

# Wood - Supply Chain Benchmarking Report

Report for the Department of Infrastructure, Transport, Regional Development and Communications

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## Executive Summary and Scope



## EXECUTIVE SUMMARY AND SCOPE

Wood is a natural resource used in construction, in products such as furniture, to make paper and packaging, and as a fuel. Wood is typically grouped into two categories: softwood and hardwood.

Softwood is mostly used for building and construction, while hardwood is typically used to make furniture and flooring. Higher quality logs of either softwood or hardwood (sawlogs) are sawn to make wood products, while lower quality logs (pulplogs) are chipped made into paper and fuel.

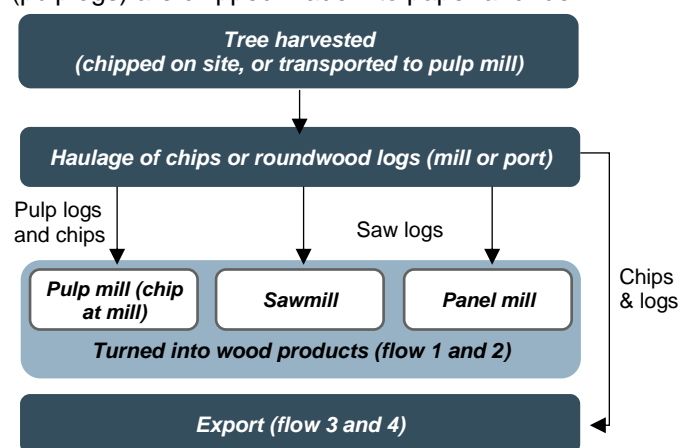


Figure 1: Forestry and hardwood supply chain key flows, represented by arrows (country agnostic).

The wood supply chain can be segmented in four key movements (referred to as 'flows' in this report).

- The first two flows consist of the movements of woodchips (**flow 1**) and logs (**flow 2**) from harvest (e.g., forest) to domestic mills to be made into wood-based products.
- The last two flows consist of the movement of woodchips (**flow 3**) and logs (**flow 4**) from harvest (e.g., forest) to port, or over land borders, for export.
- Most countries have a large number of forests, mills and ports, meaning that goods are moved between a multitude of origins and destinations, but generally as part of one of the four flows described above.

Australia is the second largest exporter of woodchips globally. In 2017-18 it produced c.24 million tonnes (mt) of roundwood (including c.12.3mt of woodchips), with roughly equal volumes of hardwood and softwood. Most of Australia's hardwood production is pulplog quality and chipped for export, predominantly to China and Japan. Comparatively, most of

Australia's softwood production is sawlog and used for domestic construction. The majority of Australia's wood freight task is wood chips, with c.10mt moved annually an average distance of c.464km. The overall weighted cost of wood freight (including all modes, logs and chips) is AUD c.\$0.17 per tonne-kilometre (tkm).<sup>1</sup>

The U.S. and Germany have been selected as comparative countries for Australia's wood supply chain as they are also amongst the top ten largest woodchip exporters worldwide with comparable features (such as broadly comparable labour costs). Australia and the U.S. both sell woodchips into the Japanese market to be made into paper and are therefore competitors. The U.S. has an estimated annual production of over 200mt of roundwood, the majority of which is softwood of pulpwood quality. The U.S. exports high volumes of wood to China and Japan, with minor volumes sent to Canada, including c.6mt of woodchips each year. Overall, cost of road freight is higher in the U.S. at AUD c.\$0.22 per tkm, with limited volumes carried by rail.

Germany is a large producer of wood and paper products. It logged c.57mt of wood (c.80m m<sup>3</sup>) in 2020 (including c.10mt of woodchips) which was predominantly softwood. From this, it produced of this. Overall, Germany's supply chain has a similar cost position to Australia at AUD c.\$0.18 per tkm by road and AUD c.\$0.09-0.10 per tkm by rail.

### Scope of this report

This report covers the movement of roundwood logs & woodchips from harvest (e.g., forest) to mills or to port for export. The movement of wood after it has been turned into different products such as paper, timber or panels is not covered in this study.

## KEY FINDINGS & AREAS FOR FURTHER INVESTIGATION

- Germany moves roughly 3 times more wood than Australia (in weight), but the total freight expenditure is only 50% higher than that of Australia. The apparent increased efficiency may be explained by the shorter distances travelled in Germany but should be investigated further.
- Overall freight rates for wood are similar between Australia and Germany. Freight rates appear higher for the U.S., the cause of which is worthy of further investigation.

<sup>1</sup> Note: All currency throughout this report is reported in Australian dollars (AUD).



# Australian Supply Chain Overview



# AUSTRALIAN SUPPLY CHAIN OVERVIEW

## Generic wood supply chain (country agnostic)

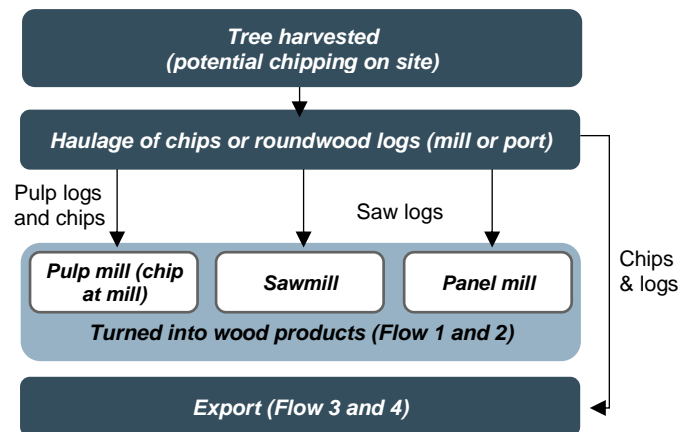


Figure 1: Forestry and hardwood supply chain (country agnostic).  
Note: exports of wood products are excluded for the diagram as they are outside of the scope of this report.

Broadly, wood is classified as either hardwood or softwood. Each has different properties and end uses. Hardwood, such as oak and beech, tends to grow slowly and is dense with a low moisture content. High quality hardwood (known as sawlog) is sawn and used in flooring, furniture, some structural applications (e.g., power poles, bridges), and in some lower-value applications such as fencing and pallets. Low quality hardwood (known as pulplog) is chipped, with the woodchips forming the raw material for pulp used to manufacture pulp and paper products.

Softwood, such as pine, grows quickly and is less dense than hardwood. Softwood sawlogs are used for construction while softwood pulplog is chipped and used for paperboard, panel, cardboard and animal bedding. Softwood is generally more moist than hardwood, giving it a lower wood to weight yield.

The form of the wood can impact the way in which it is moved. Roundwood logs are typically dense and require significant manual labour and equipment to load onto trucks. Comparatively, woodchips can be chipped directly onto a trailer, but are less dense, meaning less woodchips can be carried on the same size trailer than dense wood. Road weight limits typically dictate the size of the load and the freight economics between logs and chips are relatively similar.

Timber is susceptible to diseases and pests, which can impact the quality of logs harvested. To mitigate the risk of carrying those diseases and/or pests to the

country of destination, almost all logs and woodchips are required to undergo fumigation prior to export. The fumigation process usually occurs in stations near to the port.

The wood supply chain can be segmented into four key movements (referred to as 'flows' in this report).

- The first two flows consist of the movements of woodchips (**flow 1**) and logs (**flow 2**) from harvest (e.g., forest) to domestic mills to be converted into wood-based products.
- The last two flows consist of the movement of woodchips (**flow 3**) and logs (**flow 4**) from harvest (e.g., forest) to port, or over land borders, for export.

Most countries have a large number of forests, mills and ports, meaning that goods are moved between a multitude of origins and destinations, but generally as part of one of the four flows described above.

## Wood in Australia

Most of Australia's logs are harvested from c.2 million hectares of commercial plantations, with limited wood being taken from old-growth forests. Australia's plantation area is concentrated in Victoria (c.22%), New South Wales (c.20%), Western Australia (c.19%), Tasmania (c.16%) and Queensland (c.12%). Most sawmills are concentrated near plantations, reducing the travel distance required once logs are harvested. Wood is transported either in bulk or containers by both road and rail, with road being the dominant method of transport.

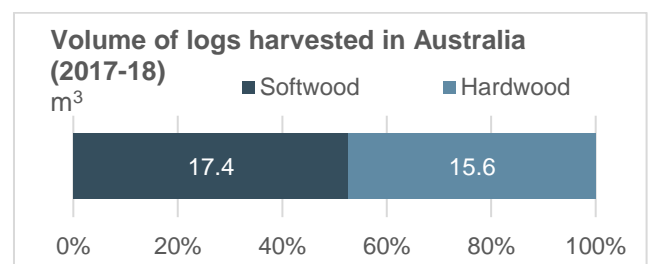


Figure 2: Volume of logs harvested in Australia by type (source: ABARES, 2021)

Most of Australia's hardwood production is pulplog that is exported to China and Japan as woodchips. These markets use the woodchips to make pulp for paper production. Australian hardwood chip is largely used to make printing and writing paper, due to its physical characteristics suited to the production of high-quality paper. Woodchips are Australia's main wood export; Australia produced c.11.5mt wood chips in 2019, exporting c.9.8mt.<sup>2</sup>

<sup>2</sup> [Food and Agriculture Organisation of the United Nations Data](#)

Australia's softwood is largely comprised of radiata pine, though Queensland's softwood plantations have more southern pines and hoop pines. Sixty percent of total softwood production is used as sawlog, with lower quality product becoming pulplog. Most pulplog is exported to China, with the remainder chipped for domestic consumption and export.

The key logging regions in Australia are:

- The Green Triangle, South Australia and Victoria (**hardwood and softwood**)
- Murray Valley, New South Wales (**softwood**)
- Central Tablelands, New South Wales (**softwood**)
- South East Queensland (**softwood**)
- Western Australia and Tasmania (**hardwood**)

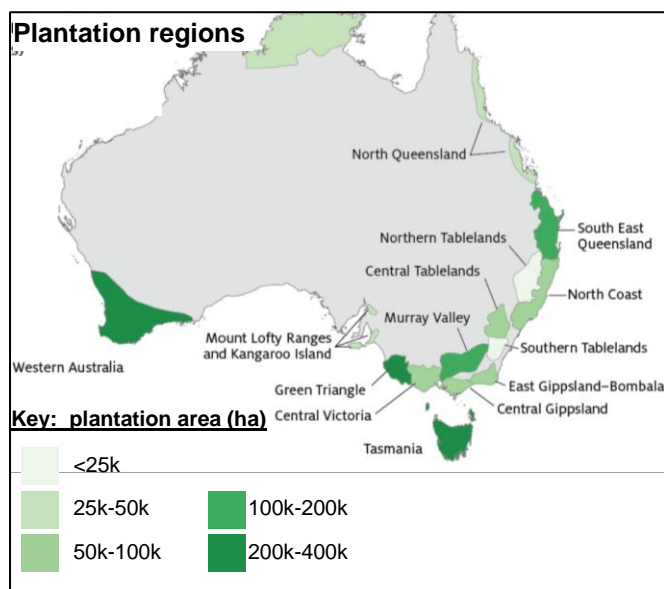


Figure 3: Plantation regions, by density (Source: ABARES)

### Flow #1: Movement of woodchip from forest to mill

Trees are harvest in the forest, and some chipping occurs on site with chips loaded directly into a trailer. The chips are then transported to nearby mills (particularly pulp mills, to be made into paper products) by road or rail. Road loads are typically c.18t per trailer (excluding the weight of the vehicle). Woodchips are typically transported in bulk but can also be containerised either at point of harvest or port for multi-modal journeys.

### Flow #2: Movement of roundwood logs from forest to mill

Logs that are not chipped on site are hauled to mills on trailers that typically carry c.20-25t. Pulp logs tend

to go to pulp mills, while sawlogs go to sawmills. Logs are usually chipped after arriving at pulp mills, with the chips used for products (e.g., paper). Logs can be transported either in bulk or in containers (for multi-modal journeys).

### Flow #3: Movement of woodchip from forest to export

Forest woodchips can be taken directly to port. Portland (Victoria), Albany (Western Australia), Bell Bay (Tasmania), Gladstone (Queensland) and Esperance Port (Western Australia) are the largest Australian ports for wood exports. Chips are typically fumigated prior to export, which either at the port or at a site nearby.

*Example: Port of Portland*

### Green Triangle wood flows

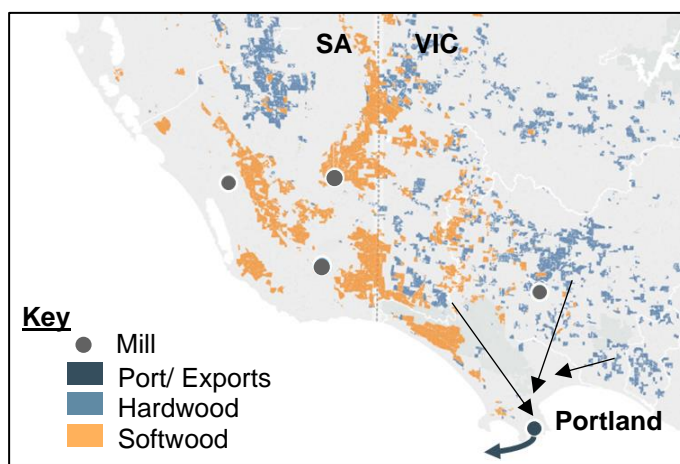


Figure 4: Green Triangle hardwood & softwood flows (source: ABARES, Forest of Wood Products Association, Port of Portland)

Wood from the Green Triangle is chipped, travelling c.50km-100km to the Port of Portland by road. After arriving at the port, mobile ship loaders fill ships that hold c.50kt of wood chips (c.1,000 truckloads).<sup>3</sup> At the port, two mobile ship loading conveyor belts fill a vessel in c.70-85 hours, loading one ship per week.

### Flow #4: Movement of roundwood logs from forest to export

Logs can also be hauled directly to port for export. Export logs are often containerised, rather than shipped in bulk, in order to streamline handling and movement. Logs must be fumigated prior to export, either at the port, or at a facility along the way.

Some ports, such as the Port of Geelong, have facilities to chip logs on site. Once chipped, the wood chips are stored before being loaded directly onto ships.

<sup>3</sup> [Australian Bluegum Plantations](#)





## Basis for International Comparison



## BASIS FOR INTERNATIONAL COMPARISON

The U.S. and Germany have been chosen as suitable comparative countries for Australia's wood supply chain, as they produce significant amounts of wood and export into similar markets (namely, Asia). In addition, Australia, the U.S. and Germany export a sizable amount of woodchips, with all three countries in the top 10 largest exporters of woodchips worldwide.

### The U.S.

The U.S. and Australian wood supply chains have the following similar features:

- Both countries generate and export significant volumes of woodchips.
- Both countries sell woodchips into the Japanese and Chinese markets.
- Both countries have significant landmasses which require longer freight movements.

While the U.S. and Australian supply chains are similar, there are notable distinctions between these geographies that need to be considered when interpreting the data in this report:

- The U.S. predominantly produces softwood, while Australia produces significant amounts of hardwood (particularly used for the production of woodchips). As such, the lower density, and therefore weight, of softwood compared to hardwood may increase the cost per tkm of transporting wood in the U.S.
- Australia is geographically isolated, while the U.S. shares a land border with Canada. Though volumes exported are not substantial, the U.S.'s land border somewhat complicates the domestic wood supply chain, as some wood from the U.S. is processed in Canada and vice versa.

### Germany

The German and Australian wood supply chains have the following similar features:

- Both countries produce significant volumes of woodchips.
- Both countries sell wood and related products into China.

While Germany and Australian supply chains are similar, there are notable distinctions between these geographies that need to be considered when interpreting the data in this report:

- Like the U.S., Germany predominantly produces softwood. As such, the lower density, and therefore weight, of softwood compared to hardwood may increase the cost per tkm of transporting wood in Germany.
- Germany shares a land border with Austria, Belgium and a number of other countries, meaning that wood can be moved between the countries via road, potentially increasing the simplicity and efficiency of road transport. Comparatively, Australia is an isolated landmass in which all exports must exit through seaports meaning additional loading and unloading of containers is required.





## U.S. Comparison



# U.S. SUPPLY CHAIN

## Wood in the U.S.

Wood production in the U.S. is concentrated in three key areas:

- The southern states (“South”)
- The pacific northwest (“West”), sometimes referred to as the Timber Belt
- The upper midwest

Wood production by region (2017, mt)	Type	Hardwood	Softwood	Total
South	Sawlog	6	22	28
	Pulplog	30	89	119
West	Sawlog	1	17	17
	Pulplog	2	8	10
Upper midwest	Sawlog	9	2	11
	Pulplog	9	11	20
Total		57	148	205

Table 1: wood production by region in 2017 (Source: United States Department of Agriculture)

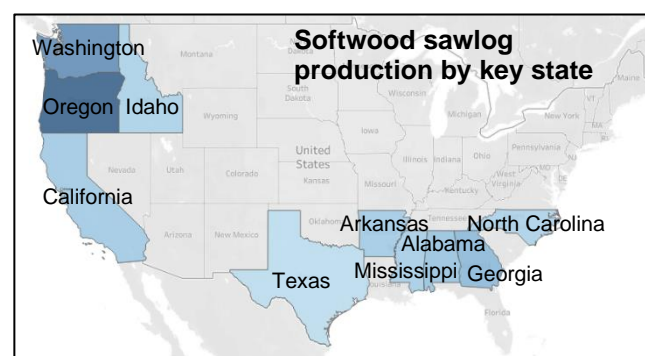


Figure 5: Major softwood sawlog producing states, representing c.75% of total production in 2015 (Source: Oregon Forest Resources Institute)

The U.S. produces c.205mt of roundwood each year. Softwood represents the largest proportion (75%), with production concentrated heavily in the south and the west. Approximately 73% of the softwood is

pulplog. Hardwood production, while limited, is concentrated in the southern states and the upper midwest.<sup>4</sup> There are more than c.550 mills located all around the country, concentrated in areas of high wood production (see figure 2 for sawmills in southern U.S. states as an example).

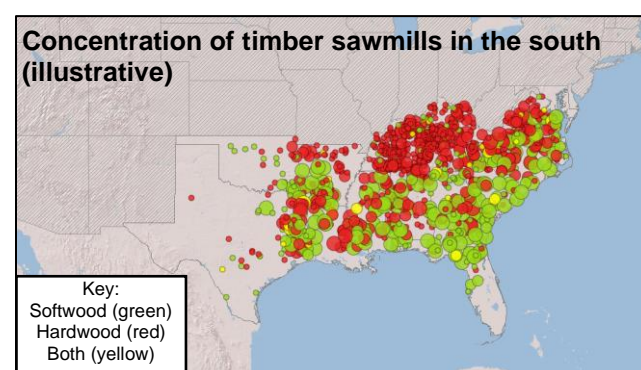


Figure 6: Timber sawmills in the southern U.S. states (Source: United States Department of Agriculture)

Softwood log exports from the U.S. have varied historically, ranging from 3.2% to 13.1% of total production over the long term (from 1965-2019).<sup>5</sup> These exports are largely to China and Japan, with minor volumes exported to Canada. Hardwood is typically exported to Japan and Canada, albeit in limited volumes. The U.S. exports 3 of woodchips annually, largely to China and Japan.

Wood moves through the U.S. by road, rail and, in few instances, barge.

## Key supply chain flows

### Flow #1: Movement of woodchips from forest to mill or plant

Timber can be chipped at forest site. The chips are typically chipped directly into a dump trailer and travel to a nearby mill. Woodchips can also be containerised if multimodal freight is required.

Generally, trucks carry c.21-26t per truckload due to federal weight limits of c.36t, though this can vary between states.

Woodchips (over c.90%) are transported by road to a destinations c.160km or 2 hours away on average. The estimated cost of a c.160km road journey is AUD c.\$700-800. Less than c.10% are transported by rail or waterways, which are generally only used for

<sup>4</sup> [United States Department of Agriculture \(2017\)](#)

<sup>5</sup> [United States Forest Products Annual Market Review and Prospects, 2015-2021: Delton Alderman, Research Scientist, Forest Products Laboratory](#)



longer distances (>160km). Rail accounted for only c.40k carriages moved in 2020 throughout the U.S.

After arriving at the mill, the chips are unloaded from the vehicle and either fed directly into the mill or piled in bulk storage on site.

#### Flow #2: Movement of roundwood logs from forest to mill

Logs can be hauled to a mill or port for chipping. 20-40ft logs are stacked on flatbed trailers. Compared to woodchips, this requires substantial loading equipment, potentially including cranes and forklifts and is a more labour-intensive process. As with woodchips, the typical journey is c.160km, costing AUD c.\$700-800.

While overall volumes are small, logs can also be moved by rail, typically in boxcars and bulkhead flatcars.<sup>6</sup> Rail cars can typically hold c.90t of wood, depending on how the wood is packed. Overall rail volumes for roundwood pulplog only make up c.12k carriages (c.1mt) p.a.

When arriving at the mill, logs are unloaded, usually with a crane, and stacked in the yard.

#### Flow #3: Movement of woodchip from forest to export

After chipping in the forest, woodchips are loaded on to road or rail, as for domestic woodchip transport.

The journey to port on average is similar to the journey to mills (c.160km), though woodchips must be fumigated prior to export. This can be done at the port in some instances, or at a separate stop along the way.

After arriving at the port, the woodchips are unloaded via a conveyer belt or by dump trailer, depending on the port infrastructure. Examples of ports that export woodchips are the Port of Morehead City (North Carolina) and the Port of Coos Bay (Oregon).

#### Flow #4: Movement of roundwood logs from forest to export

Despite their bulk nature, logs are typically packed into intermodal containers for international transport by sea, though logs can also travel in bulk. The logs are then carried by road, rail and barge to the port, but must be fumigated along the way. Some logs are also chipped at or very near the port, with chips loaded onto ships directly after chipping.

## Wood freight data in the U.S.

According to the Bureau of Transportation Statistics, c.322mt of “logs and wood in the rough” were transported in 2017 (note: this figure includes movements outside of the scope of this paper, such as imports). A total of c.53k rail cars were used to transport woodchips and pulplog in 2020.<sup>7</sup> With 90t per carriage, with full carriages, rail carried approximately 5mt of wood (of the total c.322mt of moved across all modes).

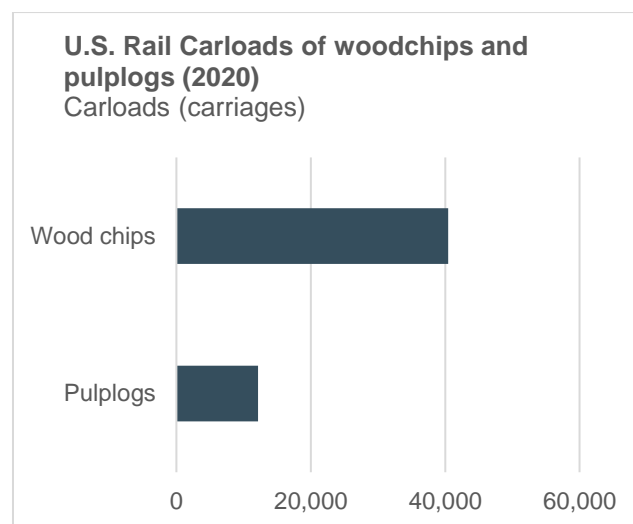


Figure 7: Carloads of wood chips and pulplogs (source: American Association of Railroads). Data for sawlogs not published, though likely to be low given pulplogs make up c.73% of wood produced.

Road costs are estimated to be AUD c.\$0.22 per tkm, with little variation for wood chips and roundwood. Rail costs are estimated to be cheaper than road costs (AUD c.\$0.13 per tkm), however, this only represents c.1-2% of the supply chain movements.

U.S. estimated costs per tkm	Road	Rail
Cost (AUD)	c.\$0.22	c.\$0.13 <sup>8</sup>

Table 2: Estimated cost per tkm (source: industry participants)

<sup>6</sup> American Association of Railroads (2021)

<sup>7</sup> American Association of Railroads (2021)

<sup>8</sup> Based on paper: Flynn “Rail vs Truck Transport of Biomass” (2006), assuming a 320km journey. 90t per carriage, adjusted using long term inflation rate to 2021 prices.



## Germany Comparison



## GERMANY SUPPLY CHAIN

### Wood in Germany

A third of Germany's land area is covered with forest (c.10.6m hectares) containing a variety of softwoods and hardwoods. Of this forest area, the key softwoods grown include spruce, largely in southern Germany, and pine which is largely in northern Germany. The key hardwoods in Germany are beech, which is located in southwest Germany, and oak, which is evenly dispersed throughout the country.

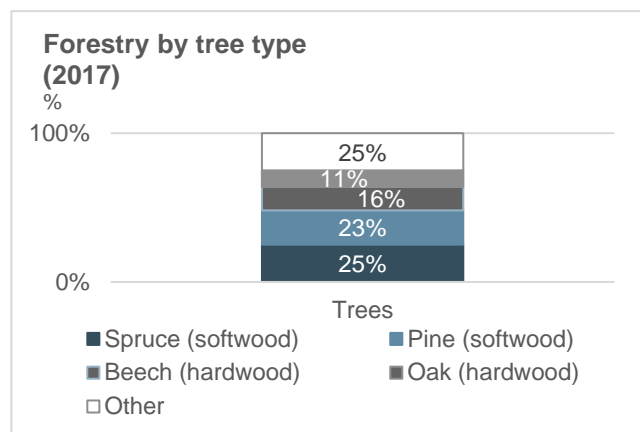


Figure 8: Forestry by tree type 2017 (Source: Federal Ministry of Food and Agriculture, Germany)

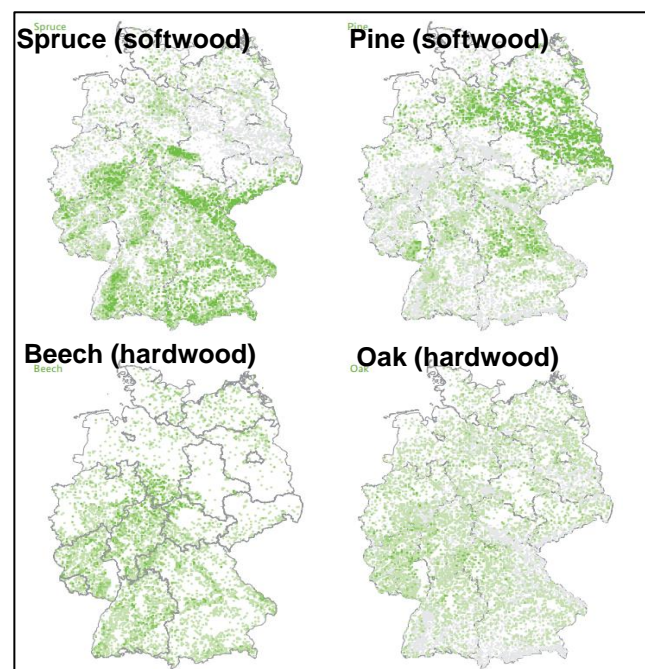


Figure 9: Distribution of spruce, pine, beech and oak (source: Federal Ministry of Food and Agriculture, Germany)

Germany logged c.80m m<sup>3</sup> (57.3mt) of wood in 2020 (excluding bark). Germany exported c.12.7m m<sup>3</sup> of this, mainly to China (c.51%), Austria (c.19%) and Belgium (c.9%).<sup>9</sup> While the exact mix varies by year, the vast majority of this (>80%) was softwood in 2019 and 2020.

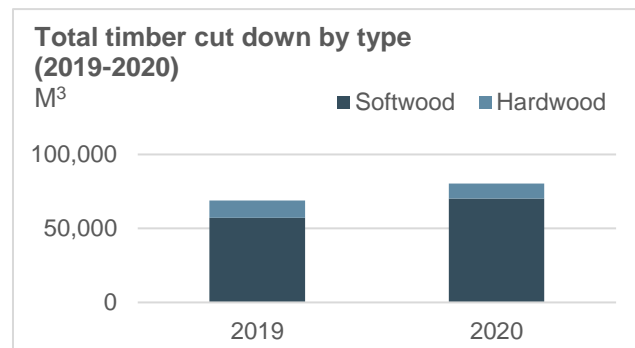


Figure 10: Total timber cut down by type 2019-20 (Source: Destatis, German Government)

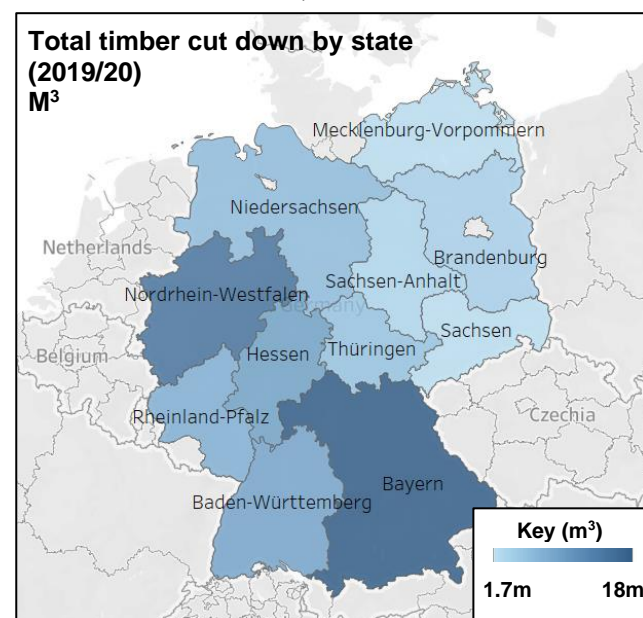


Figure 11: Total timber cut down by state (source: Destatis, German Government)

Of c.49mt of softwood cut down, Germany's sawmills handled around c.24mt in 2020. Sawmills are evenly distributed across Germany's growing regions (see figure 3). Germany also produced c.10.1mt of woodchips, particles and residues in 2019, exporting c.2mt.<sup>10</sup> Germany typically uses the chips that are not exported to produce large volumes of paper, with 152 paper mills throughout the country.<sup>11</sup> Approximately 6-7mt of roundwood was exported in 2019.<sup>12</sup>

<sup>9</sup> Timber Industry News: "Germany raw wood exports up by 42.6% in 2020" (May 2021)

<sup>10</sup> Food and Agriculture Organisation of the United Nations Data

<sup>11</sup> Die Papierindustrie (German paper industry body)

<sup>12</sup> Food and Agriculture Organisation of the United Nations Data

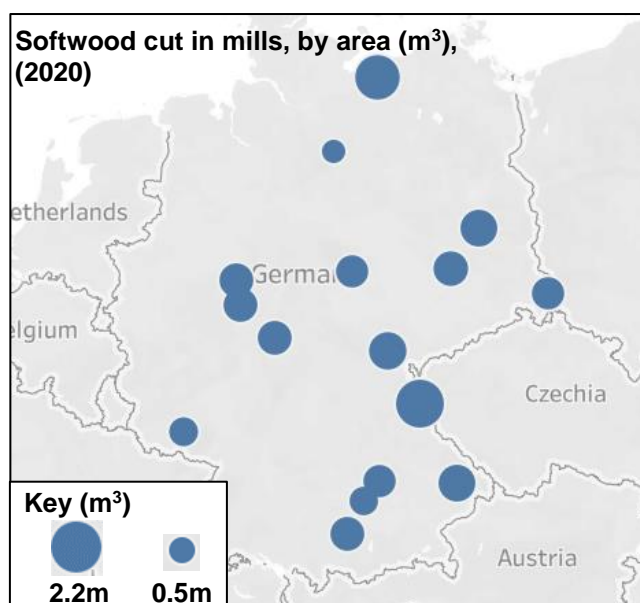


Figure 12: Softwood cut by location, top 16 mills in Germany by m<sup>3</sup> (Source: Holzkurier)

## Key supply chain flows

### Flow #1: Movement of woodchip from forest to domestic mill or plant

Once the wood is cut down, it can be chipped on site, with the wood chips blown into the transport vehicle directly. Wood chips are transported using a tractor trailer (dump trailer, combined trailer, tandem tipper or a push off trailer). The average journey to mills is c.150-200km.

For typical journeys (less than 200km), the chips travel by road, generally to a pulp mill (or energy plant) located within the state where the wood is cut down. Road weight limits are c.40t in Germany, including the weight of the truck, allowing the truck to carry roughly c.25-27t of wood.<sup>13</sup>

For journeys greater than 200km, multiple modes may be used, with a truck taking woodchips to a rail load-point or barge (in limited circumstances) terminal. Approximately c.5-10% of all journeys are multi-modal, as rail is typically not cost-effective for distances below c.200km.

### Flow #2: Movement of roundwood logs from forest to domestic mill or plant

Wood is cut down on site and loaded onto road or rail. A crane is typically used to load the logs onto large flatbed trailers and railcars that are used to carry the logs. For domestic usage, the logs are sent to sawmills or, if the wood is small in diameter, to pulp and panel mills. Similar to the movement of woodchip, the average journey to mills is c.150-200km.

### Flow #3: Movement of woodchip from forest to export

Woodchips from the forest are loaded onto similar vehicles used for domestic movements. As Germany shares a land border with several countries, woodchips can be exported directly by road, particularly to paper mills or plants in Austria. Woodchips can also be transported to seaports, such as Wismar (near Hamburg), directly from the forest. The average journey to the port is typically longer than to domestic mills, at c.300-400km.

Before being shipped, woodchips typically require fumigation which is generally done near the ports.

### Flow #4: Movement of roundwood logs from forest to export

For export, logs can be transported to port, or over land borders (particularly to Austria) by road or rail.

Logs travelling offshore can be containerised in order to make them easier to move and fumigate. Logs can also be shipped in bulk. Key German ports for export include Nordenham, which has an onsite sawmill and drying kiln, Wismar, Bremen/Bremerhaven and Brake.<sup>14</sup> Additionally, export logs can be sent to large European ports such as Rotterdam. Like woodchips, logs typically require fumigation prior to export. Similar to the movement of woodchip to port, the average journey is c.300-400km.

Once arriving at the port, the logs or containers are moved from trucks or rail using a crane. Bulk logs may be sawed or chipped at the port and collected for storage, before being loaded onto a vessel.

## Wood freight data in Germany

Logs and woodchips in Germany are typically moved by road, due to the short average distances travelled. Rail is used for greater distances, including movement to port or over land borders to other European countries.

Germany estimated costs per tkm	Road (c.25-27t per truck)	Rail
Cost (AUD)	c.\$0.18	c.\$0.09-0.10

Table 3: Estimated cost of tkm by mode (source: industry participants)

<sup>13</sup> [Maxxstrans Road Transport Fact Sheet](#)

<sup>14</sup> [Germany Trade & Invest: Germany's Seaports](#)





# Data comparison

## DATA COMPARISON

A high-level summary of the key freight metrics for each country is shown in the table below.

Estimates	Australia (CSIRO)	U.S.	Germany
Annual tonnes moved (c.mt)	c.18.9	c.205.4 <sup>15</sup>	c.57.3 <sup>16</sup>
Annual net tkm (c. millions)	c.6,838	c.32,808 <sup>17</sup>	10,000 <sup>15</sup>
Annual trailers / shipments (c.000)	c.988	c.7,900 <sup>18</sup>	c.2,000-3,000 <sup>17</sup>
Cost of movement (\$AUD per TKM)	Total, all types – weighted average of road and rail (majority road): \$0.17	Road: \$0.22 Rail: \$0.13 <sup>19</sup> Total, all types – weighted average (mode agnostic): c.\$0.22	Road: \$0.18 Rail: \$0.09-0.10 <sup>18</sup> Total, all types – weighted average (mode agnostic): \$0.17
Total transport costs (\$AUD m)	\$1,171	\$11,000-13,000 <sup>20</sup>	\$1,700-2,000 <sup>21</sup>
Average trip distance (km)	363	c.160 <sup>22</sup>	c.150-200
Average trip duration (c. hours)	3-6	2-3 <sup>21</sup>	2.5-3.5 <sup>21</sup>
Estimated road vehicle loads	c.18t (woodchips) c.20-25t (logs)	c.21-26t	c.25-27t

<sup>15</sup> [USDA](#)

<sup>16</sup> German Government

<sup>17</sup> Tonnes \* average distance

<sup>18</sup> Total tonnes divided by c.26T per trailer

<sup>19</sup> Average based on expert interview estimates

<sup>20</sup> Estimated based on TKM \* \$/TKM, assuming a 95% road, 5% rail modal split

<sup>21</sup> Estimated based on TKM \* \$/TKM, assuming a 90% road, 10% rail modal split

<sup>22</sup> Expert interviews



## FREIGHT DATA COMPARISON SUMMARY

Wood is an important input into housing and construction, as well as furniture, paper and biofuel. Woodchips are an important export for Australia and the efficiency of the wood supply chain is an important factor in the competitiveness of these exports. Australia transports c.19mt of roundwood and woodchips, which is a relatively small task compared to the U.S. (c.200mt) and Germany (c.57mt). However, Australia's exports of woodchips (c.14.5m m<sup>3</sup>, 9.8mt) are high compared to the U.S. (6.3m m<sup>3</sup>, 4.3mt) and Germany (3m m<sup>3</sup>, 2mt). The average trip distance in Australia is noticeably longer (3-6 hours) than in the U.S. (2-3 hours) and Germany (2.5-3.5 hours).

The cost of moving wood products in the U.S. is higher than in Australia. Australia's weighted average cost of freight is AUD c.\$0.17 per tkm (all types), while the weighted average freight costs in the U.S. are noticeably higher at AUD c.\$0.22 per tkm (AUD c.\$0.22 for road and AUD c.\$0.13 for rail). Germany has a relatively similar weighted average cost of freight to Australia at AUD c.\$0.17 per tkm (road freight rates at AUD c.\$0.18 and rail freight rates at AUD c.\$0.09-0.10 per tkm). The reason for the relatively higher transport costs in the US would be logical focus for further investigation.

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