Market Access

Future market dynamics and potential impacts on Australian timber imports

FINAL REPORT

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Forest & Wood Products Australia

Future market dynamics and potential impacts on Australian timber imports

FINAL REPORT

Prepared for

Forest & Wood Products Australia

by

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IMPORTANT NOTICE

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Executive Summary

On current trajectories, Australia faces the prospect of being consistently unable to meet demand for new housing, because of a persistent and growing gap between demand and supply of sawn softwood timber, in particular.

By no later than 2050, Australia will have:

- A population between 33.62 and 39.97 million people
- New housing demand around 259,000 dwellings per annum
- 5.175 million additional households whose demography will demand a marginally different housing mix to the current distribution of housing formats
- Sawn softwood demand of 6.507 million m^3 per annum – almost 2.0 million m^3 per annum higher than 2021
- Local sawn softwood production static at between 3.600 and 3.800 million m^3 per annum due to constraints on sawlog supply
- An Implied Gap between demand and local production of 2.638 million m^3 per annum, equivalent to 40.5% of total demand

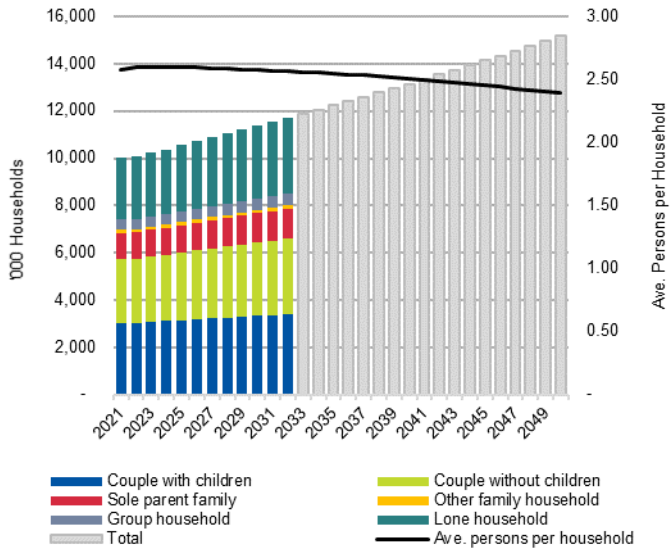
To bridge the Implied Gap, Australia could establish as much as 468,000 hectares of additional softwood plantations.

A growing population, but limited change in housing formats

Australia's population growth to 2050 will result in the national population being between 33.62 million and 39.67 million people. The actual population depends mainly on the birth rate and the rate of net overseas migration, with other demographic factors largely certain, within narrow bands.

As the population expands, the nation ages and other demographic factors come into play, the nature of Australia's households and the types of dwellings they require will change. However, the changes in household formation and housing types will continue to be very gradual. As an example, the forecast number of persons living in each household will decline from 2.57 in 2021 to 2.39 in 2050.

Extrapolated Household Formation and Average Household Size: 2021 – 2050



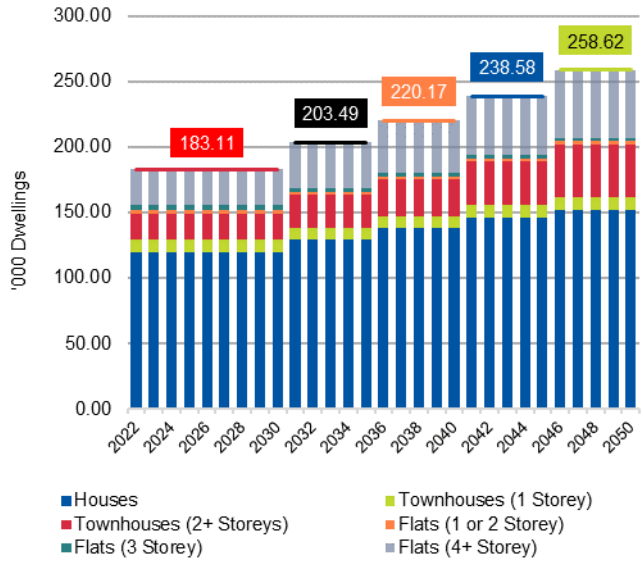
Source: ABS, NHFIC and IndustryEdge

Based on the population and household formation data, it is calculated that by 2050, Australia will have 5.175 million additional households.

Houses will continue to dominate Australian dwellings

Based on this data, it is calculated that by 2050, free-standing houses will account for a projected 58.7% of total new approvals, 2+ storey townhouses for 15.5% and 4+ storey flats and apartments for 19.9% of the total.

Housing Demand by Type: Annual & Half Decadal: 2021 – 2050 ('000 Dwellings per annum*)



Source: ABS, NHFIC & IndustryEdge research and estimates

* Annual average of the modelled outputs for the half decade (eight years 2022-30)

'000 Dwellings per annum	2022-30	2046-50	CAGR28	2050 Proportion
Houses	120.03	151.68	0.84%	58.7%
Townhouses (1 Storey)	9.46	10.34	0.32%	4.0%
Townhouses (2+ Storeys)	19.74	39.96	2.55%	15.5%
Flats (1 or 2 Storey)	2.60	2.59	-0.02%	1.0%
Flats (3 Storey)	3.56	2.59	-1.14%	1.0%
Flats (4+ Storey)	27.72	51.47	2.23%	19.9%
Total	183.10	258.62	1.24%	100.0%

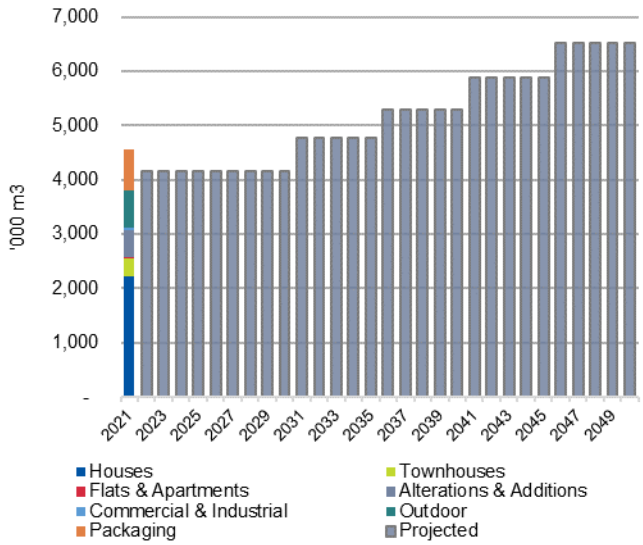
In addition to housing, and other dwellings, there is additional demand for sawn softwood in Australia, including for industrial applications like packaging and a very wide range of outdoor uses.

Sawn softwood demand will lift to at least 6.507 million m^3 before 2050

A consequence of firm and predictable growth in demand for housing in established formats is that demand growth for sawn softwood products can also be projected.

From demand that reached a calculated 4.566 million m^3 in 2021, based on an average annual rate of growth of 1.6% per annum, by 2050 at the latest, Australia's sawn softwood demand will lift to a projected 6.507 million m^3 per annum.

Australian Sawnwood Demand: Annual & Half Decade: 2021 – 2050 ('000 m^3 per annum*)



Source: ABS, ABARES, FWPA, Omega Consulting, HireThinking and IndustryEdge

* Annual average of the modelled outputs for the half decade (eight years 2022-30)

While based on underlying demand described here, the sawn softwood demand projection is consistent with the assessments of ABARES, based on log availability and estimated sawmill yields.

Softwood plantations do not support significant processing expansion

Australia's softwood plantation estate has not expanded for almost three decades. The estate was calculated to total 1.028 million hectares in 2020. The availability of softwood logs is the main constraint on expanding processing to bridge the gap between sawn softwood demand and supply.

From this data, it is estimated sawn softwood output capacity is between 3.600 and 3.800 million m^3 per annum.

Implied Gap between demand and local supply capacity will average 40.5% from 2046-2050

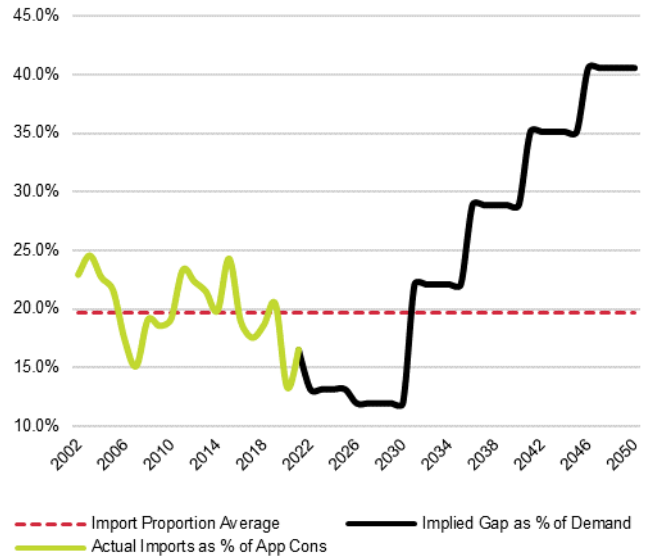
Before 2050, against largely stable production capacity that aligns directly with existing resource availability, the Implied Gap between demand and Production Capacity will increase by 1.691 million m^3 or 179%, lifting to 2.638 million m^3 per annum. The Implied Gap will experience an average annual rate of growth of 3.7%.

The Implied Gap between local supply and demand was a record 0.947 million m^3 in 2020-21, with imports totalling 0.690 million m^3, implying that 0.257 million m^3 of demand was not met (or at least, not met by supply of sawn softwood).

Imports unlikely to supply all the Implied Gap

If imports were to supply all the Implied Gap, they would have to lift from a long-term annual average of 19.7% of total supply, to 40.5% of total supply before 2050. In quantity terms, imports of sawn softwood would need to reach 2.062 million m^3 per annum before 2050, almost triple the level recorded in 2021.

Import Proportions: Actual, Average, and Implied: 2002 – 2050 (%)



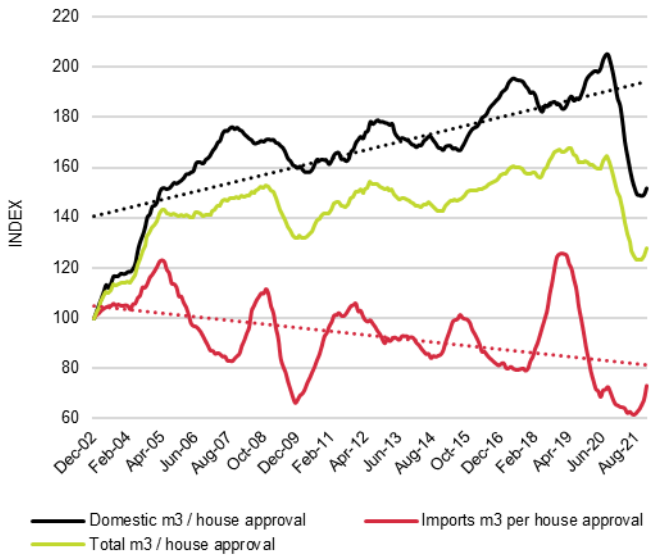
Source: ABS, ABARES and IndustryEdge

Analysis of volatility in both demand (primarily from a growing population) and supply (both domestic and imported) demonstrates it is unlikely imports can meet all the Implied Gap.

It is evident that when import supply reaches certain levels, it supplies strong and compelling market pricing signals. In the recent cycle, that situation saw prices rise significantly, including for domestic supply. That situation could easily reverse in another cycle. Imports increasing as a proportion of total supply is likely to lead to increased price volatility in the total Australian market.

On the demand side, the volatility of housing demand is driven by a multitude of factors and is therefore unpredictable. On the supply side, as historic supply demonstrates, imports cannot always be responsive to demand signals, and over time, in relative terms, imports have been in progressive decline, while local supply has been expanding.

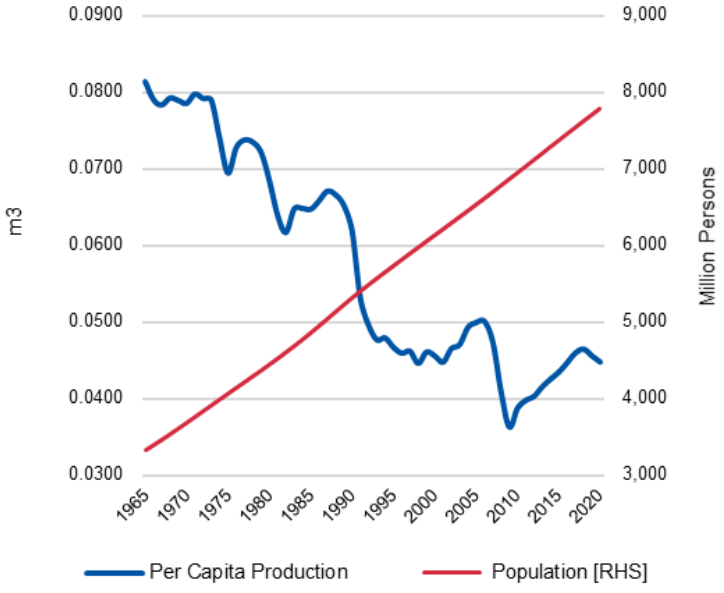
Australian Sawn Softwood Supply by Provenance per House Approval: (INDEX)



Source: ABS, FWPA, IndustryEdge and HireThinking

International availability of sawn softwood is declining and the volumes available to supply growing global demand face increased competition. Over the fifty-five years to 2020, the global population increased an average 1.7% per annum, while the global supply of sawn softwood per capita declined an average 0.17% per annum. Put another way, while global sawnwood production may have increased in absolute terms, the continuing reduction on a global per capita basis further demonstrates the limitations on imports to meet the implied gap.

Global Per Capita Sawn Softwood Production: 1965 – 2020 (m^3 & million persons)



Source: FAO, United Nations and IndustryEdge

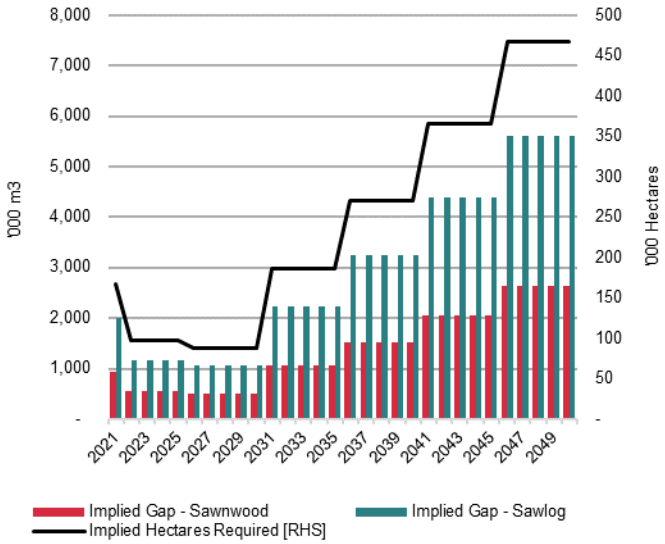
Entire housing construction 'system' is under stress

The supply chain for Australian housing – the 'system of work' – is under more stress than just challenges associated with timber supply. All the evidence points to an Australian system that has capacity (materials, labour, infrastructure, logistics and so on) that is capped at around 110,000 dwellings per annum. Any additional building demand resides in the pipeline of work.

Plantation establishment to address implied gap

By contrast, if local supply was to be increased to meet all the Implied Gap between Sawn Softwood demand and local supply, it is calculated Australia would need an additional 468,000 hectares of softwood plantations before 2050.

Implied Sawn Softwood, Sawlog and Plantation Gap: 2021 – 2050 ('000 m³ & '000 Ha)



Source: ABARES, Omega Consulting & IndustryEdge

'000 m³ & '000 Ha per annum	2026-30	2031-35	2036-40	2041-45	2046-50
Implied Gap - Sawnwood ('000 m³)	499	1,055	1,529	2,066	2,638
Implied Gap - Sawlog ('000 m³)	1,061	2,245	3,253	4,396	5,612
Implied Hectares Required ('000 Ha)	88	187	271	366	468

The reality is that the most likely scenario for the successful future supply of sawn softwood in Australia will involve growth in imports consistent with their long-term proportion of the total Australian market (averaging around 20% of the total), coupled with significant expansion of the national softwood plantation estate.

If the average sawn softwood import proportion continued to be 20% of total demand over all time periods, before 2050, Australia would require an additional 240,000 hectares of softwood plantations.

Because exogenous factors weigh upon import supply and its potential growth, it is likely both prudent and necessary for expansion of the softwood plantation estate to be towards the upper end of the required Implied Hectares – closer to the 468,000 hectares. This will assist in establishing the 'buffer stock' required to meet demand volatility when it peaks beyond expected levels, as was the case in 2020 and 2021.

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Abbreviations

ABARES	Australian Bureau of Agricultural & Resource Economics
ABS	Australian Bureau of Statistics
AS/NZS	Australian & New Zealand Standards
AUD	Australian dollars
AUD/m^3	Australian dollars per cubic metre
bft	Board feet
CAGR	Compound annual growth rate
Fis	Free-In-Store
Fob	Free-On-Board
FWPA	Forest & Wood Products Australia
Ha	Hectares
H3	H3 treated pine timber
m^3	Cubic metres
MGP	Machine Graded Pine
N & C America	North and Central America
pa	per annum
%	percentage
'000	thousand

Contents

1 Background and introduction

In 2020 and especially 2021, Australia experienced a rapid increase in demand for all building materials, not least for market dominating wood products. For the first time in memory, a surge in demand was unable to be matched by an increase in supply: either from domestic or imported sources.

In that context, industry participants considered there was an urgent need to understand these particular market events, especially and specifically for the largest group of wood products used in dwellings: sawn softwood products, herein defined as being almost entirely sawn wood. The requirement was for this analysis to be undertaken in the broadest possible manner, with regard to the prevalent demand and supply factors and their interactions.

Although the focus of this analysis is immediate and focussed on the future, it is inevitably informed by significant history – going back at least two decades – and especially by the 'moment in time' represented by the most recent market experience.

This report provides an historical overview, detailed description and analysis of the supply and demand of sawn softwood timber over the last two years. It charts the course of both demand and supply to 2050, in half-decadal average terms (other than the early period from 2022-30 set out to create symmetry from 2030) and seeks to explain the basis for projections that although worrying, must be considered a call to urgent action to ensure Australia will continue to have capacity to build the nation.

2 Global timber market dynamics and supply projections

In 2022, the world faces numerous challenges, some of which are so immediate they have muted public consideration of some of the more enduring issues faced by humanity.

One of the most pressing strategic considerations for the world is how to address the ever-present and growing difficulties associated with continuous growth in the global population. How will the global population be fed and housed? Do we have sufficient resources to ensure that all the most basic human needs are met?

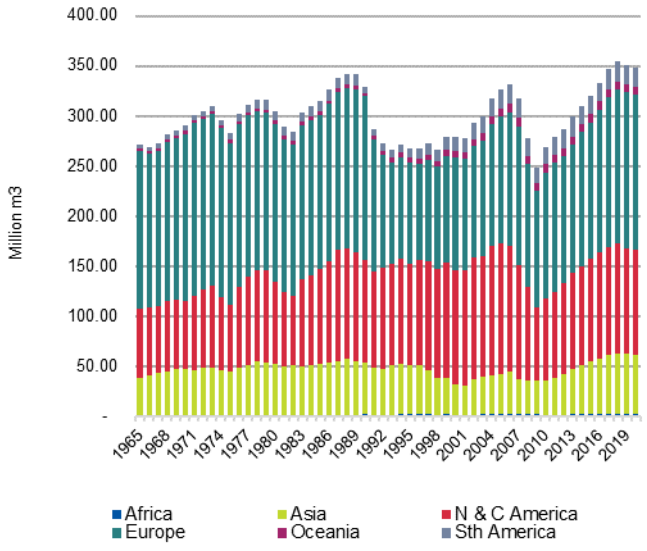
In this interim report, we frame this major human challenge from the perspective of supplies of sawn softwood timber, which remains the most significant input to housing in the world.

2.1 Global sawn softwood supplies are stagnant over the longer term

In 2020, global production of sawn softwood totalled 348.8 million m^3, marginally lower than the peak of 354.4 m^3 achieved in 2018. Over the twenty-five years to 2020, production rose by 80.8 million m^3 or at a rate of just 1.06% per annum.

The chart here shows global softwood timber production by region.

Global Softwood Timber Production by Region: 1965 – 2020 (Mm^3)



Source: FAO

Million m^3	1970	1995	2020	CAGR25
Africa	2.16	2.69	3.07	0.54%
Asia	42.88	48.50	59.02	0.79%
N & C America	67.08	102.04	104.74	0.10%
Europe	161.42	100.10	154.78	1.76%
Oceania	2.99	5.14	8.17	1.87%
Sth America	6.64	9.59	19.04	2.78%
Total	283.17	268.06	348.83	1.06%

Although at first examination the expansion in sawn softwood production of the last decade looks impressive, the reality is quite different, especially when considered from a per capita perspective.

2.2 Proportional sawn softwood production is falling across the globe

Sawn softwood products are used, for the most part and as later analysis in this report demonstrates, to construct dwellings in which people live. Thus, the central driver of demand for sawn softwood is the formation of households and population growth.

In 2020, the global population was estimated to be 7.794 billion people[1].

A fundamental feature of demography is that future population growth is largely determined by the existing population. The growth is essentially 'baked in' for decades to come. We explore this topic further in respect of Australian demand.

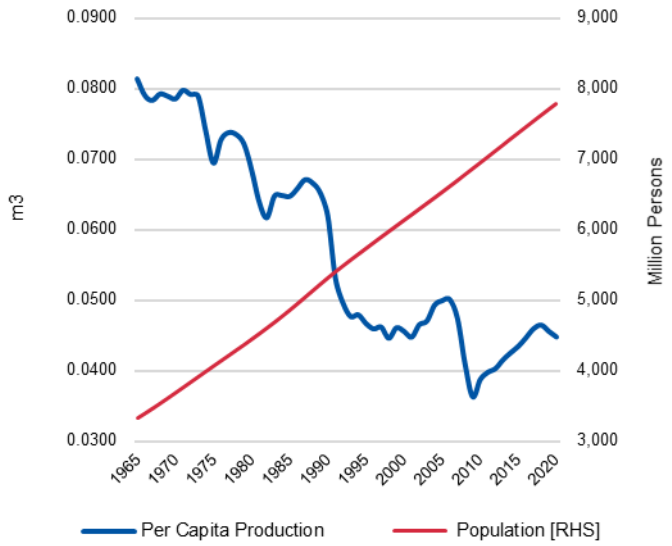
From 1965 to 2020, the global population grew at an average annual rate of 1.70% per annum. It is forecast to grow at around that rate until at least 2050.

Here, the implications of a consistently growing population are observable. The chart shows global sawn softwood production on a per capita basis, along with the consistent population growth.

In 1995, per capita production of sawn softwood was 0.0467 m^3 per annum. By 2020, per capita production had declined an average of 0.17% per annum to 0.0448 m^3 per annum. Annually, this may seem insignificant, but compounded over many years and multiplied by billions of people, per capita production describes a downward trend that is already challenging for global timber markets.

[1] United Nations, 'World Population Prospects', 2019

Global Per Capita Sawn Softwood Production: 1965 – 2020 (m^3 & million persons)



Source: FAO, United Nations and IndustryEdge

As this analysis discusses in detail, declining global per capita production, coupled with growing international demand, is a particular issue for the Australian economy, given its own medium-term supply and capacity limitations and projected population growth and future demand.

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3 Historic and projected demand and demand drivers for sawnwood in Australia

Australia has always been a significant consumer of wood and wood products. Initially, these products were derived from what are still extensive and abundant natural forests. For the better part of the last century, the development of softwood plantations has allowed for the majority of Australia's sawnwood to be supplied by plantations and specifically, by softwood species.

As set out here, demand for sawnwood is primarily driven by the Australian housing industry, especially free-standing houses and their close relation, townhouses, coupled with alterations and additions. As Australia's population has grown, demand for housing has grown, and with it, demand for sawnwood, in particular.

Demand is one matter, but consumption is another matter altogether. Demand is potentially limitless, while consumption is limited by demand on the one hand, and availability of total supply on the other hand.

In this section, we analyse consumption of sawnwood in Australia, describe and analyse the drivers of demand and project a demand profile for sawnwood, to 2050. This leads into the assessment in later sections of whether the current gap between demand and supply of sawnwood is temporary, or is structural and related, whether any gap will be stable or will expand over time.

3.1 Australia's *apparent* consumption of sawn softwood: 2005 to 2021

Consumption of sawn softwood is a useful starting point for understanding the supply chain's response to demand.

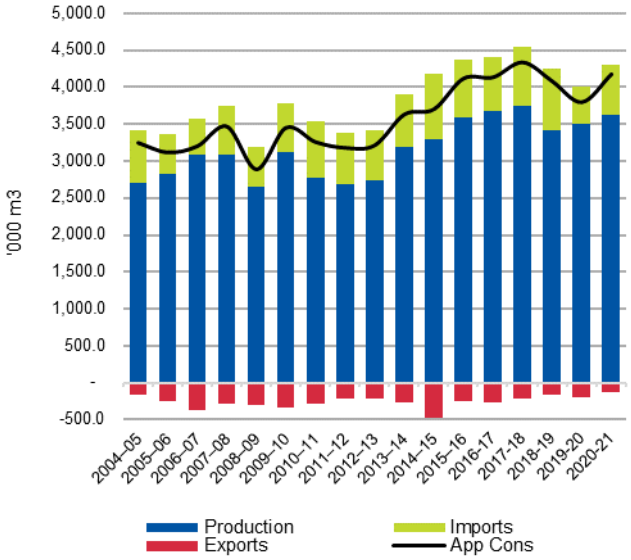
In 2020-21, one measure indicated Australia's apparent consumption of sawn softwood[2] reached 4.183 million m^3, an increase of 10.0% on the prior financial year[3].

As the chart below demonstrates, under this definition, sawn softwood consumption has been increasing since 2004-05, growing by an average 1.6% per annum. The growth rate over the last decade has been a more substantial 2.5% per annum, achieved as industry deployed improved technologies throughout the supply chain to maximise capacity.

[2] This analysis is based on the sawn softwood survey and data series collected and reported by Forest & Wood Products Australia (FWPA). That survey does not reflect the entirety of softwood sawnwood produced in Australia. The survey data has been extrapolated consistent with other data series (ABARES and Omega Consulting) to provide a complete understanding of apparent consumption. Comparison of these two data series implies the FWPA data series represents an average 84.7%, which factor has been used for the extrapolation.

[3] Consumption of sawnwood in Australia is higher in total than displayed here, because of the influence of sawn hardwood timber. Although some hardwood (most notably in Tasmania) is still deployed into structural activities like house framing, the very significant majority of Australia's demand is supplied by softwood species.

Apparent Consumption of Sawn Softwood: 2005 – 2021 ('000 m^3)



Source: ABS, FWPA and IndustryEdge

'000 m^3	2005 >>>	<<< 2020	2021
Production	2,711.4	3,498.1	3,619.3
Imports	700.2	505.2	690.3
Exports	-165.5	-201.8	-126.4
Apparent Consumption	**3,246.1**	**3,801.5**	**4,183.2**

The table and chart deliver some important information.

Since 2005, sawn softwood production measured under this approach has increased an average 1.8% per annum, while apparent consumption increased 1.6% per annum. By contrast, imports declined an average 0.1% and exports fell an average 1.7% per annum.

Sawn softwood production peaked at 3.746 million m^3 in 2017-18 and was 3.4% or 0.126 million m^3 lower in 2020-21.

In addition to growing demand for sawn softwood, exports have been progressively declining, for instance. At a little more than 0.126 million m^3 in 2020-21, exports were at their lowest in more than fifteen years, as local producers prioritised supply into domestic markets. The long-term decline in exports is evidence of production operating under capacity constraints.

Combined, these two factors mean that in 2020-21, local supply (production less exports) was an apparent 3.493 million m^3, just 1.2% or 0.044 million m^3 lower than in the peak consumption year of 2017-18.

In the context of the very significant efforts of the Australian supply chain to meet rampant demand in 2020 and 2021, this initial analysis alone establishes a key point: the current local capacity to supply sawnwood in Australia is limited to somewhere between 3.6 and 3.8 million m^3 per annum. Meeting demand above that level currently requires imported supply.

These themes, and the current and prospective availability of imports to meet increasing demand, are explored later in this report.

3.2 Australian sawnwood demand drivers

Demand for sawnwood is derived primarily from housing demand, in particular free-standing houses and townhouses, coupled with demand from alterations and additions to existing dwellings. For the most part, the demand is for structural framing timbers and for exterior products as diverse as decking, outdoor furniture and fencing.

There is also substantial industrial demand for sawnwood products, especially for packaging materials.

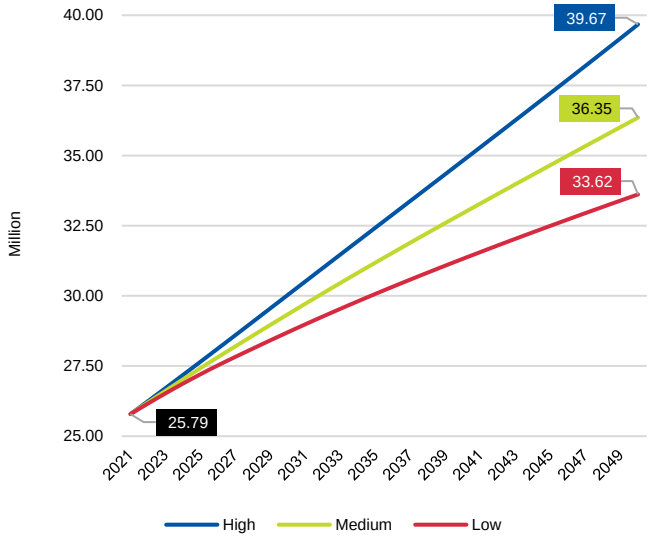
Though not specifically addressed in this analysis, it is pertinent to note declining availability and consumption of sawn hardwood products means there is additional demand for sawn softwood products.

3.2.1 Australia has a growing population

In June 2021, Australia's population was calculated to be 25.79 million people. Applying established projections demonstrates that by 2050, the population will rise to between 33.62 million and 39.67 million people.

The chart below shows these projections, which are derived from a complex mix of the existing population and its demographic profile, known and forecast birth and death rates and morbidities and net overseas migration. Though displayed on a linear curve, the analysis reflects the impact of the global pandemic and the temporary cessation of migration. By 2050, had the pandemic not arisen, it was projected the Australian population would have been between 33.93 million and 40.62 million people.

Australia's Projected Resident Population Scenarios: 2022 – 2050 (Million Persons)



Source: ABS & IndustryEdge

The three scenarios combine the elements of population growth to present the theoretical maximum, minimum and mean population projections, based on recent events (including the impact of the pandemic), established data and expected policy (especially as related to overseas migration).

Each of the scenarios has a different average annual growth rate from 2021 to 2050:

- High 1.50% per annum
- Medium 1.19% per annum

- Low 0.92% per annum

While the detail is relevant, the central point is that under all scenarios, Australia's population will continue to grow to 2050, and beyond.

This is critical because it is growth in the Australian population that has and will drive the formation of households and the demand for housing.

3.2.2 Impact of the pandemic on population and household formation may be short-lived, but these forecasts and projections do not allow for that

There is no doubt the pandemic has impacted Australia's population and therefore its household formation rates. The impact is the population is smaller than it would otherwise have been, and there are less households than would have been the case without the pandemic.

Australia's projections for each of the scenarios was that in mid-2021, the population would be between 26.20 million persons (the 'low' scenario) and 26.40 million persons (the 'high' scenario). However, the actual population was calculated by the Australian Bureau of Statistics to be 25.79 million persons, as set out above.[4]

The primary reason for the lower actual population was the effective cessation of overseas migration over the course of the pandemic.

Though not yet a matter of public policy, there is speculation Australia's migration levels will move from the low to middle levels of the ABS' forecast range, to the mid to high levels, for at least several years. Labour shortages and related impacts at the time of writing provide the context and driver for higher levels of net overseas migration.

Importantly however, this report's analysis of population and household formation growth does not rely on expectations of increased net overseas migration (or other increases in the rate of population growth, for that matter). The forecasts and projections are anchored by the actual population level (25.79 million persons in mid-2021), the gradually changing average number of persons forming each dwelling, the implied rate of household formation and the changing types of dwellings in which Australian households are living.

3.2.3 Households are changing, but not as quickly as we imagine

In 2021, Australia's 25.79 million population was living in 10.019 million households. By 2032, it is forecast Australia will have 11.721 million households, an average annual increase of 1.4% or an additional 1.702 million households. This amounts to an average 154,727 new households per annum.[5]

It is vital to emphasise that households are different to dwellings. Households are groups of people (including individuals living alone) who identify as a household. For the most part, they reside in a single dwelling, but that need not be the case, as holiday houses demonstrate.

As a result, it is reasonable to consider the number of new households formed per year as the *baseload* or *absolute minimum* number of new dwellings that must be added to Australia's housing stock.

We then add to that baseload created by new household formation, additional dwellings including:

- All those replaced because of destruction by natural disasters like fires and floods;
- Replacements related to changing land use considerations such as land values increasing dramatically in inner urban areas resulting in re-developments;
- Holiday and short stay residences, and

[4] ABS, Cat. 3222.0 Population Projections, Australia, 2017 (base) - 2066
[5] NHFIC, State of the nation's housing 2021-22 (2022)

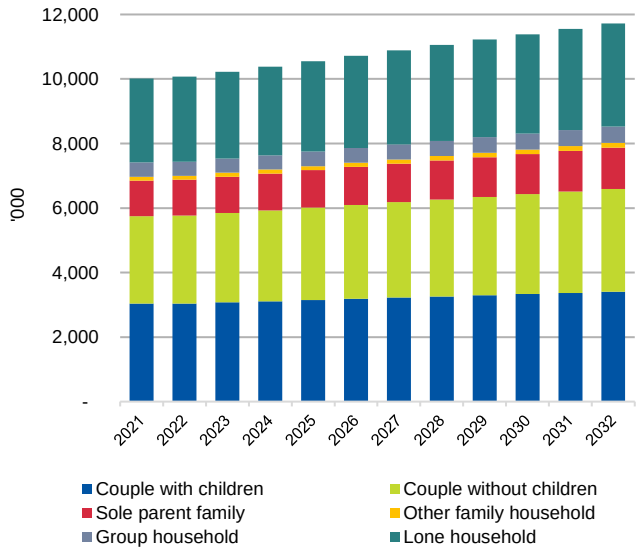
- Replacements of one housing format for another due to demographic changes and the changing 'formats' of households.

The last point is critical to examine because it underscores a very gradual change in the nature of Australia's households.

Latest demographic data demonstrates that from 2021 to 2032, Australian household formation will continue on trends of the last decade and more. Growth in 'Lone households' and in households of 'Couples without children' will be faster than growth in households of 'Couples with children'.[6]

The chart demonstrates the aggregate forecast growth in households, but it also points to the gradually changing types of households in which Australians will live. The details are provided in the table.

Australian Household Formation by Household Type: 2021 – 2032 ('000)



Source: NHFIC

'000s	2021	2032	Additional	Total % Change	Ave. Annual % Change
Couple with children	3,043	3,404	361	11.9%	1.0%
Couple without children	2,702	3,190	488	18.1%	1.5%
Sole parent family	1,107	1,280	173	15.6%	1.3%
Other family household	121	142	21	17.4%	1.5%
Group household	443	507	64	14.4%	1.2%
Lone household	2,603	3,198	595	22.9%	1.9%
Total	**10,019**	**11,721**	**1,702**	**17.0%**	**1.4%**

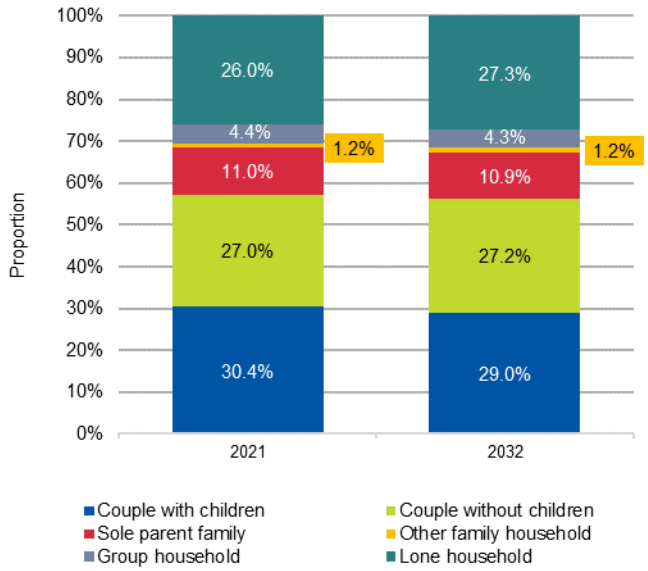
Although the types of households in Australia is changing over time, largely due to the ageing of the population, lower fertility rates and significantly improved life expectancy, these changes are gradual. Demographic trends take literally decades to have a meaningful impact, in most cases.

That is certainly the case for Australia's household formation, as this chart demonstrates. Households containing couples with children will decline from 30.4% of the total in 2021 to 29.0%

[6] ibid

of the total in 2032. Proportionally, almost all that decline is taken up by growth in lone households, those containing a single person.

Australia's Household Formation by Type: 2021 v 2032 (Proportion)



Source: NHFIC

There is complexity in forecasting household formation by type, far into the future.

An ageing population resulting in an increase in lone person households can subsequently become a younger population which may or may not have more households with children, for instance. A further example is that as numbers of migrants and patterns of migration change, cultural factors will also contribute to changing household types. As a final example, household separation patterns also impact on household formation rates, and go some way to explaining why lone household growth will be strong over the coming decade, but sole parent households will decline by a small amount.

It is significantly less complex to forecast the likely number of households into the future.

While the specific types of households is gradually changing, the reliable data is that Australia's household formation rate from 2021 to 2032 is an average 1.4% per annum. It is also useful to note that over that period, the average number of people per household remains almost constant at 2.57 persons per household.

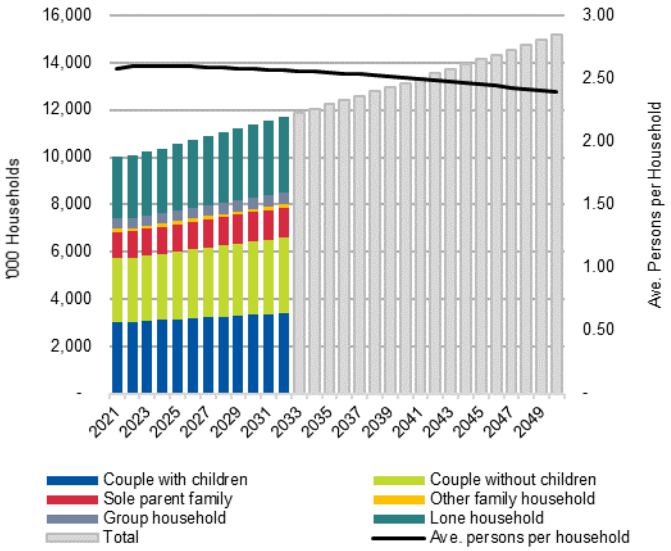
As the next section shows, linear household formation extrapolations to 2050 result in the projected average number of people per household declining, but only marginally.

3.2.3 Household formation to 2050

A simple extrapolation of the forecast growth rates to 2032 suggests Australia will have around 15.194 million households in 2050. When matched with the population data considered earlier in this analysis, that means the average household in 2050 will be made up of 2.39 persons, 7.0% less than the 2.57 persons per household calculated for 2021. This arises because population growth will be slower than growth in household formation.

This can be observed in the chart.

Extrapolated Household Formation and Average Household Size: 2021 – 2050



Source: ABS, NHFIC and IndustryEdge

A somewhat smaller average household size by 2050 indicates two important features of the future demand for housing in Australia.

First, Australia will require proportionally more dwellings (to accommodate households) than is currently required. This has implications for the intensity of building activity in the housing sector.

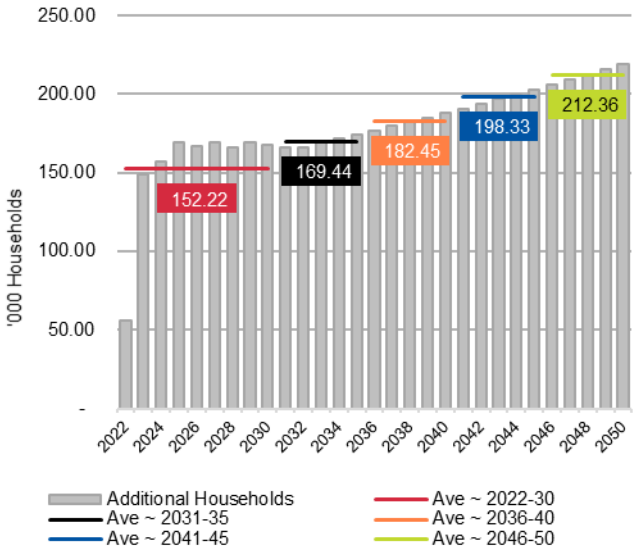
Second, housing formats will continue to change to accommodate Australia's changing demographic patterns. This evolution is likely to involve smaller average dwelling sizes and may have some implications for the volume and quality of building materials used in those smaller dwellings.

3.2.4 Demand for housing to 2050

Based on the foregoing forecasts and projections, from 2021 to 2050, Australians will form an additional 5.175 million households, or an average of 178,458 per annum. That equates to approximately 24,000 more households per annum on average over the entire period than for the decade to 2032.

Based on the NHFIC data outlined earlier, from 2022 to 2030, the forecast average annual household formation rate will be 152,220 households, rising to 212,360 additional households per annum from 2046 to 2050.

Household Formation: Annual & Half Decadal: 2021 – 2050 ('000s per annum*)

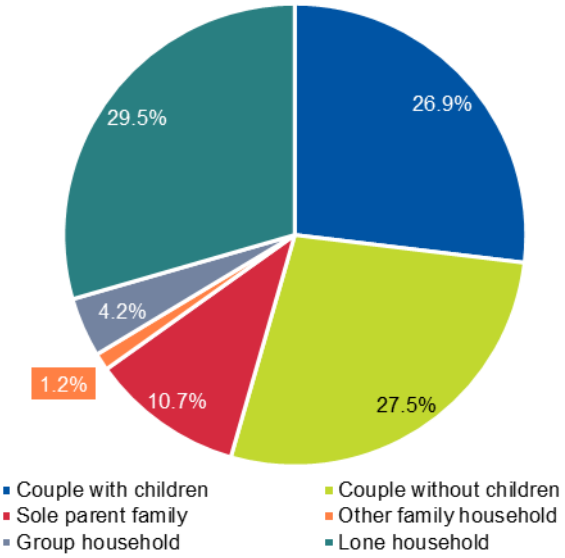


Source: ABS, NHFIC and IndustryEdge

* Annual average of the modelled outputs for the half decade (eight years 2022-30)

Each of these new households will require a dwelling in which to live. Although it is not possible to be precise, using the same projection base as set out above, the base load of additional dwellings would result in the household types set out below.

Household Formation by Type: 2050 (Proportion)



Source: ABS, NHFIC and IndustryEdge

Most importantly, the projections allow an understanding of the total number of households likely to be formed over the period to 2050 and the number of each of the types of households. This data

provides vital information in developing an understanding of specific housing demand driven by household formation and feeds directly into the model projecting sawn softwood demand to 2050.

Australian Households by Type: 2021 – 2050 & 2050 ('000s & %)

'000s & %	2021-50		2050 Snapshot	
	Additional	Proportion	Total	Proportion
Couple with children	1,046	20.2%	4,089	26.9%
Couple without children	1,484	28.7%	4,186	27.5%
Sole parent family	516	10.0%	1,623	10.7%
Other family household	64	1.2%	185	1.2%
Group household	189	3.7%	632	4.2%
Lone household	1,876	36.2%	4,479	29.5%
Total	**5,175**		**15,194**	

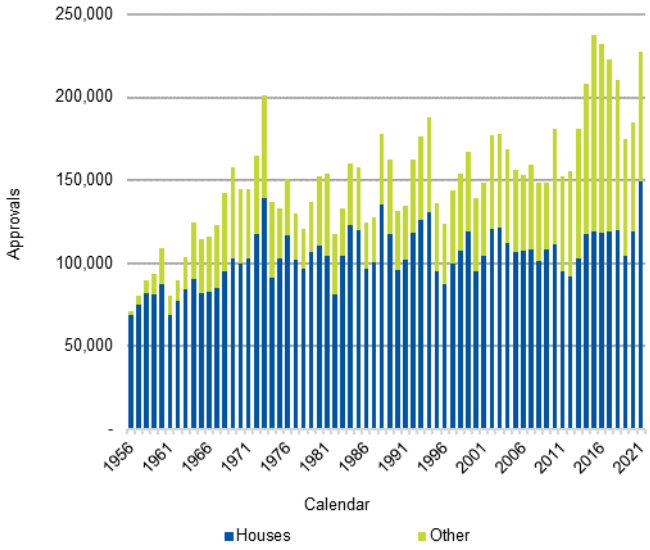
Source: ABS, NHFIC and IndustryEdge

3.2.5 Houses, townhouses and flats: Australia's housing formats

Since records were kept, Australian households have always preferred free-standing houses over all other housing formats combined. Analysis projects this preference will continue into the future, albeit diminishing over time as the types of households formed by Australians changes.

In 2021, Australia approved 227,626 dwellings. That was the third highest annual total on record and at 23.0%, the second largest year-on-year increase for approvals over a calendar year.

Australian Dwelling Approvals: Houses v Other: 1956 – 2021 (Number)



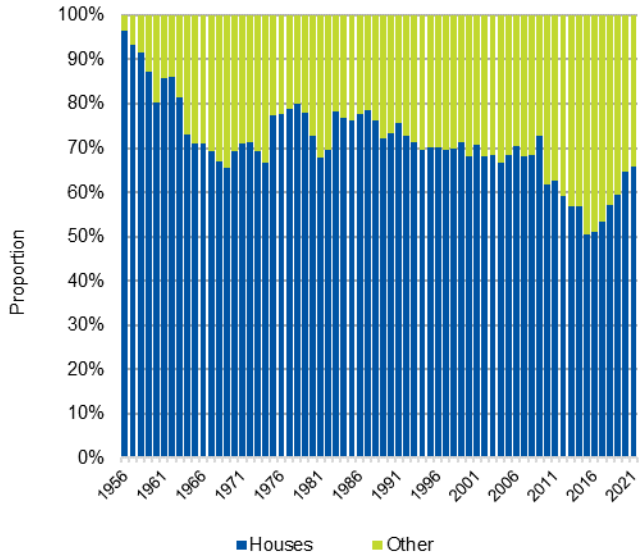
Source: ABS & IndustryEdge

The two calendar years in which approvals were higher than 2021 were 2015 and 2016. In both those years, the approval of free-standing houses and of all other formats combined were almost equal. But even in these 'heady' years for multi-storey residential developments, free-standing houses amounted to more than half of all approvals.

Relevantly, free-standing houses reached the all-time record high of 149,695 approvals in 2021[7], a rise of 25.2% on the prior year. In 2021, free-standing houses accounted for 65.7% of all approvals, a twelve-year proportional high.

The magnitude of the approvals was a surprise to many, however, the Australian preference for free-standing houses had been reasserting itself since it reached the low of 50.4% in 2015. The chart below shows the proportion of approvals of free-standing houses and other housing formats, since records began.

Australian Dwelling Approvals: Houses v Other: 1956 – 2021 (Proportion)



Source: ABS & IndustryEdge

This chart tells an important story, further summarised in the table below. Although housing formats have changed over time, as a proportion of the total, free-standing houses have always accounted for more than half of all approvals.

Over the sixty-five years for which there is data, free-standing houses have accounted for 71.3% of all approvals. Even at their lowest point (2015), they accounted for 50.4% of total approvals.

Number	2001	2011	2021	All Time
Houses	104,818	95,467	149,695	**71.3%**
Other	43,610	56,839	77,931	**28.7%**
Total	148,428	152,306	227,626	
Houses (%)	**70.6%**	**62.7%**	**65.7%**	

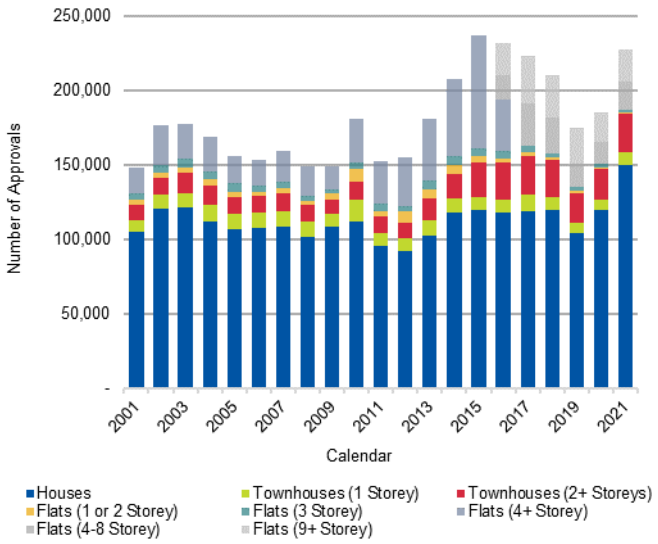
As the patterns of household formation change over time, so also will housing formats continue to change. Over the last two decades, in addition to the national fixation on free-standing houses, there has been significant attention in Australia on the development of multi-storey apartment buildings, containing significant numbers of individual dwellings.

Though the attention has been understandable because of the 'boom and bust' nature of the multi-storey apartment sector, especially in the nation's major cities, that attention has often been at the

[7] ABS, 8731.0 Building Approvals, Australia, Table 20, Original

expense of other housing formats that are also growing their influence in the Australian housing market. The chart below shows the last twenty years of Australian dwelling approvals by type.

Australian Dwelling Approvals by Type: 2001 – 2021 (Number)



Source: ABS & IndustryEdge

The table confirms the observations displayed in the chart. In particular, the data demonstrates the continued growth in free-standing house approvals (+1.8% per annum since 2001) and the strong growth in 4+storey flats and apartments (+4.4% per annum since 2001). What is often overlooked is the very strong and mainly stable growth in approvals of 2+ storey townhouses (+4.8% per annum since 2001).

	Houses	Townhouses		Flats & Apartments		
		1 Storey	2+ Storey	1 or 2 Storey	3 Storey	4+ Storey*
2001	104,818	8,256	10,191	3,564	4,591	17,008
2021	149,695	8,674	26,134	826	2,123	40,174
Average Annual % Change	**1.8%**	**0.2%**	**4.8%**	**-7.0%**	**-3.8%**	**4.4%**

Source: ABS & IndustryEdge

* Includes all formats above 4 storeys

Considered in conjunction with the changes in household formation set out earlier, it is reasonable to assert that households that once would have selected only a free-standing house are now significant among those choosing a 2+ storey townhouse.

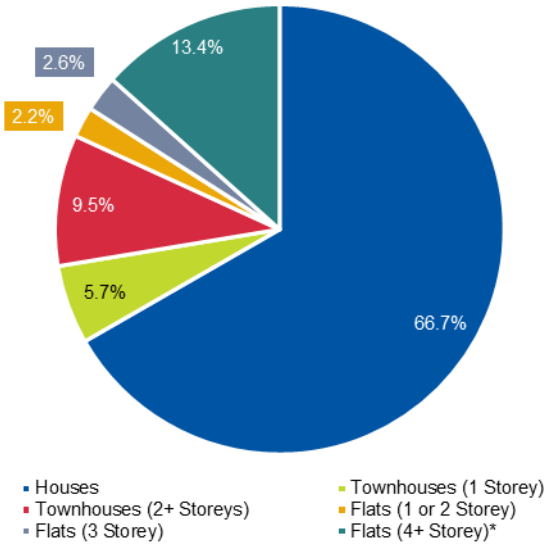
There are other potent reasons for this change, including the increasing cost of land, efforts to maximise population density in inner urban areas while maintaining the national preference for open space and a desire from households to avoid outer-urban sprawl, commuting time and costs

and the tyranny of inadequate infrastructure at the outer reaches of major cities where the new free-standing houses predominate.

As much as Australians are forming different households and gradually changing household formats, they are also gradually changing dwelling formats. This is not a binary change between houses on the one hand and multi-storey apartments on the other. Much of the change in housing formats is being experienced with townhouses that retain more of the characteristics of free-standing houses that remain the national preference.

To underscore this, as displayed below, over the period 2001 to 2021, 2+ storey townhouse approvals accounted for 9.5% of total approvals, with 4+ storey flats and apartments accounting for 13.4%. Both are relatively minor compared with the 66.7% average share of approvals for free-standing houses.

Australian Dwelling Approvals by Type: 2001 – 2021 (Proportion)



Source: ABS & IndustryEdge

* Includes all formats above 4 storeys

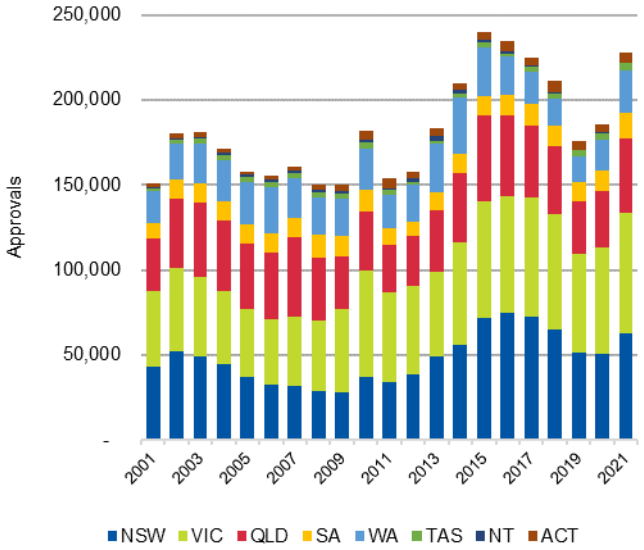
The outputs from this analysis are adopted in the modelling that projects Australia's future housing demand.

3.2.6 Australian dwelling approvals by state and territory

Population, population growth and locality are the drivers for regional shares of dwelling approvals across the country. There are other overlays at different times – the relative strength of local economies being foremost among them.

The chart and table here show Australian dwelling approvals by region.

Australian Dwelling Approvals by State and Territory: 2001 – 2021 (Number)



Source: ABS

Number	NSW	VIC	QLD	SA	WA	TAS	NT	ACT
2001	43,210	44,533	30,520	9,077	18,707	1,573	1,117	2,343
2011	34,433	52,295	27,664	10,058	19,917	2,556	1,322	5,510
2021	62,735	71,013	43,564	14,826	25,471	3,901	638	5,631
2021 %	27.5%	31.2%	19.1%	6.5%	11.2%	1.7%	0.3%	2.5%

The important feature of this data is its role in driving the destination of both local sawn softwood production and imports.

3.2.7 Other drivers of housing demand, and assumptions

Household formation is the major driver of dwelling demand in Australia. It is however not the sole driver. Market participants decide to build new dwellings for a range of reasons. Some of the most significant are set out below.

Assumptions of demand for each of these for 2022 has been used to calculate a linear growth rate to 2050. The outputs have been deployed in the model projecting Australia's future housing demand.

It is critical to note that these items of additional demand are highly sensitive to shifts in public policy, as set out under each of the specific items.

Replacement dwellings

As housing stock ages, it is replaced over time, but with little consistency. When replacement occurs close to capital cities and other major centres, higher land values and changing demographic patterns often result in increased density. That is, when one dwelling is removed, it is common for multiple dwellings to replace it.

In 2022, we estimate there will be demand for 16,000 replacement dwellings and the linear growth rate will be 2.0% per annum from 2022 to 2050. We note prior work of the ABS suggests the number of demolitions may be closer to 20,000 per annum.[8]

Sensitivity to public policy is relatively high for replacement stock, especially related to planning and related regulations, to interest rates and policies that support households have higher levels of disposable income or net borrowing capacity.

Private holiday and second dwellings

If Australia has a fixation on free-standing houses, it has a growing love affair with second dwellings, usually in coastal or rural settings. Again, this is partly demographic, with an ageing population having more financial capacity to finance second dwellings.

In 2022, we estimate there will be demand for 8,000 holiday dwellings and the linear growth rate will be 2.0% per annum from 2022 to 2050.

Sensitivity to public policy is extreme for private holiday and secondary dwellings. Changes in capital gains or inter-generational wealth transfer taxes have a pronounced impact in this sub-sector.

Other, including Aged Care and Short Stay

Every year, thousands of Australians enter aged care dwellings of various types. That number is growing and will continue to grow for most of the first half of the century. Often, the specific number of dwellings in an aged care facility is unclear, as is also the case for the 'short stay' stock. This cohort includes hotels, motels, some holiday parks and so on. A further, but small, group of dwellings is constructed each year in previously industrial buildings.

In 2022, we estimate there will be demand for 3,200 other dwellings. Reflecting the ageing of the Australian population, the linear growth rate will be 2.5% per annum from 2022 to 2050.

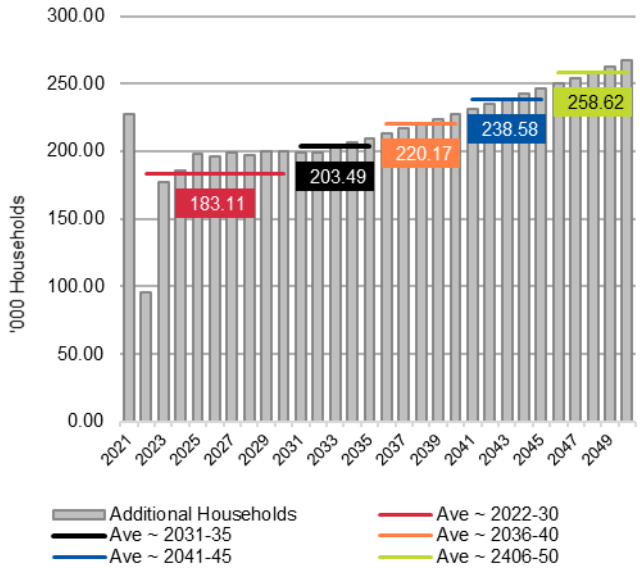
As a country with an ageing population, the available stock of aged care housing is likely to grow. Any practical change in emphasis to support this housing format more extensively could result in increased expenditure and a significant rise in the number of dwellings actually being constructed.

3.2.8 Australia's total housing demand to 2050

Modelling based on all the assembled data shows that by 2050, Australian dwelling approvals will rise to around 267,000 dwellings per annum, averaging 258,620 dwellings per annum from 2046 to 2050.

[8] ABS, 'National, state & territory level dwelling demolition approvals', (2021)

Housing Demand: Annual & Half Decadal: 2021 – 2050 ('000s per annum*)



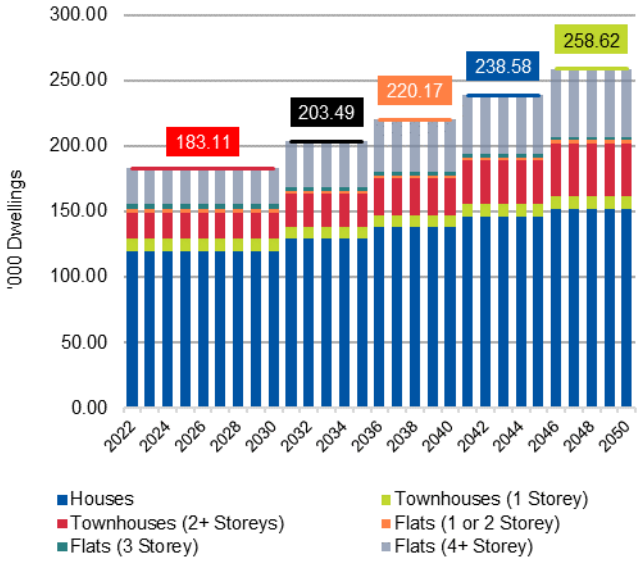
Source: ABS, NHFIC & IndustryEdge research and estimates

* Annual average of the modelled outputs for the half decade (eight years 2022-30)

Based on all the foregoing, the projected additional households were distributed by housing type, initially from 2022 to 2030 and subsequently on a half-decadal basis. This distribution demonstrates that by 2050, free-standing houses will account for a projected 58.7% of total new approvals, 2+ storey townhouses for 15.5% and 4+ storey flats and apartments for 19.9% of the total.

This can be observed in the table and chart below.

Housing Demand by Type: Annual & Half Decadal: 2021 – 2050 ('000 Dwellings per annum)



Source: ABS, NHFIC & IndustryEdge research and estimates

'000 Dwellings per annum	2022-30	2046-50	CAGR28	2050 Proportion
Houses	120.03	151.68	0.84%	58.7%
Townhouses (1 Storey)	9.46	10.34	0.32%	4.0%
Townhouses (2+ Storeys)	19.74	39.96	2.55%	15.5%
Flats (1 or 2 Storey)	2.60	2.59	-0.02%	1.0%
Flats (3 Storey)	3.56	2.59	-1.14%	1.0%
Flats (4+ Storey)	27.72	51.47	2.23%	19.9%
Total	183.10	258.62	1.24%	100.0%

To complete this distribution of future approvals, from 2035, the three smaller formats were held at stable proportions, allowing for the analysis to focus on the three major formats. Ultimately this is a more conservative projection than the trend suggests because for 1 & 2 storey flats and 3 storey flats, the trends suggest they would cease to experience any approvals as early as 2032.

On balance, we are satisfied that some future representation of these 'out of favour' formats is likely but will not be significant.

It is this profile of demand for dwellings which is the primary driver for sawnwood demand in Australia.

3.2.9 Other drivers of sawnwood demand

While demand for dwellings is the base demand driver for sawnwood demand in Australia. There are other drivers, some of which are caused by changing trends and others that are less certain or at least more cyclical.

We can identify from data and industry intelligence that outside of housing, there are three main processes in the Australian economy that use significant volumes of sawn softwood.

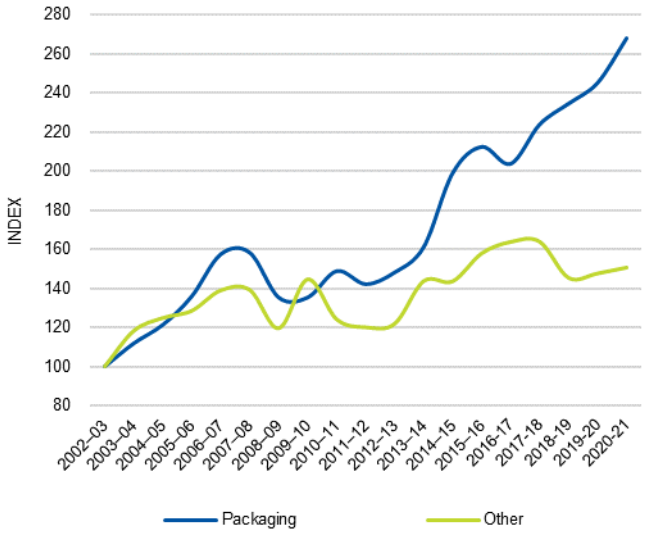
Importantly, all of the data in this sub-section is based on the FWPA Sawn Softwood Data Series. As set out earlier, it does not represent the totality of production and therefore, the volumes should be treated as indicative and understated. A focus on the proportions and trends is recommended.

Packaging is big business

Pallets, crates and cases have always been a significant driver of demand for sawnwood. In 2021, sales of locally produced sawn softwood sold as packaging and industrial grades accounted for 21.1% of total sales. That was a rise from 2020 of 20.3%, in a year when total local sales were forced down by 6.5%. In 2002, Packaging accounted for 13.0% of total sales.

As can be seen in the index chart below, growth in sales to the packaging and industrial market have grown steadily over the two decades over industry has reported and aggregated data. Significantly, they have grown at a far faster rate than (5.6% per annum on average over eighteen years), compared with all other grades, that have been growing a solid 2.3% per annum over the same period.

Australian Sawn Softwood Sales: Packaging v Other: 2003 – 2021 (INDEX)



Source: FWPA & IndustryEdge

It is important to note some of the reasons this has occurred. Sawmill recoveries have improved with investment and technological innovation. More material is recovered and utilised, especially for non-structural applications.

At the same time, the continued restriction and removal of access to native forests has removed most of the hardwood resource used to manufacture industrial timber packaging. Softwood timber has been able to meet this demand.

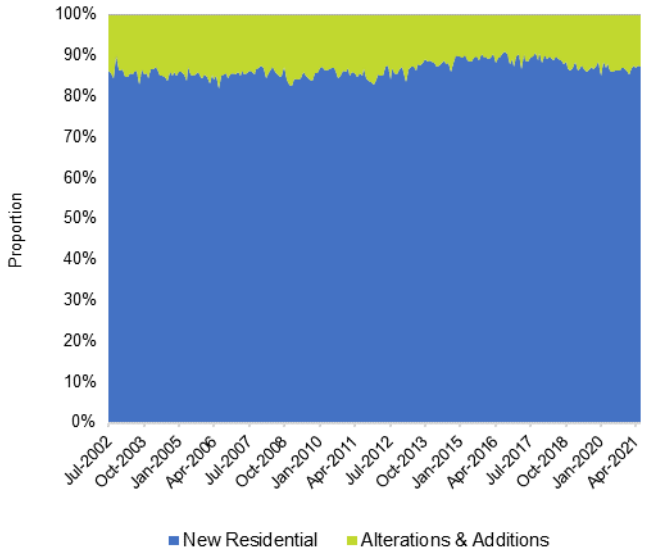
Alterations and additions are a major sub-sector of the Australian housing economy

Although the magnitude is variable and cyclical, Australians routinely maintain, renovate and upgrade their existing dwellings on a continuous basis.

Whether kitchen and/or bathroom updates, the addition of rooms or something more substantial again, the ‘alterations and additions’ market in Australia is a very large consumer of building materials, including sawn softwood products and a range of other timber and wood products.

As the chart here shows, since 2002-03, the proportion of total residential building value in Australia committed to alterations and additions has been relatively stable, averaging 13.2% of the total. The peak proportion was 17.9% in June 2006 and the lowest proportion was 8.8% in August 2016.

Value of Alterations & Additions v All New Residential: 2003 – 2021 (%)



Source: ABS and IndustryEdge

Estimates of sawn softwood timber use in alterations and additions vary widely between analysts. The later sections of this report adopt a conservative approach to determining the amount of sawn wood used in alterations and additions in Australia.

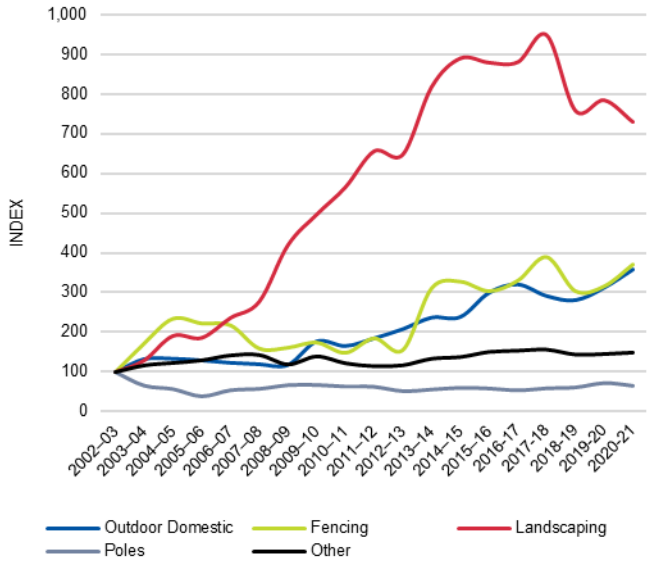
Poles, posts and the great outdoors

Beyond the construction of dwellings, Australia uses large quantities of sawn softwood products in the outdoor environment, primarily associated with fencing, decking and external structures (gazebos and similar).

In addition, sectors like agriculture, horticulture and viticulture use softwood posts and poles routinely for fencing and a variety of other non-domestic purposes. The impact of this demand can be seen below, where local sales of sawn softwood graded as ‘Outdoor Domestic’, ‘Fencing’, ‘Landscaping’ and ‘Poles’ have increased from 10.5% of total sales in 2002, to 18.4% of the total in 2021. It is relevant to qualify ‘Outdoor Domestic’, a combined category including H3 Treated MGP grades, a quality/structural product.

Their growth rates – some absolutely stellar – are best observed in this index chart, compared with all ‘Other’ grades combined (effectively Structural and Packaging). In aggregate and combined, consumption of these ‘outdoor’ grades has been growing an annual average 6.5% over the last eighteen years.

Australian Sawn Softwood Sales: 'Outdoor Grades' v Other: 2003 – 2021 (INDEX)

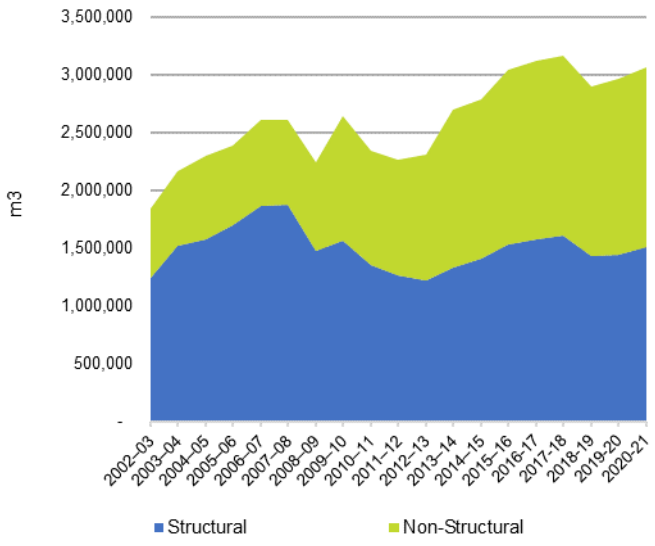


Source: FWPA & IndustryEdge

The result? Structural grades appear to be a declining proportion of total supply

In 2002, the proportion of locally produced sawn softwood used for framing and structural purposes in Australian houses was reported to be 66.2%. It hovered around that level and grew to a peak of 72.2% in mid-2008. Subsequently, as the chart below shows, that proportion had crashed to a low of 48.1% in mid-2020 and in 2021, was a modestly higher 50.4% of total local supply.

Australian Sawn Softwood Sales: Structural v All Other: 2003 – 2021 (m^3)



Source: FWPA & IndustryEdge

In the context of growing demand being fuelled primarily by demand for housing, this is a potentially disturbing situation that needs to be understood properly.

The declining contribution of structural timber as a proportion of total sales of locally produced sawn softwood has arisen for several inter-related reasons, in our assessment. These are summarised here:

1. The static softwood plantation estate may have necessitated some more aggressive harvest regimes, in order to supply required timber in previous years;
2. Thinning regimes in some plantation estates have been adjusted to produce a younger end-product, providing an increased proportion of logs more suitable for non-structural outcomes;
3. Higher marginal returns being achieved from some non-structural grades of sawn timber than from some of the structural grades.

Some of the system or supply chain issues that have contributed to this enduring challenge are set out at **Section 5.2**, in particular, **5.2.1**.

Regardless of the cause, consequently, as discussed in detail in **Section 6**, Australia has relied on imports of sawn softwood to supply the 'buffer stock' required to ensure supply of structural timber.

The data presented here is taken up and deployed in the sawnwood demand model.

3.3 Projected Australian sawn softwood demand to 2050

By 2050, Australia's annual average sawn softwood demand will increase almost 43% to a projected 6.507 million m^3.

Though this increase in demand sounds dramatic, the average annual rate of growth in total consumption is projected to be just 1.3% per annum.

Critically, the projections to 2050 are more conservative than the established consumption growth rate of 1.9% per annum from 2005 to 2021.

The projection is based on all the foregoing material outlining population growth, household formation rates, changing housing types and sizes and timber's market share in structural framing. The projections are underpinned by established industry research defining the amount of sawn timber used in the average free-standing dwelling and in townhouses.

3.3.1 Sawn softwood demand growth is as locked in as population growth

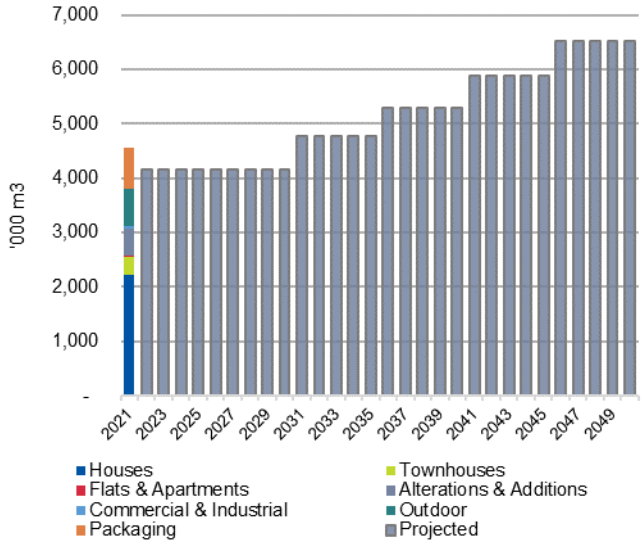
Just like the population growth that drives housing demand, at some level, sawnwood demand growth is broadly locked in, for some years into the future.

As we have noted elsewhere in this analysis, it is notable that demand and consumption are different from one another. The most recent example – and possibly the best in history – is 2021. It is projected that aggregate sawnwood demand in 2021 was at least 4.566 million m^3, while apparent consumption was lower by around 0.250 million m^3.

It may be of course that established inventories were used to supply some of this apparent under-supply, but it is clear from the expanding volume of building work committed but not yet commenced that demand was higher than consumption. The unmet demand from 2021 spilled over into 2022, creating the much discussed and observably very large pipeline of ongoing building work that resides in the Australian economy in the first half of 2022.

The projected demand profile can be observed in the chart and table below. To emphasise the distinction between demand and consumption, 2021's demand by end-use is included.

Australian Sawn Softwood Demand: Annual & Half Decade: 2021 – 2050 ('000 m³)



Source: ABS, ABARES, FWPA, Omega Consulting, HireThinking and IndustryEdge

'000 m³ per annum	2022-30	2046-50	CAGR28
Projected Demand	4,168	6,507	1.6%

3.3.2 Conservative factors of demand drive the projections

The central theme of this analysis – its governing proposition – is that Australia is already experiencing a gap between its sawnwood demand on the one hand, and its sawnwood supply on the other. The gap is growing and will continue to expand without a break, through to 2050, with the consequences becoming progressively more serious for the Australian economy and society.

Demonstrating this econometrically is straight forward, using established consumption data and demand growth rates set out in this analysis.

Our confidence in the reliability of the data and the immutability of population and household formation trends has resulted in IndustryEdge deploying conservative assessments of future demand, as the assumptions from which demand has been projected.

These are the main driving factors for the sawnwood demand forecast.

Factor Description	Actual Factor	Used Here
Sawnwood used per house [1]	14.58 m³	14.58 m³
Sawnwood used per townhouse [2]	Unknown	67% of 14.58 m³
Market share of structural timber framing [3]	Unknown	85%
Sawnwood used per flat and apartment [4]	Unknown	0.411 m³
Sawnwood used per alteration and addition to a residential dwelling [5]	Unknown	22.6% of sawnwood used in houses
Sawnwood used per commercial or industrial building [6]	Unknown	1.88% of sawnwood used in house and townhouse for year
'Outdoor' sawnwood demand [7]	+6.50% pa	+3.25% pa
'Packaging' sawnwood demand [8]	+5.60% pa	+2.80% pa

Source: IndustryEdge

Data Sources and Notes

1. **CALCULATION:** FWPA, 'Timber Usage in residential Construction 2017-18 Dataset. Report on methodology and results.' October, 2021.
2. **CALCULATION:** Based on the average ratio of square metres of townhouses compared with free-standing houses, as calculated by BIS Oxford Economics.
3. **ASSUMPTION:** Average national proportion of houses framed in structural timber. Applied only to House and Townhouse calculations.
4. **ASSUMPTION:** Factor is 2.825% of the calculated 14.58 m^3 sawnwood used per house and townhouse. On average, over all time periods, the value of Alterations & Additions has been 11.30% of the value of residential dwelling construction. The 2.825% is one quarter of the 11.30%.
5. **ASSUMPTION:** Factor is 22.60% On average, over all time periods, the value of Alterations & Additions has been 11.30% of the value of residential dwelling construction. The 22.60% is double the average, reflecting the widely held expectation renovations include significantly more timber per square metre than new builds.
6. **ASSUMPTION:** Factor is 1.88% On average, over all time periods, the value of Alterations & Additions has been 11.30% of the value of residential dwelling construction. This has been halved for the factor set out at (3) above. The 1.88% is one-third of the 5.650% and one sixth the 11.30%.
7. **CALCULATION:** Factor is 3.25%. Since 2005, demand for 'Outdoor' sawnwood grades has averaged 6.50% per annum. 'Outdoor' sawnwood demand is forecast to grow at half that rate or 3.250% per annum.
8. **CALCULATION:** Factor is 2.80%. Since 2005, demand for 'Outdoor' sawnwood grades has averaged 5.60% per annum. 'Outdoor' sawnwood demand is forecast to grow at half that rate or 2.80% per annum.

3.3.3 Rational assumptions used to adjust sawnwood production data

The pre-eminent Australian data series for sawnwood production is the FWPA Softwood Survey. It provides a monthly and largely consistent inflow of data, based on locally produced sawn softwood sales. It is separated into logical categories and forms the base of this analysis. As a voluntary data series, it does not include all softwood processors.

IndustryEdge has examined two recent bodies of work to inform an extrapolation 'factor' to more accurately describe aggregate Australian production.

The 2019 work of ABARES[9] was a very useful starting point and is also used later in this analysis.

Because it is based on assessment of Australian softwood sawmilling capacity and that in turn has been based on log availability and other measures, the 2017 work of Omega Consulting[10] proved to be particularly useful in assessing the likely total national production of sawn softwood.

Notably, the Omega Consulting work also relies on data series assembled by ABARES[11], based on industry surveys of log harvests. From that harvest, exports are netted out and the remainder is described by end-use.

In 2019-20, the 'Sawnwood and veneer' logs are estimated by ABARES to have totalled 9.465 million m^3. Of this, at least 0.800 million m^3 was veneer log. The 'Sawnwood softwood' output from the harvest is estimated by ABARES to be 3.751 million m^3, on a nominal sawlog supply of around 8.6 to 8.7 million m^3.

[9] ABARES, 'Economic potential for new plantation establishment in Australia: Outlook to 2050', 2019

[10] Omega Consulting, 'Implications of wood fibre supply dynamics in Australia, 2017

[11] ABARES, 'Australian Forest & Wood Products Statistics', various

For 2020-21, data is not yet available from ABARES. However, based on the massive (10-12%) losses of the plantation estate from the 2020-21 fires and the requirement to reduce the nominal harvest on a continuing basis, this analysis assumes the 2020-21 softwood sawlog supply was around 7.700 million m^3. It is recognised fire salvage in 2020-21 may have inflated that harvest, delaying the reduction to the estimated 7.700 million m^3 per annum.

The analysis also assumes an implied sawnwood yield averaging 47%, inclusive of all sawnwood products, regardless of grade or quality.

Our assessment is that the FWPA data series represents around 85% of all sawn softwood production. The foregoing data setting out production for 2021 and the subsequent projections are extrapolated by that factor.

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4 Supply of sawnwood in Australia to 2050

Australia's sawnwood supplies have long been a topic of intense consideration and periodic concern. Much of the 20th Century saw Australian states expanding their softwood plantation estates, focussed on the establishment of a purpose grown resource able to build the nation's future.

At the same time and with the exception of war years, Australia has always been a recipient of wood products from international markets. At different times, the proportions of imports have changed, as local and international demand and supply intersected.

At some point in the 1990s, the dynamics changed to the point where the resource base meeting the domestic proportion of supply became more or less stable. Consequently, it has not grown to match the growth in demand experienced over the last two decades. Inevitably, that has increased reliance on imports to meet domestic demand, changing the dynamics of the domestic market and potentially impacting the Australian economy.

In this section we further describe the supply of sawn softwood in Australia, from both a local and import perspective. A description of the gap is provided and the question of market and supply volatility and its potential implications is explored.

4.1 Australian sawn softwood production

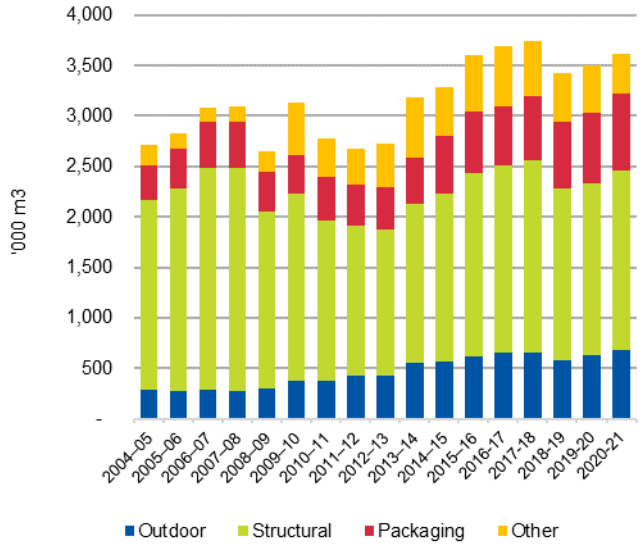
In **Section 3.1** of this report, Australia's *apparent* consumption of sawn softwood is set out, based on the FWPA Sawn Softwood data series. This shows that in 2020-21, production was 3.619 million m^3.

Australia's domestic production of sawn softwood is reported to FWPA by the majority of domestic processors, based on their monthly sales. As discussed in **Section 3**, the series does not represent the entirety of production. However, this data series has additional importance – it is the only source of consistent analysis that reliably advises the types of sawnwood products manufactured and their end-uses.

Based on data assembled by ABARES from analysis of log harvest and availability (details and references are set out in Sections 3 and 5), it is possible to extrapolate the data collected by FWPA and to assemble a complete production profile.

Doing so demonstrates that in 2020-21, total Australian production was an estimated 3.619 million m^3 around 0.127 million m^3 below the record of 3.746 million m^3 reported in 2017-18. It is recognised there are likely to be differences between the 'dry' output measure of the FWPA data series and the 'green' nominal data of the ABARES data series.

Australian Sawn Softwood Production by Main Application: 2005 – 2021 ('000 m³)



Source: FWPA & IndustryEdge

'000 m³	2005 >>>	<<< 2020	2021
Outdoor	292.3	629.1	679.2
Structural	1,870.8	1,703.7	1,780.2
Packaging	346.1	699.1	764.1
Other	202.2	466.1	395.8
Total	2,711.4	3,498.1	3,619.3

4.1.1 State-based production

Sawn Softwood production data is available for the South-Eastern states of Australia and is presented here. The data excludes operations in Tasmania and Western Australia. It should be noted this data has been aggregated, rounded and calculated to proportions of total to maintain confidentiality of data provision.

In aggregate, among the South-Eastern states, the patterns of production show continuous growth in Victorian and New South Wales production.

South-Eastern Australian Sawn Softwood Production by State: 2014 – 2021 (%)

2014-21	QLD		NSW		VIC		SA	
	Low	High	Low	High	Low	High	Low	High
8 years ave	17%	21%	27%	31%	43%	47%	5%	8%

Source: FWPA and IndustryEdge

4.2 Australian sawn softwood imports

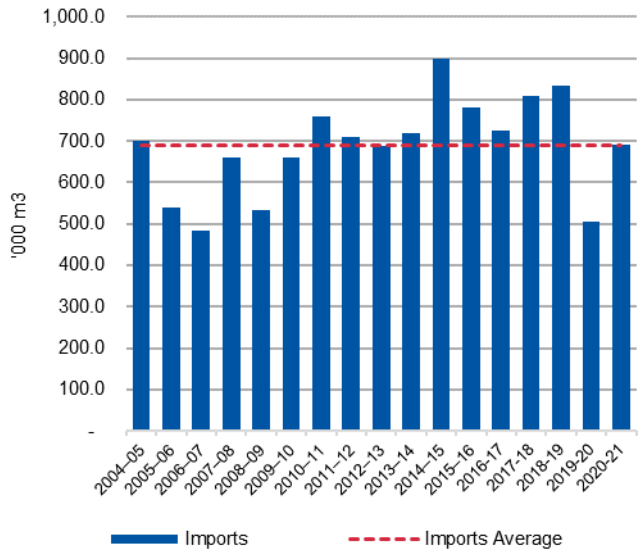
As the consumption data described at Section 3.1 sets out, Australia's reliance on imports of sawn softwood has been significant and continues to grow.

Although not always a popular view, the reality is that the Australian sawnwood market relies on imports to meet demand. Within the limits canvassed in **Sections 4.3** and **4.4**, imports are important because they offer a cost-effective means of managing peaks and troughs in the economy and provide international price signals and deliver industry and product development information.

4.2.1 Level of imports

In 2020-21, imports of sawn softwood totalled 0.690 million m^3, accounting for 16.5% of apparent consumption. As the chart shows, over the last twenty-five years, imports have averaged 0.688 million m^3 per annum and have ranged from a low of 0.483 million m^3 in 2006-07 to a high of 0.899 million m^3 in 2014-15.

Imports of Sawn Softwood: 2005 – 2021 ('000 m^3)

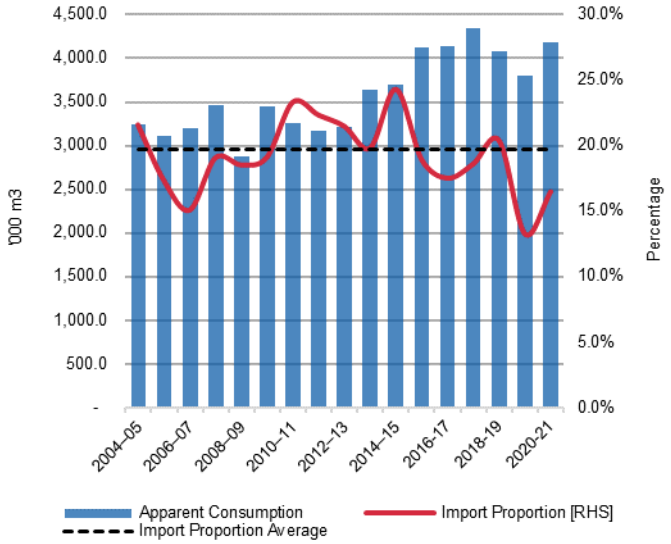


Source: FWPA & IndustryEdge

Although imports have observably been higher in other financial years than in 2020-21, the more important consideration in this analysis is the proportion of apparent consumption supplied by imports.

Over the period since 2004-05, sawn softwood imports have ranged from a low of 13.3% of apparent consumption (2019-20) to a high of 24.3% (2014-15). The average import share of apparent consumption over that period was 19.7%. This can be observed in the chart below.

Australian Sawn Softwood Imports & Apparent Consumption: 2005 – 2021 ('000 m³ & %)



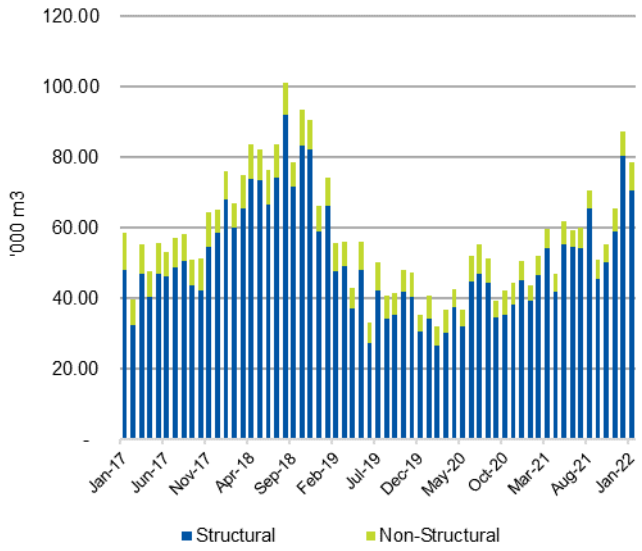
Source: ABS, FWPA & IndustryEdge

It is important, in the context of this analysis, that the import proportion of apparent consumption appears to have peaked in 2014-15, since when it has trended down. This data feeds into the analysis indicating the global availability of logs and/or capacity of imports to supply increased demand for sawnwood is diminishing.

There is further analysis of the changing role of import supply in **Section 4.4**.

Examining imports in detail over the last five years, we can observe that structural grades accounted for 86.1% of imports as the chart below demonstrates clearly. This points to a feature of sawn softwood imports: they support building and construction activity, the vast majority of which is in residential dwellings. Structural sawn softwood imports play a vital role in building the nation.

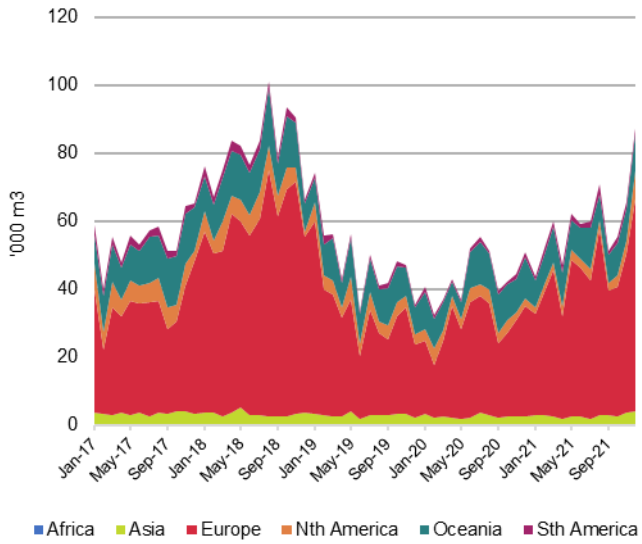
Australian Sawn Softwood Imports: Structural v Non-Structural: Jan '17 – Dec '21 ('000 m³)



Source: ABS and IndustryEdge

Australia's sawn softwood imports originate mainly in Europe, supplemented by consistent but diminishing supplies from New Zealand, supported by small volumes from other regions.

Australian Sawn Softwood Imports by Region of Origin: Jan '17 – Dec '21 ('000 m³)

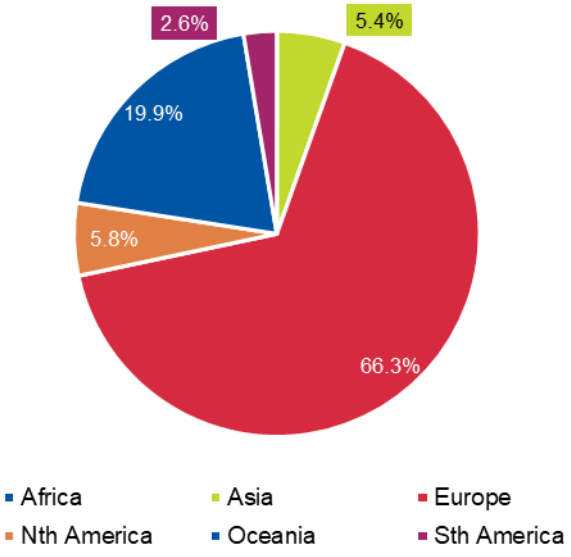


Source: ABS and IndustryEdge

A detailed table of sawn softwood import volumes, by country, is set out at **Appendix 1**.

To underscore what is fast becoming a strategic dilemma (not to mention a geo-political risk), the proportion of import supply from Europe in 2020-21 was 66.3%, or just short of two-thirds of the total.

Australian Sawn Softwood Imports by Region: 2020-21 (%)



Source: ABS and IndustryEdge

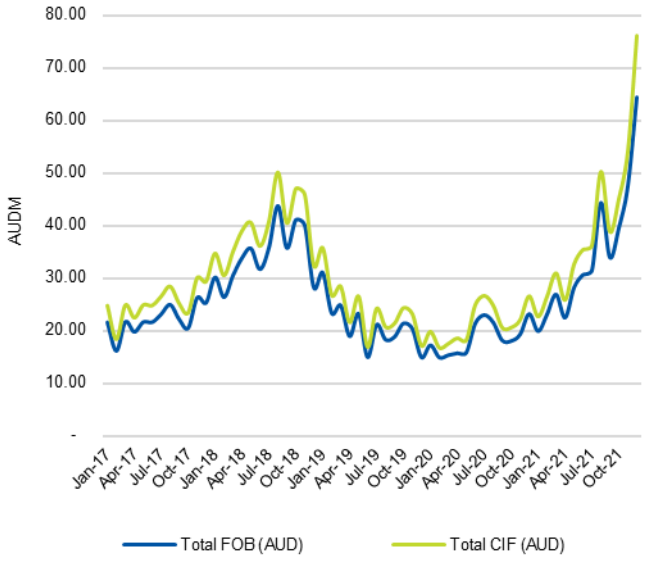
The European share of the Australian import market represents a lifeline in the context of demand that is now routinely greater than the capacity of domestic supply. The modelling here shows demand being greater than domestic supply until at least 2050.

That the import lifeline is tenuous, lengthy and distant is increasingly evident from a logistics and cost perspective.

Tyrannies of distance are an observable and continuing risk to sawn softwood import supplies required to meet the needs of the Australian market. It may be that the more significant risk is the evolving market position of Australia, relative to other, larger, more proximate and more lucrative markets for the major European producers. This is also addressed further in **Section 4.4**.

The value of Australia's sawn softwood imports lifted a massive 85% in 2021, rising to AUD412.62M, up from AUD223.25M in 2020. That was on a free-on-board basis, with the total value of goods 'landed' into Australia reaching AUD475.20M. As the chart below shows, both are very clear records.

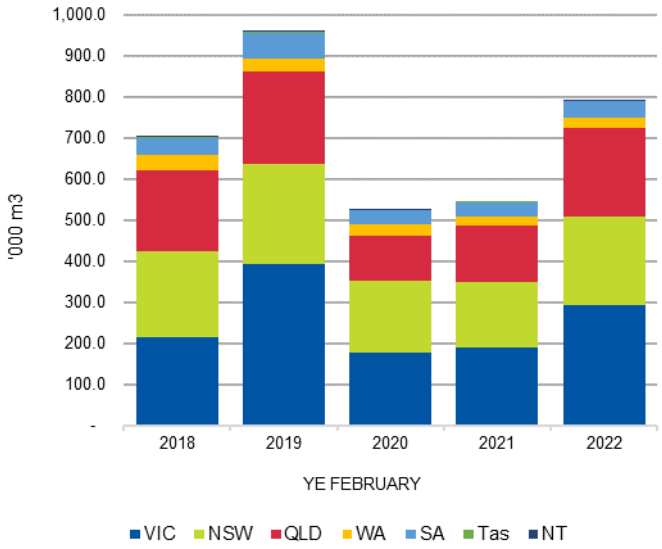
Australian Sawn Softwood Imports: Jan '17 – Dec '21 (AUDM)



Source: ABS and IndustryEdge

With one exception – imports to Victoria over the year-ended February 2019 – imports of sawn softwood to Australia are largely proportionately consistent over time, as set out below.

Sawn Softwood Imports by State: YE Feb '18 – YE Feb '22 ('000 m^3)



Source: ABS and IndustryEdge

'000 m^3	2018	2019	2020	2021	2022
VIC	214.9	393.8	178.2	191.8	293.2
NSW	211.0	245.3	174.2	159.9	216.7
QLD	195.4	223.9	111.9	135.1	215.6
WA	38.0	31.4	27.3	21.5	24.2
SA	42.6	64.5	32.6	37.4	40.4
Tas	1.7	1.7	1.2	2.4	1.7
NT	0.2	0.3	0.1	-	0.1
Total	703.8	960.9	525.6	548.1	791.8

4.2.2 Opportunity cost of imported supply

At a headline level and from a domestic perspective, the opportunity presented over the last year was to supply up to an additional AUD500M of sawn softwood, supporting a larger and more capable domestic supply chain. While that opportunity alluring at the macro level and will clearly grow over time, the reality is that the market will always include some volume of imports.

Though some will argue imports should be entirely unnecessary, the evidence indicates the Australian market needs the influence of imported supply to ensure it calibrates effectively to global conditions.

The better question, in the author's assessment, is what is the appropriate average proportion of imports in the Australian market? That question is not easily answered, even empirically.

There are however indicators of what might demonstrate imports are at appropriate levels. The first is the volume of imports required to meet specific demand for sawn softwood over a reasonable period of time: without creating value-destroying surpluses or market-disrupting deficits. The second is the level of imports at which domestic price adjustments respond to the prevailing price movement trends in international markets

It is difficult to quantify an actual import level when those conditions will be met, and it will change as the complex mix of domestic and international conditions shifts and alters.

To operationalise the concept, we can consider the market for softwood logs.

Australia is an open-trading economy, with limited regulation on key aspects of trade. In that context, if the export of softwood logs from Australia is to be limited to only those logs that cannot be domestically processed, Australian sawmills and other wood processors must be able to pay an international equivalent price for the logs.

It might follow therefore that Australia needs sufficient imported sawn softwood in its market, for the market to respond to international price signals, increase its own prices and thereby secure access to the available softwood log resource.

4.2.3 Volatility of pricing

With that analysis in mind, the recent period of significant price increases for sawn softwood is a very useful case study. The price increases were driven by prices in markets from which imports are supplied. The magnitude of price increases was a more than adequate signal to the domestic market, and one that the data shows was long overdue.

If there is a strategic concern about this 'case study' it is that it demonstrates the structure of the domestic market and supply chain has not worked to correct prices over a relatively long period of time. While it may be a comfort that prices have increased, it is worrying the driver came from outside the domestic economy and from beyond the industry's influence.

Below, we outline the widening gap between domestic supply and demand of sawn softwood products. As the gap widens, the reliance on external supply and the responsiveness to external signals will become more regular and pronounced. Just as the recent reliance on the external signals was pronounced upwards movement, it is just as likely a future reliance could produce pronounced downwards movements.

This matter is addressed further in the remainder of **Section 4**.

4.3 Australian sawnwood production capacity and gap to 2050

In 2020-21, modelled demand for sawnwood in Australia was 4.566 million m^3, of which an estimated 3.619 million m^3 was supplied locally. Consequently, imports of at least 0.947 million m^3 were required to meet the demand, however, imports for the year totalled 0.690 million m^3.

The remainder of demand – a minimum of 0.257 million m^3 – was either met by substitute products or was not met in that timeframe and was added to the 'pipeline' of work or 'work at hand'.

That financial year represents something of a live experiment, providing a window into a potentially more volatile future for the Australian housing industry and ultimately, for the Australian economy and society.

Based on established production information and consistent with recent production data, we calculate Australia's current sawn softwood output capacity is around 3.600 to 3.800 million m^3 per annum.

The relationship between the volume of logs available to process and production capacity is not absolute. It is however very close. It is unlikely in Australia that sawnwood production capacity will ever be significantly ahead of log availability, in part because there is almost complete visibility to the availability and capabilities of the entire nation's resource profile. Establishment of resource will, in most cases, precede establishment of processing capacity.

Given any additional hectares planted in 2022 would only be available for harvest in the latter part of the forecast period, holding production capacity stable is therefore appropriate.

However, in modelling Australia's sawnwood demand, production capacity and the gap between the demand and capacity over time, we have applied small increases in production capacity to represent improvements in plantation productivity and operational effectiveness, through to 2050. The average annual net increase we have applied to capacity is 10,000 m^3.

It should be noted the 10,000 m^3 per annum equates to something less than 0.3% per annum over the longer term and is significantly less than the anecdotal annual average improvement of around 1.0% per annum. We have adopted this conservative approach in part to reflect the loss of resource (and therefore constraints on future log availability) arising from the fires of 2019-20. This factor is expanded upon in the next section.

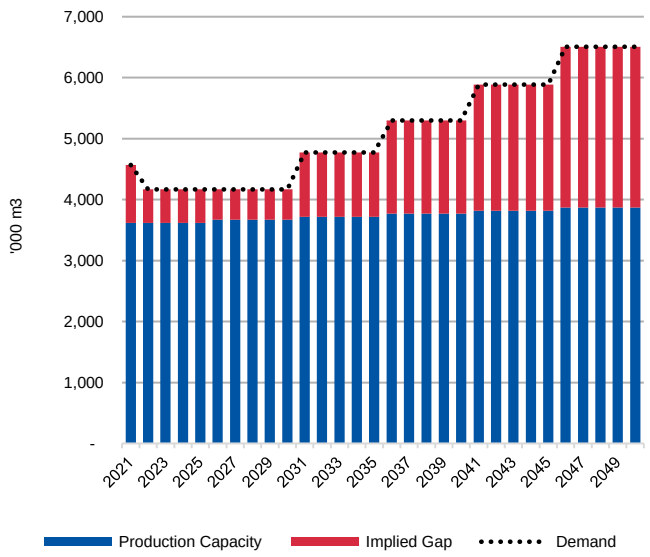
The modelling is deceptively simple. It uses the demand profile calculated and projected in Section 3 and applies the totality of local production capacity to meeting that demand. All shortfalls are reported, as can be seen below, as the 'Implied Gap'.

The Implied Gap is essentially the amount of demand that must be met by import supply – or substitute products – if the demand is to be met.

By 2050, against largely stable production capacity that aligns directly with existing resource availability, the Implied Gap between demand and Production Capacity will increase by 1.691 million m^3 or 179%, lifting to 2.638 million m^3 per annum. The Implied Gap will experience an average annual rate of growth of 3.7%.

As subsequent discussion demonstrates, reliance on imported supply at these levels will place at risk the capacity of Australia to meet the housing demand created by a growing population.

Australian Sawn Softwood Demand, Local Production & Implied Gap: 2021 – 2050 ('000 m^3 per annum*)



Source: ABS and IndustryEdge

* Annual average of the modelled outputs for the half decade (eight years 2022-30)

'000 m^3 per annum	2021	2026-30	2046-50	CAGR28
Demand	4,566	4,168	6,507	1.3%
Production Capacity	3,619	3,669	3,869	0.2%
Implied Gap	947	499	2,062	3.7%
Gap as % of Demand	20.7%	11.9%	40.5%	2.4%

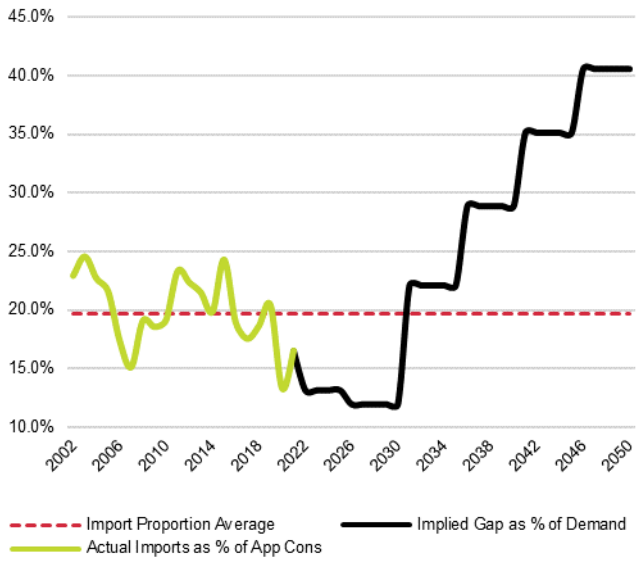
While the number itself is huge, before 2050, the Implied Gap of 2.062 million m^3 per annum will also represent 40.5% of total demand, up from just 13.2% in 2022.

As outlined in Section 4.2, over the last twenty-five years, imports have averaged 19.7% of apparent consumption. That is less than half the contribution that would be required if the entirety of the Implied Gap was to be met by imports.

This is displayed in the chart below, which displays the long-term average import proportion, the downwards trend of actual annual import proportions over the two decades to 2021 and critically, the Implied Gap.

The stark reality displayed in the chart is that by no later than 2031, the requirement for import supply will be **permanently** above the long-term average proportional contribution of imports. Notably, it is also the case that by no later than 2036, the requirement for import supply will be **permanently** above the long-term average actual import volume.

Import Proportions: Actual, Average, and Implied: 2002 – 2050 (%)



Source: ABS, ABARES and IndustryEdge

As the next section discusses, there are far reaching implications and increased uncertainties that arise from an ever-growing reliance on import supply, assuming it is even feasible.

One of the most relevant considerations is that like production capacity, imports are not a 'magic pudding'. That is, there are not endless supplies of sawnwood sitting just off the Australian coast, waiting for a clear signal to enter the Australian market. The entire world is challenged by shortages of wood fibre, as set out in **Section 2**.

The simple reality is that Australia is – for most of its European suppliers – one of the smallest and most distant markets. There are complex global dynamics that determine the actual level of import supply from one moment to the next. Ever expanding demand is not the sole determinant of supply.

Imports are needed and welcome, including for the market signals they provide, but it may be unrealistic to expect that this supply source can cover all the implied gap of 40.5% when historic levels have averaged 19.7%.

4.4 Long-term impact of the 2019-20 fires

In 2019-20, Australia's bushfire season was particularly serious, from many perspectives. In aggregate 8.3 million hectares of native forests were burnt and around 130,000 hectares of plantations was also impacted.[12]

The longer-term impact of the damage to the total plantation estate is that less softwood will be available for harvest. As ABARES pointed out in its report, the shorter-term impact was that some fire-damaged softwood was harvested (especially in New South Wales) as salvage wood, masking the longer-term impact over shorter time periods.

Industry calculations are that around 11% of the total softwood plantation estate was significantly damaged by the 2019-20 bushfire season.

Because there is no spare plantation capacity, over the medium to longer term, it must be expected that total log availability will be impacted on an ongoing basis, with some periods worse than others, depending on the age-class of the plantations damaged by fire in 2020-21.

4.5 Volatility of demand and supply increases risks

The inter-relationship of demand and supply is always an important consideration. In this section we describe how volatility in supply originates, outline the impact of that volatility and consider the importance of establishing and maintaining theoretical and practical 'buffer stock'.

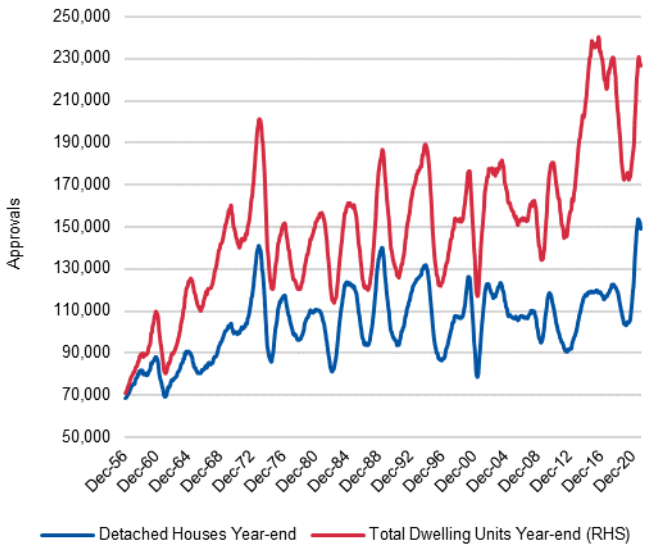
A key driver of demand in the Australian market is residential construction, in particular detached houses. Anecdotally between 85-90% of houses are built with timber frames. Underlying demand for housing is driven by the household formation rate, defined and discussed in Section 3, in considering the outlook through to 2050.

It is important to note that the actual rate of housing demand is much more volatile than linear models suggest. The broader impact of domestic and international economic conditions is variable, including the effect of interest rates and employment activity.

Perhaps the most obvious indicator of these drivers of volatility is housing approval data, which is a pre-cursor to construction. The chart demonstrates the cyclical nature of the housing sector with the available data back to January 1957 showing many peaks and troughs.

[12] ABARES, 'INSIGHTS: Analysis of effects of bushfire and COVID-19 on the forestry and wood processing sectors', 30 June 2020

Australian Residential Dwelling Approvals: 1956 – 2021 (Number)



Source: ABS & HireThinking

However, market information is clearly telling us that the current cycle is different to previous cycles. There are capacity challenges occurring throughout the supply chain, from availability of sawlogs, the production and importation of sawn timber, to availability of tradespeople, amongst a range of factors that are leading to significant delays in housing completion times.

The simple explanation is the level of demand in this cycle is significantly higher than previously experienced. This can be seen in the following table showing the peaks and troughs in recent cycles of free-standing house approvals.

Cycle	Year-Ending	Peak	Trough
1	June 2010	118,816	
	June 2012		90,980
2	May 2016	120,183	
	April 2017		115,748
3	July 2018	122,803	
	January 2020		103,426
4	August 2021	153,923	

Source: ABS

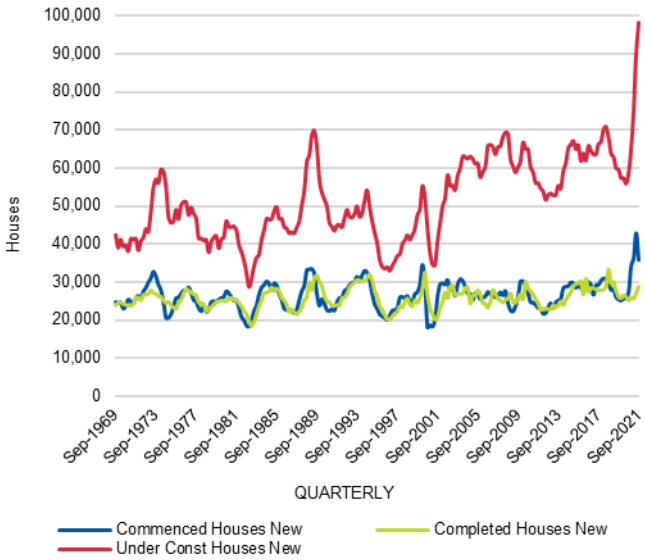
Where the previous three cycles peaked at around 120,000 free-standing house approvals, the current cycle has peaked at 153,923 detached house approvals.

This demand surge is impacting the time it takes to complete a house.

While the official data on completion times is limited, data on houses under construction is a useful proxy, as it shows the relationship between housing starts and completions. If starts and completions are in balance, houses under construction will be steady. Alternatively, if houses under construction are growing, it means capacity is not keeping up with demand.

In March 2022, houses under construction are at record levels, driven by record housing commencements.

Housing Activity: Starts, Under Construction, Completions: SQ'69 – SQ'21 (Number)



Source: ABS & HireThinking

Volatility in the housing sector largely arises because there are so many external drivers and pressure points on both demand and supply.

In volatile industries, the challenge is to have sufficient flexibility in the supply chain to deal with the oscillations in demand created by these unpredictable external factors.

In a market-based economy, price is the signal which moves these forces towards balance. However, that assumes that supply can respond at the same rate or pace as demand.

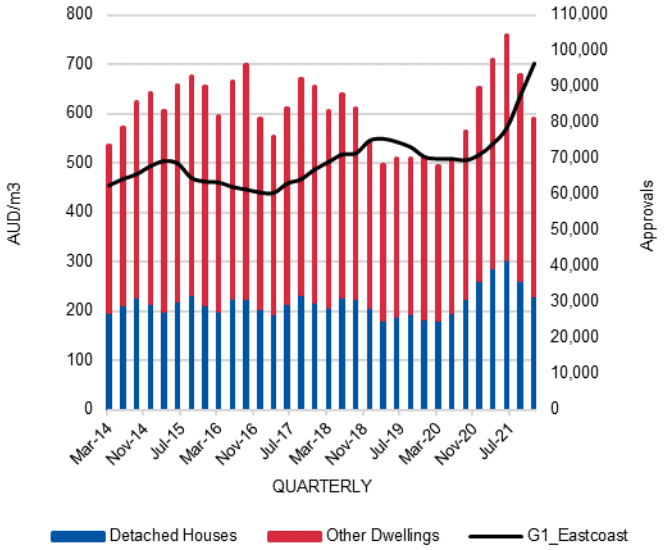
In situations where demand exceeds supply, the expectation is prices will rise to draw in more supply (for example, local production, imports, substitute products and so on) and/or reduce demand. Similarly, if supply exceeds demand, the expectation is prices will fall, thereby reducing supply and/or increasing demand.

These are dynamic processes with markets constantly evolving and moving towards equilibrium. In previous cycles this has worked well with movements in prices generating supply and demand responses.

It is important to consider whether normal supply and demand dynamics apply to the housing sector and sawnwood supply.

The chart below shows movements in price (represented by G1 Structural Untreated MGP Grades) are generally more gradual and tend to lag housing approvals due to the time between approvals and starts.

Housing Approvals & Quarterly Timber Prices: MQ'14 – DQ'21 (AUD/m³ & Number)



Source: ABS, FWPA & HireThinking

After the previous dwelling approvals peak in June 2018, total approvals eased significantly, with detached houses experiencing a less severe decline. This is reflected in pricing which moderated from early 2019 through to September 2020.

After September 2020, the current cycle was underway, with a rapid and significant increase in free-standing house approvals. However, in this cycle, the movement in prices has been well above the previous peaks but that has generated a relatively less active supply response.

Untreated Structural <120mm MGP Grades (G1 Eastcoast): AUDFis/m³

Cycle	Month	Peak	Trough
2	Mar-15	$503.21	
	Mar-17		$438.79
3	Mar-19	$548.52	
	Sep-20		$505.07
4	Dec-21	$701.39	

Source: FWPA

Economic literature talks extensively about how to deal with volatility in supply chains. It is recognised that where demand volatility is present, small movements in demand can cause a ripple effect (sometimes called the 'bullwhip effect') which leads to increasing oscillations or volatility.

At the company level, many solutions are offered; from holding greater inventory (buffer stock), diversifying suppliers and better use of technology to improved forecasting of demand, amongst other considerations.

At an industry level, the 'buffer stock' concept is broadened beyond inventory, to incorporate processing capacity, external supply (that is: import availability) and substitute products. This is expanded upon significantly in **Section 5** of this analysis.

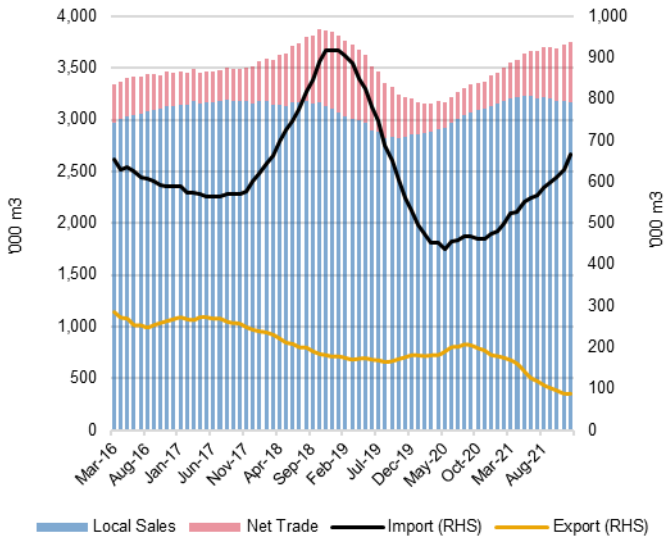
In this current cycle, it is apparent that the industry wide 'buffer stock' derived from any one or combination of these sources is yet to eventuate at the levels required, despite the significance of the price signals.

This is where theory and reality collide, as despite the quality of the signals (that is: the magnitude of the price increases), supply has not been able to respond at the same rate as demand.

Previously, the sawnwood supply chain has managed these demand challenges with a combination of increased production, complemented by increased imports. Historically, that combination has effectively represented the 'buffer stock' required to deal with volatile demand associated with unpredictable housing cycles.

The big difference in the current cycle is local production has been unable to produce beyond earlier production peaks because it has been constrained by the availability of softwood sawlogs, of the right specification in the right location. This is shown on the blue bars in the chart below.

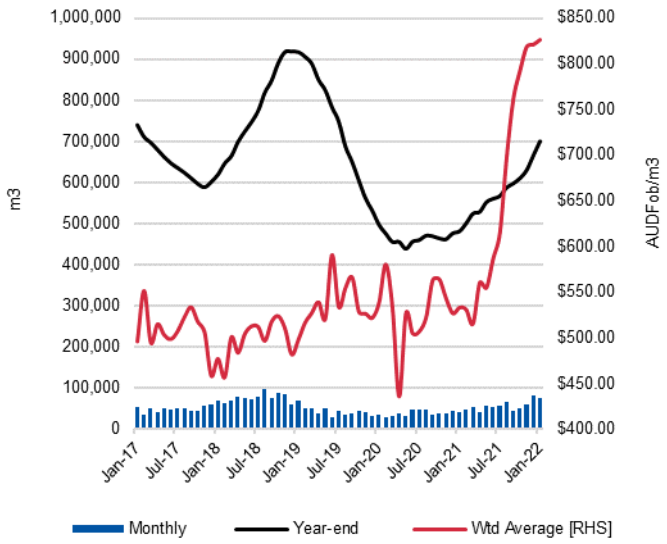
Annualised Apparent Consumption of Sawn Softwood: Mar '16 – Dec '21 ('000 m³)



Source: ABARES, FWPA & HireThinking

At the same time, the more variable 'swing' volume provided by imports has been more muted due to global market conditions, despite the observable market signal of rapidly increasing and historic prices. This is shown on the red line in the chart below.

Australian Sawn Softwood Imports: Jan '17 – Dec '21 ('000 m³ & AUDFob/m³)



Source: ABS, IndustryEdge & HireThinking

The differences in the supply response are summarised in the following table.

By the year-ended December 2021, local processing was running at similar levels to the previous peak, as recorded by FWPA, operating at 3.173 million m³. By contrast, at 0.666 million m³, imports were 0.252 million m³ lower than their peak, representing the entirety of the shortfall, in a context where demand was around 25% higher (around 123,000 free-standing house approvals in mid-2019, compared with around 154,000 in mid-2021).

Apparent Volatility: Local Processing v Import Supply: ('000 m³ & %)

'000 m³	Local Processing		'000 m³	Import Supply	
	Peak	Trough		Peak	Trough
Jun-18	3,173		Dec-18	919	
Oct-19		2,817	May-20		437
Dec-21	3,173		Dec-21	666	
Variance b/w cycles	<1, (<0.1%)		Variance b/w cycles	252 (27.4%)	

Source: ABS & HireThinking

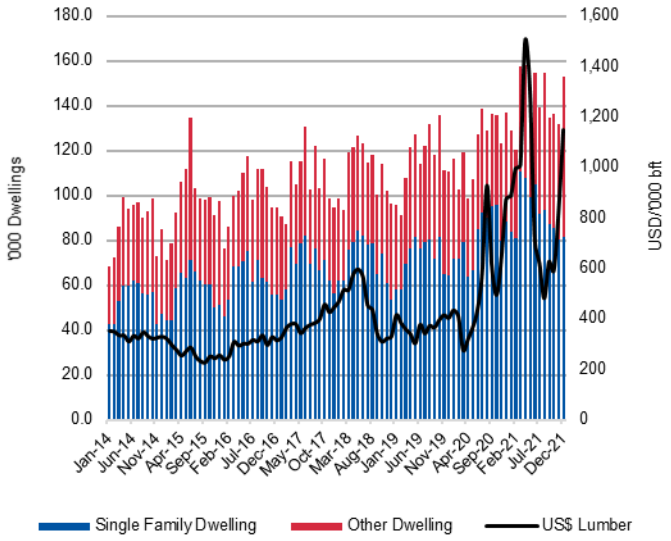
This shortfall in total supply has contributed to the challenge of meeting demand and means the capacity to establish or retain the required 'buffer stock' to manage the volatility has been severely constrained. This is a significant challenge given the projected growth in future demand means an even greater 'buffer stock' will be required, both in volume and proportional terms.

Logically, the 'buffer stock' would ideally be a combination of local production and imports. This is a complex relationship, influenced by many factors, especially the relationship between global prices and Australia prices.

In the current cycle, the constraints on local processing, coupled with the strength of global markets, has created a shortfall, when compared to the previous peak in 2018. Global logistics challenges, including the seagoing and land-side costs of shipping and freight have also been a particular challenge. The relationship of logistics to the establishment and maintenance of adequate buffer stock is addressed in **Section 5**.

For example, as can be seen in the following chart, while the US market's monthly housing permits were up in June 2018, they were within the normal cyclical range. However, in 2021 this measure of demand and prices moved to unprecedented levels, generating a massive global supply response.

US Housing Permits & Lumber Prices: Jan '14 – Dec '21 ('000 Dwellings &USD/'000 bft)



Source: US Census, Market Watch and HireThinking

The consequences of any constraint on local supply to work with imports to ensure adequate 'buffer stocks' means there will be greater volatility in the future. This is especially the case given the expected continued growth in housing demand outlined in **Section 3** and the currently static local capacity described in **Section 4**.

This situation can be observed in the current cycle, compared to previous cycles.

By using a simple macro measure of cubic metres of sawn softwood produced per dwelling approval, we can see current 'coverage' at the lowest levels since at least the early 2000s. We note that was when the FWPA sawn softwood data series was instituted and was 'onboarding' processors.

Beyond the 'settling in period', the data shows aggregate supply of locally produced sawn softwood has consistently averaged between 26 – 28 m^3 per free-standing house approval. By late 2021 local supply had declined to less than 21 m^3 per free-standing house approval.

At some point the current cycle will peak. Over time, with fewer approvals, demand and supply will move back towards balance. As a result, the current pressure in the system will abate, supply and demand will come closer to equilibrium and prices should ease. However, the key here is not the troughs – they present different challenges. Rather, the challenge is how to handle more and more frequent peaks, so that the disruption and delays currently experienced in housing construction are not repeated in the future.

Managing demand volatility requires increased supply chain capacity. The capacity of imports to meet a growing gap between demand and locally supply is clearly limited, currently stretched and largely, outside the direct control and even influence of the Australian housing sector, the supply chain and even Governments.

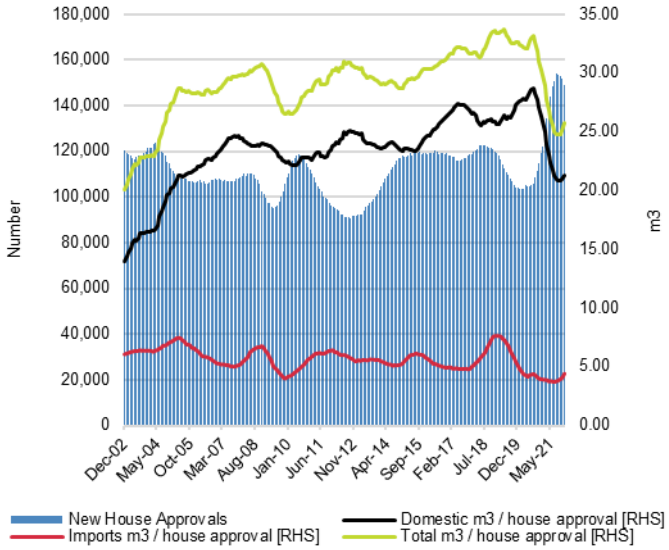
Ultimately, managing demand volatility requires increased local supply chain capacity, and potentially increased integration to global markets.

There are limitations to this analysis. First, there are other markets for sawn softwood timber beyond free-standing housing. Second, the supply data (local processing and imports) does not include the full universe of products (For example, engineered wood products and other substitute products) which may be used in dwelling construction.

However, this simplified analysis provides a trend direction, showing the shortfall in the capacity of supply to meet demand – the 'buffer stock' – which is particularly apparent in the present cycle.

The chart here shows the level of new free-standing dwelling approvals and shows the proportion of supply by provenance per dwelling. The chart clearly demonstrates the 2020 and 2021 spike in approvals was met by a sharp fall in the average volume of sawn softwood supplied per dwelling.

Australian Sawn Softwood Supply by Provenance v House Approvals (Number & m³)

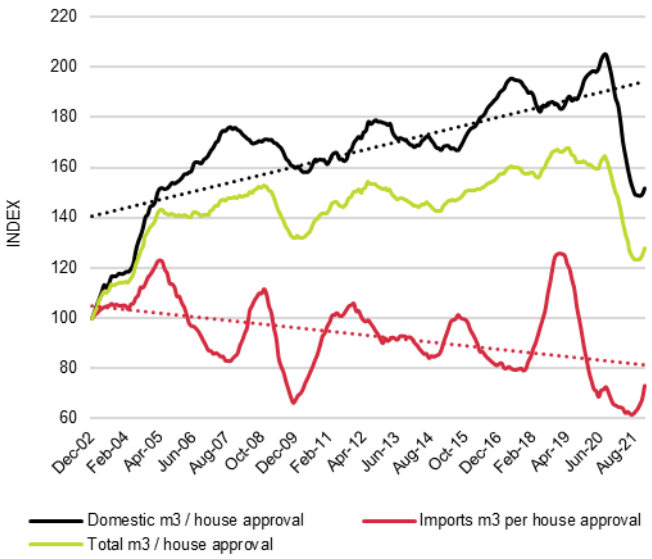


Source: ABS, FWPA, IndustryEdge and HireThinking

The shortfall in supply was largely taken up by domestic production, which was unable to expand to provide a consistent supply of sawn softwood to meet the very large increase in approvals. Imports were not as dramatically impacted, but that does not mean some simplistic reliance on increased imports can be the answer to oscillations in demand.

In fact, as can be observed in this index chart, while the average amount of domestically produced sawn softwood per new dwelling approval has been increasing through the cycles of the last twenty years, the opposite is the case for imported supply. The linear trendlines are particularly telling.

Australian Sawn Softwood Supply by Provenance per House Approval: (INDEX)



Source: ABS, FWPA, IndustryEdge and HireThinking

This is critical information because it shows that over the long-term, growth in demand for sawn softwood has been met by an expansion in domestic supply, while imports have declined.

'Buffer stock' will, as set out here, include a role for import supply, but cannot be limited to imports, especially as they continue to respond to growing global demand pressures from their own challenging supply-side position as described in Section 2.

To meet the challenges of certain future demand, an expansion of the softwood plantation estate is required, to provide more logs for processing into sawn softwood, allowing imports to continue to provide complementary supply.

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5 Residential Construction System of Work or Supply Chain

This report has detailed the outlook through to 2050 and identified the significant shortfall in supply to meet the expected growing demand. In the longer-term, an expansion of the softwood plantation resource base is required to facilitate an expansion of local processing, complemented by imports.

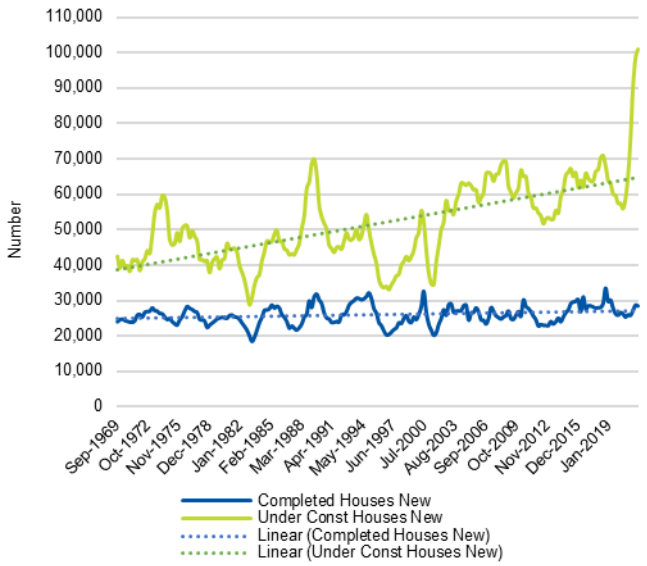
In the shorter-term, opportunities to improve supply chain integration will be critical to maximising supply. In considering this, the authors have considered Australia's system of construction for residential housing, or the supply chain and its capacity.

5.1 System of residential construction work under stress

During the current housing cycle, housing approvals reached record levels which has flown through the pipeline with housing commencements and in turn houses under construction. This is a logical interconnection between demand and supply. However, this highlights a significant underlying problem which is that supply of housing (completions) has not increased in line with the increase in demand (approvals/commencements) and, consequently, houses under construction has blown out to record levels, reaching 101,022 in December 2021 quarter.

This is not a transitory problem, as the trend position over the past 50 years shows houses under construction moving upwards from some 40,000 to above 60,000. In comparison, completions are relatively static at around 25,000 per quarter, moving from 24,037 in September quarter 1969 to 27,237 completions in June quarter 2021.

New Houses: Under Construction & Completed: SQ69 – DQ21 (Number)

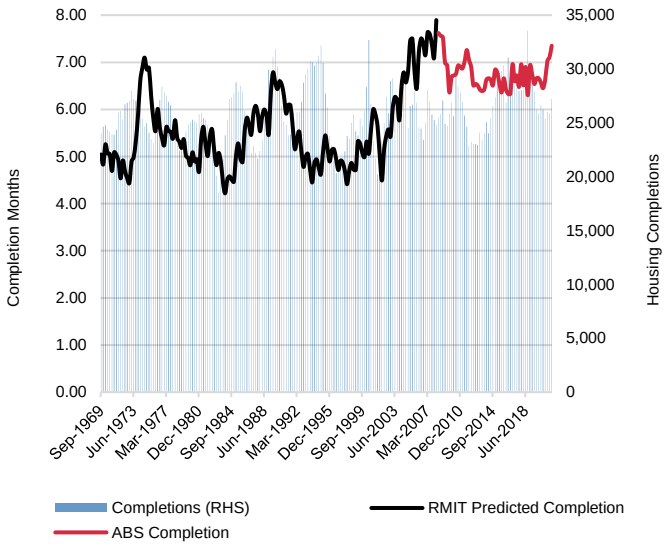


Source: ABS and HireThinking

Drawing on research undertaken by RMIT as part of a series on residential housing construction published by the Australian Housing and Urban Research Institute (AHURI)[13] the following chart demonstrates the impact on the time it takes to build a house.

In times of peak demand, the number of completions has remained relatively stable. So, with more houses commencing, the pipeline of houses under construction is getting larger, (the orange line) meaning it is effectively taking longer to build the same number of houses.

Housing Completions: Time v Completions: SQ69 – JQ21



Source: ABS, RMIT and HireThinking

The ABS now publishes data on housing completion times, with the recent data series commencing June 2008. To better understand the historic trend in completion times Dr Ehsan Gharaie, RMIT, developed a model to predict the past activity in this area. The predicted times model correlates well with the more recent ABS actual data. In September quarter 1969 the average completion time for a new house was 5.04 months. In the ensuing period there has been a number of housing cycles which have generally seen the completion times increase.

In the recent cycle, the data at June 2021 shows average completion times running at 7.35 months, with houses under construction at 90,284. However, the critical factor is that house completions in the June 2021 quarter were 27,237 which as the above graph demonstrates have remained relatively stable over the period since 1969.

The RMIT research explores a number of reasons, including:

- Availability of building materials
- Availability of tradespeople
- Increase in the size of houses being built.

[13] Australian Suburban house building: industry organisation, practices and constraints, Dalton et al AHURI October 2013. Link https://www.ahuri.edu.au/research/final-reports/213

5.2 Residential housing construction is a manufacturing system

Whilst intuitively, the above factors should explain the difficulty of matching demand volatility with increased supply/production of housing, the realty appears even more complex. The RMIT research suggests that at a macro level, residential housing construction is actually similar to a manufacturing system, as defined under lean manufacturing principles.

In that context, Little's Law[14] states that if you overload the stable system of production, all you will do is take longer to produce the same number of units.

The data suggests residential housing is operating as a similar system, wherein capacity is about 25-30,000 completed houses per quarter and if demand (approvals) rises above that level, all that happens is it takes longer to build with houses under construction growing (the work in progress [WIP] in lean manufacturing).

There are clearly opportunities to refine the construction system with companies always looking to improve the scheduling of their individual projects. The problem arises when these efforts are aggregated at the macro level and the system seeks to exceed its capacity.

5.2.1 System, supply chain integration and capacity are closely linked

The logical solution – at least in theory – is to expand the capacity of the system or supply chain, to meet the predicted peaks in demand. This is far more complex in practice, for two powerful reasons.

First, a system of work means a capacity improvement in one stage or point in the system is only going to be effective when its predecessors and antecedents have equivalent supply and demand capacities. Throughout the points in the housing system or supply chain, there must be integration or at least clear signals that capacity needs to increase, and there must be structural support for that.

Second, when additional supply chain capacity is established – whether throughout the points in the supply chain or at a specific point in it – that additional capacity will be dormant for periods when there is lower demand and will only be called into action during periods of higher demand. The capital, operating and other costs of the additional capacity must be covered by the supply chain and the price it receives, for the products it manufactures.

Put another way, any marginal additional capacity within the supply chain, will come at higher cost than the 'always on' or core capacity. This is not merely a question of charging a higher price when the additional capacity is in operation. The sustainable establishment and maintenance of the additional capacity (in whatever form that might take at different points in the supply chain) must be addressed in the price of all the goods produced by the system.

5.2.2 Opportunities to improve supply chain capacity

It will be apparent that achieving an integrated approach to supply chain capacity expansion is challenging. Many in the forestry and wood products points in the housing construction supply chain are intimately involved in exactly these considerations.

In that context, the authors are aware that the short examination of options and opportunities below requires further work and exploration, both at the system or supply chain level and at the enterprise level.

Opportunities to better integrate the supply chain and expand the capacity of the construction system could involve:

[14] Little's Law defined Link https://itsadeliverything.com/littles-law-the-basis-of-lean-and-kanban

- Improved market and supply chain information and sharing of that information to support business decision making;
- Supply chain level identification of bottlenecks (points in the supply chain with capacity less than the predecessor points in the supply chain) causing delays in completion times;
- Co-design of capacity improvement projects to encourage and support symmetrical capacity improvement activities;
- Training to expand labour capacity and capability;
- Introduction of new systems of work, including increased modular offsite manufacture for improved efficiency and waste minimisation.

Shifting from the theoretical, to the practical, and by way of example, the authors provide the following, noting most of these are derived from direct discussion with Australian industry and they are not exhaustive or novel.

Greater utilisation of the existing resource

As noted earlier, Australia is an exporter of softwood logs which are generally not suitable for local processing. These logs may be:

- Smaller in diameter, arising from silviculture thinning operations,
- Located in geographic areas where local processing capacity is limited, or
- Larger, out of specification logs.

Strategically there is value in some of this resource being used to produce structural building materials. This is not novel and it is noted that further technical and market work is underway to support developments of this type.[15]

Sawmill Productivity and Recovery

Australian sawmills are generally configured to work on an eight hour, two shift basis, from Monday to Friday. Sometimes, when resource is available and there is a production backlog, additional shifts might be scheduled for Saturday. The maintenance load on a sawmill is high due to the physical challenges of processing a log through the production line. A driver of improved productivity is greater throughput from faster log processing and increased uptime/machine availability during the shift.

Sawmills continuously work on improving recovery. This is reflected in, among other activities, upgrades of scanning equipment to optimise sawing pattern, technology associated with presenting the logs to the sawblade and in some situations, use of smaller kerf sawblades.

Integration with Frame and Truss piece sizes to reduce wastage

Greater utilisation of existing resource could be achieved by measures to reduce process waste. Frame and Truss manufacturers use proprietary software to design and cut customised orders for builders. The stock of timber available will generally require the cutting of longer lengths resulting in some waste. Similarly on a building site where the wall frames and sometimes the roof trusses maybe cut and fabricated on site waste can be as high as 30%[16]

Better integration of the supply chain, where material lengths could be optimised at the sawmill in specific orders, is a logical pathway to reduce supply chain waste.

Additional sources of supply

Presently, sources of supply accord with the Australian grading system for structural products covered by AS/NZS 1748[17]. This is a machine grading system with the main products meeting MGP10 and MGP12 strength characteristics.

[15] ATMAC, GTFIH etc
[16] Building Site Waste Link https://www.sciencedirect.com/topics/earth-and-planetary-sciences/construction-waste
[17] Structural Grading Link https://www.woodsolutions.com.au/structural-grading

Other jurisdictions use different grading systems with local production geared to meet those relevant standards. Australia would be able to access a wider supply network if there was more interchangeability with international standards.

5.3 Additional capacity and costs must be addressed throughout the supply chain

Establishing additional capacity in the supply chain is similar to establishing a physical buffer stock as set out in Section 4. In this case, instead of holding additional stock (inventory) at appropriate points in the supply chain), the system of work would hold additional capacity.

Regardless of the point in the supply chain at which the additional capacity is held, even if it is integrated and symmetrical across the supply chain, the cost of that additional capacity must be covered by the price of the final product provided to the market. The terminal value must be sufficient to cover the supply chain's intermediate values to ensure returns are sufficient at all points, to facilitate the expansion of the supply chain and its capacity.

Thus, the value or price of a house or other dwelling specifically determines the financial capacity of the supply chain to sustain all its capacity (core and additional).

In turn, specifically for the forestry and wood products supply chain, the value and price of frames and trusses and other timber elements must be sufficient to sustain capacity for frame and truss fabricators, for sawmills and other wood processing and for plantations to be established and regrown, as well as the many other activities that are integrated to the entire supply chain.

So, as supply chain capacity is increased to meet additional demand for housing, the prices of the products used to manufacture those houses will rise, and must be sustained, to cover the cost of additional capacity that may not always be fully utilised.

In the modern geo-political context, it could be argued sovereign capacity and self-sufficiency have not been as pressing for almost eighty years and there is therefore a role for government in these endeavours. However, Government can only support these activities and the future capacity of the supply chain largely rests in its own hands.

There is no one point at which the supply chain needs to act, and no point in the supply chain should act independently of the others. Collective supply chain action is required to increase capacity in a coordinated and systematic manner.

6 Need for additional softwood plantations

The gap analysis set out at **Section 4.3** demonstrates that local sawn softwood processing and the log supply available to it will be insufficient to meet Australia's growing demand for sawn softwood over all time periods to 2050, and beyond.

Importantly, as we have discussed throughout this report, imports have played a critical role in bridging the gap, in most instances over the last two decades. Imports will continue to play the important role described here, supplementing a core of local supply.

However, it is not feasible for imports to expand continually to bridge the gap. As the analysis of volatility and its impacts set out in **Section 4.4** demonstrates, it would also leave the Australian economy increasingly vulnerable to exogenous factors that it would also be less able to predict and largely unable to influence as the supply to demand gap grows.

It is not certain exactly what level imports will be over any time period and it is outside the control of the Australian economy what the import response will be to growing Australian demand.

Local capacity to produce sawn softwood is fundamentally linked to log availability, and therefore to Australia's base of softwood plantations.

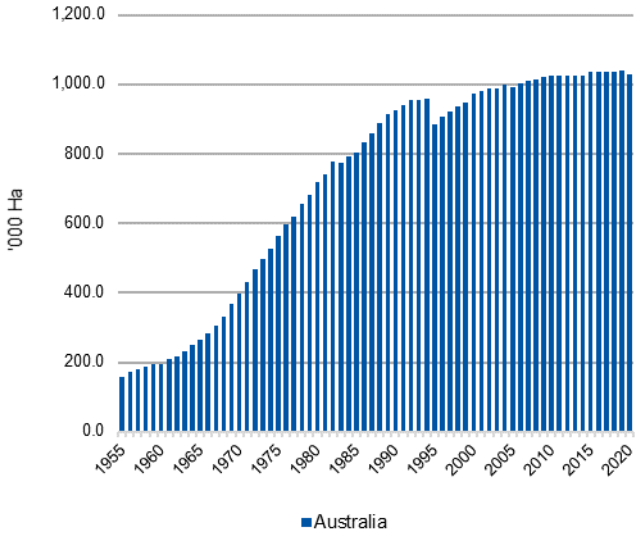
Here we describe the Australian softwood plantation base and its current outlook and model the quantity of additional softwood plantations required to bridge the gap between local sawn softwood supply and demand to 2050.

6.1 Australia's existing softwood plantation estate is not expanding

Since the early 1990s – around thirty years ago – growth in Australia's softwood plantations slowed to a crawl from which it is yet to accelerate. The long-term consequence is the existing gap between demand for sawn softwood in Australia and the capacity of the domestic industry to meet that demand.

In 2020, Australia's softwood plantation estate totalled 1.028 million hectares. Since 1990, the total softwood plantation estate grew just 0.3% per annum, as the chart shows.

Australian Softwood Plantations: 1955 – 2020 ('000 Ha)



Source: ABARES

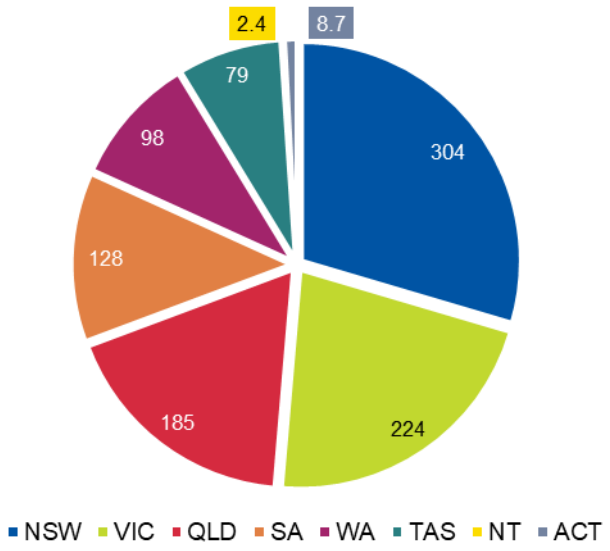
There are complex, inter-related and at times controversial reasons the national softwood plantation estate ceased to expand and failed to respond to the potent and unerring market signals provided by population growth, household formation rates and ultimately, housing demand. We have outlined the major structural issue, as we identify it, in **Section 5.2.**

The authoritative data set for plantations in Australia is assembled and reported by ABARES, in its five yearly reviews. The most recent was released in October 2021[18] and its data is used in this section.

In 2020, Australia's softwood plantation estate was distributed as set out below. It is noted that the fires of 2019-20 are estimated to have destroyed around 11% of the total softwood plantations, impacting future log availability.

[18] ABARES, 'Australian plantation statistics and log availability report 2021', (2021)

Australian Softwood Plantations by State/Territory: 2020 ('000 Ha)



Source: ABARES

6.2 Softwood plantations required to bridge the 2050 supply to demand gap for sawn softwood

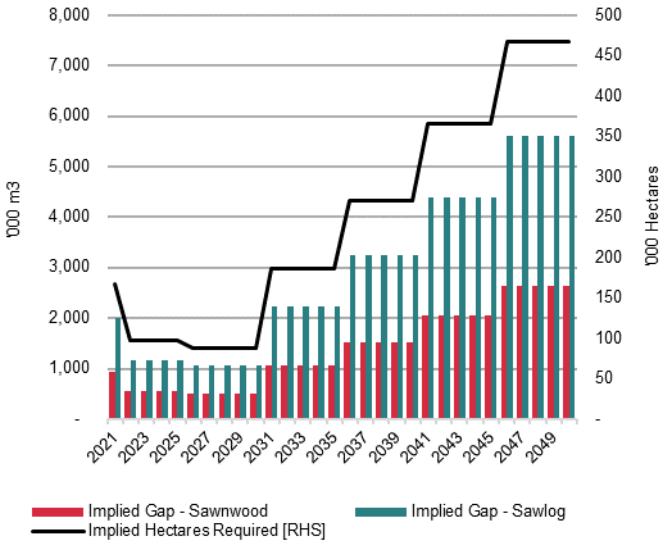
If Australia were to meet the expected annual demand gap for sawn softwood, at or before 2050, we project the total national softwood plantation estate would need to grow by around 468,000 hectares. This is the aggregate number of hectares required to entirely bridge an annual sawn softwood deficit that before 2050 will reach an estimated 2.638 million m^3 per annum.

It should be noted this modelling assumes hectares damaged by fire in 2019-20 (amounting to approximately 10% of the total national estate) will also be re-planted on a 'net-net' basis. Further, the modelling assumes any further fire or other losses will also be re-planted on a 'net-net' basis.

It is important to note at the outset the model and its projections yield the *maximum* number of required hectares, because it assumes all the gap must be met by expanded local production. However, the reality is that imports will continue to be an important contributor to meeting demand, as discussed in this report.

The chart here shows the implied sawn softwood gap, converts that to sawlogs and shows the calculation of hectares required to bridge the gap.

Implied Sawn Softwood, Sawlog and Plantation Gap: 2021 – 2050 ('000 m³ & '000 Ha)



Source: ABARES, Omega Consulting & IndustryEdge

'000 m³ & '000 Ha per annum	2026-30	2031-35	2036-40	2041-45	2046-50
Implied Gap - Sawnwood ('000 m³)	499	1,055	1,529	2,066	2,638
Implied Gap - Sawlog ('000 m³)	1,061	2,245	3,253	4,396	5,612
Implied Hectares Required ('000 Ha)	88	187	271	366	468

If the average sawn softwood import proportion continued to be 20% of total demand over all time periods, before 2050, Australia would still require an additional 240,000 hectares of softwood plantations. We note this is broadly consistent with previous work undertaken by ABARES.

6.2.1 Factors and assumptions direct the projections

The plantation hectares required to bridge the growing gap between sawn softwood demand and supply has been projected using the demand projections set out in Section 3 and the supply projections in Section 4. The assumptions deployed in those section have been adopted entirely.

Additional assumptions and calculations have been utilised to calculate the required hectares set out here.

Factor/Assumption Description	Actual Factor	Used Here
Sawnwood produced per m³ of Sawlog [1]	Variable	47%
Sawlog growth per hectare of plantation [2]	12.0 – 17.0 m³ / ha / year	12.0

Source: IndustryEdge

Data Sources & Notes

1. **CALCULATION:** Adopting the same sawnwood yield proportion as Omega Consulting[19], based on recent and extensive analysis of sawnwood processing in Australia. This factor is held constant across all time periods.
2. **CALCULATION:** Adopting the same Mean Annual Increment (MAI) as that used by Omega Consulting and broadly consistent with the current MAIs set out in the Regional Yield Tables in the latest report on Australian plantation statistics and log availability.[20] We note other recent work of ABARES assumed a growth rate for newly established plantations of up to 17.0 m^3 per hectare per annum.[21] We have elected to adopt the number used by Omega Consulting because it more closely approximates the current MAI.

19 Omega Consulting, 'Implications of wood fibre supply dynamics in Australia, 2017

20 ABARES, 'Australian plantation statistics and log availability report 2021', (2021)

21 ABARES, 'Economic potential for new plantation establishment in Australia: Outlook to 2050' (2019)

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7 Conclusion

As Australia's population continues to grow, demand for new dwellings will continue to expand at a predictable and reliable rate. That powerful driver of consumption of building materials provides a very firm base from which to project Australia's future sawn softwood demand.

This analysis of those and other factors projects that over the five years 2046 to 2050, Australia will consume an annual average of 6.507 million m^3 of sawn softwood. Demand will progressively increase to at least that level.

By contrast, in 2021, demand for sawn softwood was modelled at 4.566 million m^3 or 1.941 million m^3 less than projected for the period 2046 to 2050. It is telling that in 2021, not all the demand was met, because domestic production was at capacity and there were insufficient imports available.

In 2021, domestic production is calculated to have operated at capacity, producing 3.619 million m^3 of sawn timber products.

Australia's softwood plantation estate has not expanded over more than two decades. Softwood log supply in Australia is the main limiting factor on production of sawn softwood, which is projected to be stable to 2050, increasing incrementally only as forest and processing technologies improve.

Modelling and projections demonstrate that from 2021 to 2050, Australia's sawn softwood production capacity will be limited to between 3.6 and 3.8 million m^3 per annum.

By 2046 to 2050, the gap between annual average sawn softwood demand of 6.507 million m^3 and modelled domestic production capacity will be around 2.638 million m^3 per annum. Import supply at that level would represent 40.5% of total demand, more than double the long-term average 19.7% of local demand that has been met by import supply.

Imports play an important role in supplementing local production. However, the data and analysis demonstrate global supplies of sawn softwood are diminishing and factors of market volatility are increasingly evident.

If imports were to be the sole source of supply to meet the implied gap in 2050 this would represent some 40.5% of Australia's apparent consumption. As described earlier, this would be a significant increase above the historic levels averaging 19.7%. It is more likely import supply will oscillate through greater extremes in future, even more than experienced in 2020 and 2021.

It is one thing to supplement local production with imports that provide swing capacity, buffer stock and external market signals, it is altogether another to leave the capacity to meet market demand to external supplies, especially with all the mounting pressures those imports face.

The alternative to over-reliance on import supply is plantation establishment.

If all the 6.507 million m^3 of sawn softwood demand was to be met by local production, the modelling indicates that by 2046 to 2050, Australia would need to have established an additional 468,000 hectares of softwood plantations, in a range of locations across the country.

Ultimately, a continuing role for imports and an expanded softwood plantation estate and domestic production must each be part of the solution that will see Australia bridge the current gap between constrained local production capacity and future demand.

These are important considerations because plantations established today will not yield the bulk of their wood until very close to 2050.

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July 2022

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APPENDIX 1

Australian Sawn Softwood Imports by Country: MQ17 – DQ21 (m^3)

'000 m^3	Canada	Czech Republic	Estonia	Germany	Lithuania	New Zealand	Russian Federation	Sweden	Other	Total
MQ17	16,329	23,894	24,757	6,107	8,722	28,910	-	8,399	36,903	154,021
JQ17	12,818	22,196	27,561	4,918	9,217	29,574	947	12,374	37,378	156,982
SQ17	16,206	21,506	27,072	6,057	7,543	38,416	511	13,098	36,378	166,787
DQ17	11,021	23,833	33,735	10,551	7,122	40,141	818	12,118	41,999	181,337
MQ18	14,435	28,230	34,916	17,339	9,739	31,869	5,948	26,901	48,951	218,327
JQ18	13,585	26,292	28,762	34,884	8,979	37,866	7,395	25,746	58,916	242,425
SQ18	17,923	18,808	35,347	45,000	8,262	38,287	14,975	27,693	57,034	263,330
DQ18	9,225	27,981	22,364	51,303	10,407	35,384	13,667	16,329	63,608	250,269
MQ19	11,262	23,805	26,355	13,317	9,391	27,690	8,398	20,136	45,741	186,094
JQ19	9,571	12,096	19,979	10,212	6,604	26,974	5,514	15,636	26,100	132,685
SQ19	9,654	13,552	15,457	8,728	9,428	29,464	7,165	7,319	32,076	132,842
DQ19	8,181	13,588	17,958	9,493	9,355	26,177	6,145	5,302	34,523	130,721
MQ20	7,876	9,285	13,908	7,391	8,757	26,554	2,977	6,111	27,136	109,994
JQ20	6,484	11,490	18,248	11,130	11,592	18,738	8,052	14,943	30,973	131,651
SQ20	7,246	8,202	14,222	13,069	11,568	33,490	6,322	20,182	31,835	146,136
DQ20	4,465	7,288	14,233	17,678	7,613	30,961	7,461	13,681	34,091	137,470
MQ21	3,696	15,119	17,808	23,995	10,483	26,155	6,390	10,509	41,503	155,659
JQ21	5,222	14,501	16,977	28,176	8,569	26,291	5,210	21,981	41,324	168,253
SQ21	4,853	11,961	17,758	31,263	15,729	26,160	4,588	26,009	43,653	181,975
DQ21	10,794	13,897	21,312	38,718	18,955	28,747	4,288	24,206	47,400	208,317

Source: ABS