	5,905,630	1,503,251	0
\$60	3,696,204	6,557,781	1,669,253	0
\$65	5,039,780	8,941,545	2,276,030	0
\$70	6,718,717	11,920,304	3,034,259	0
\$75	8,090,604	14,354,298	3,653,821	0
\$80	9,693,436	17,198,031	4,377,681	0

Table 16: Woodflow estimates for Clearfell

CLEARFELL				
ADDITIONAL VOLUME (M3)				
ACCU PRICE	SMALL	INTERMEDIATE	MEDIUM	LARGE
\$30	0	0	0	0
\$35	248,284	844,167	3,029,068	844,167
\$40	845,824	2,875,802	10,319,055	2,875,802
\$45	1,851,825	6,296,206	22,592,267	6,296,206
\$50	2,226,001	7,568,404	27,157,213	7,568,404
\$55	2,609,801	8,873,324	31,839,575	8,873,324
\$60	2,897,903	9,852,869	35,354,412	9,852,869
\$65	3,941,792	13,402,094	48,089,867	13,402,094
\$70	5,250,232	17,850,788	64,052,826	17,850,788
\$75	6,318,294	21,482,201	77,083,191	21,482,201
\$80	7,581,896	25,778,447	92,499,134	25,778,447

Appendix 2: Assumptions re Softwood Production Induced by Increased Carbon Price

Final products for each harvesting operation from first thinning (T1) to clearfell (CF) were taken from Forestry SA data and interpreted with the input of Dr Jim O'Hehir. These proportions were seen as a fair approximation for the Green Triangle NPI region.

Table 18 - 21 Shows additional woodflow (m3) estimated at \$5 increments for each final product. The results show the additional woodflow at that price point including all prices below the price listed in the tables i.e. Volume at each price up to and including that price.

Abbrev.	Product	Use
SAW	Sawlog	Sawn timber
REC	Recovery	
PLP	Pulp	paper
PRS	Preservation	Post, rails, strainers
CHP	Chiplog	Chip board
PLY	Plywood	plywood

Table 17: Assumptions of proportions of woodflow to final product

	SAW	REC	PLP	PRS	CHP	PLY
T1 Small	0	0	0.72	0.28	0	0
T1 Inter	0	0	0	0	0	0
T1 Med	0	0	0	0	0	0
T1 Large	0	0	0	0	0	0
T2 Small	0.22	0.04	0.42	0.32	0	0
T2 Inter	0.54	0.06	0.34	0.06	0	0
T2 Med	0	0	0	0	0	0
T2 Large	0	0	0	0	0	0
T3 Small	0.25	0.01	0.67	0	0.07	0
T3 Inter	0.66	0.05	0.25	0	0.04	0
T3 Med	0.97	0.03	0	0	0	0
T3 Large	0	0	0	0	0	0
CF Small	0.03	0.01	0.54	0	0.42	0
CF Inter	0.37	0.06	0.26	0	0.2	0.11
CF Med	0.63	0.1	0	0	0.09	0.18
CF Large	0.65	0.15	0	0	0	0.2

Table 18: Estimated woodflow to final product – Thin 1

	THIN 1					
	ADDITIONAL VOLUME (M3)					
	SAW	REC	PLP	PRS	CHP	PLY
\$30	0	0	0	0	0	0
\$35	0	0	861,468	335,015	0	0
\$40	0	0	2,919,030	1,135,178	0	0
\$45	0	0	6,160,342	2,395,689	0	0
\$50	0	0	7,362,217	2,863,084	0	0
\$55	0	0	8,609,979	3,348,325	0	0
\$60	0	0	9,566,464	3,720,291	0	0
\$65	0	0	13,163,437	5,119,114	0	0
\$70	0	0	17,605,110	6,846,432	0	0
\$75	0	0	21,248,436	8,263,281	0	0
\$80	0	0	25,313,147	9,844,002	0	0

Table 19: Estimated woodflow to final product – Thin 2

	THIN 2					
	ADDITIONAL VOLUME (M3)					
	SAW	REC	PLP	PRS	CHP	PLY
\$30	0	0	0	0	0	0
\$35	326,195	49,551	446,185	289,087	0	0
\$40	1,108,910	168,452	1,516,820	982,760	0	0
\$45	2,386,434	362,517	3,264,277	2,114,952	0	0
\$50	2,860,523	434,535	3,912,759	2,535,109	0	0
\$55	3,348,820	508,710	4,580,675	2,967,858	0	0
\$60	3,719,052	564,951	5,087,096	3,295,972	0	0
\$65	5,085,533	772,530	6,956,233	4,507,001	0	0
\$70	6,786,783	1,030,962	9,283,283	6,014,717	0	0
\$75	8,178,585	1,242,387	11,187,056	7,248,187	0	0
\$80	9,780,898	1,485,790	13,378,776	8,668,221	0	0

Table 20: Estimated woodflow to final product – Thin 3

	THIN 3					
	ADDITIONAL VOLUME (M3)					
	SAW	REC	PLP	PRS	CHP	PLY
\$30	0	0	0	0	0	0
\$35	595,131	35,937	356,480	0	45,128	0
\$40	2,025,653	122,319	1,213,353	0	153,602	0
\$45	4,399,907	265,689	2,635,516	0	333,639	0
\$50	5,281,912	318,949	3,163,832	0	400,520	0
\$55	6,188,027	373,665	3,706,588	0	469,229	0
\$60	6,871,363	414,929	4,115,902	0	521,046	0
\$65	9,369,114	565,756	5,612,039	0	710,446	0
\$70	12,490,311	754,230	7,481,616	0	947,122	0
\$75	15,040,694	908,236	9,009,279	0	1,140,514	0
\$80	18,020,410	1,088,166	10,794,110	0	1,366,462	0

Table 32: Estimated woodflow to final product – Clearfell

	CLEARFELL					
	ADDITIONAL VOLUME (M3)					
	SAW	REC	PLP	PRS	CHP	PLY
\$30	0	0	0	0	0	0
\$35	2,776,812	482,665	353,557	0	545,729	806,924
\$40	9,459,698	1,644,282	1,204,454	0	1,859,122	2,748,929
\$45	20,710,813	3,599,948	2,636,999	0	4,070,312	6,018,432
\$50	24,895,596	4,327,346	3,169,826	0	4,892,750	7,234,504
\$55	29,188,017	5,073,454	3,716,357	0	5,736,343	8,481,854
\$60	32,410,143	5,633,523	4,126,613	0	6,369,590	9,418,183
\$65	44,085,006	7,662,844	5,613,112	0	8,664,060	12,810,825
\$70	58,718,591	10,206,450	7,476,330	0	11,540,009	17,063,253
\$75	70,663,804	12,282,764	8,997,251	0	13,887,611	20,534,457
\$80	84,795,927	14,739,206	10,796,620	0	16,665,008	24,641,163