

**Gottstein Fellowship Final Report**

December 2023

# **OVERSEAS EXPERIENCES IN RESILIENT TIMBER CONSTRUCTION**

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The Joseph William Gottstein Memorial Trust Fund, known as the Gottstein Trust, began in 1971. This national educational trust helps to encourage innovation within Australia's renewable wood products and forestry industry.

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The Trust strives for the pursuit of excellence in people, processes, and products. And, in so doing, contributes to the evolution of Australia's wood products and forestry industry. Governed by several Trustees with close industry links, each year the Trust calls for applications from interested candidates for Fellowships, Scholarships and Skill Development grant awards. Grants are awarded to individuals through a competitive selection process. The funding provided enables recipients to pursue projects, study or specific skill development. Regular short courses and industry field trips are also run - focussing on understanding both forest science and wood science. People involved in Gottstein activities have opportunity to build their knowledge and networks and expand their own capacity to contribute to the industry. The direct beneficiary is the industry.

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## About the author

Paolo's experience with Engineered Wood Products encompasses both hands-on and advisory roles in research, products development, design and construction of timber structures, quality assurance, life cycle assessment, and training. After a Forestry degree in Florence (Italy), he joined a plywood industry for 7 years before starting an independent timber consulting and engineering practice. Whilst working, he also completed a PhD in Industrial Technologies, Wood in Nancy (France).

Paolo has been a pioneer in the design of multi-storey timber buildings, prefabricated homes and transportable units, timber-plastic composites, and the production of cross laminated timber out of low-grade wood. He also authored a widely used book on the design of timber structures and funded the development of structural engineering software.

Working with FWPA/WoodSolutions since 2016, Paolo has succeeded in changing many mindsets about mid-rise timber structures, by demonstrating to Australian developers, builders, and consultants how to take advantage of their efficiencies and cost savings. He is currently the manager of FWPA's Resilient Timber Homes Program, within which this project has been proposed, co-funded by The Gottstein Trust and FWPA, and run.

## Acknowledgement

I would like to personally thank the Gottstein Trust and FWPA for jointly funding and supporting my research trips.

## Acknowledgement of Country



In the spirit of reconciliation, we acknowledge the Traditional Custodians of Country throughout Australia, and we acknowledge their connection to the land and their custodianship of Country and forests. We pay our respect to Elders past and present and extend that respect to all Aboriginal and Torres Strait Islander peoples.

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## Executive summary

Timber buildings can be very resilient if appropriately designed and constructed but suffer from a perception issue due to wood's inherent organic nature. Inappropriate urban planning and climate change are putting an increased proportion of Australian homes at risk from natural disasters. This is causing many properties to become uninsurable, and additional planning problems. The timber sector needs to offer solutions to homeowners, property developers and regulators to ensure that it is not excluded from those areas that are more disaster prone. And the need for resilient timber construction is not unique to Australia.

The purpose of this project was to examine some of the approaches, experiences, and case studies of resilient timber construction (or tools to offset any additional costs associated with a 'Code+' timber-based option), from Countries where the risk factors, the socio-economic framework and the evolution of the timber industry are comparable with Australia.

The theme for this Gottstein Fellowship project was proposed because of its synergy with the author's role in FWPA's Resilient Timber Homes program (which is focused on Australia). Some of the project's findings have also been incorporated into WoodSolutions Technical Design Guide 56 *Resilient Timber Homes*, because they have a generic nature and may be interesting for its broader audience.

But those learnings which are **relevant to the Australian timber industry's success, and its resilience** with respect to the pressure from its competitors and a volatile global business environment, are only described within this report. Briefly, they are:

Experience	Activity	Relevance to the Australian timber industry
FORTIFIED (USA)	Insurance-backed support tools for cyclone resistance (research, testing, design, training and quality marking).	A similar tool will fulfill a market demand for quality and de-risking. And it will be more credible than the <a href="https://rbccouncil.org/resilience-ratings/">https://rbccouncil.org/resilience-ratings/</a> .
HABITAT STRONG (USA)	Promotion of better construction practices, support to disadvantaged communities.	May be useful for remote communities, i.e. with the support of an insurance company.
MBAR (CAN)	Support to pilot projects and best practices.	Can be a good model of a proactive interaction with local Governments, for a program of activities and legislative initiatives.
FII (CAN)	Funds selected forestry-related initiatives, within R&D, evolution of the building codes, marketing, etc.	More flexible than the AFWI and the current voluntary matching schemes.
MTDP (CAN)	Funding for incremental costs in the design and construction of mass timber buildings that demonstrate emerging or new processes.	Good model for a specific program (doesn't need to be focused only on mass timber).
AUREUS EARTH (USA)	Finances mass timber construction by issuing carbon offsets to building owners, through Carbon Asset-Backed Securities (CABS).	Smart idea, and the right to issue and market CABS should belong to the supply chain, or their representative organization.
AQC (FRA)	Applying lessons learned from insurance claims to improve the quality of construction, the product certification and the Codes.	Very effective and efficient way to collaborate with regulators, insurers, and industrial organisations towards common goals.
WOODRISE ALLIANCE (International)	An efficient network of 26 organisations from 15 Countries, to support common projects, share knowledge and results.	Would help our industry to collaborate towards the bigger picture, build better local skills, and attract investments.
ECOSCALE (FRA)	Assessment of the circularity level of the construction products, through 4 indicators.	As leading construction players strengthen the eco-design of their products, an early adoption of a similar tool would provide a leading edge.
BOPAS (UK)	Provides evidence that offsite construction systems will be readily mortgageable for a minimum of 60 years.	Enhances confidence and supports easier adoption of offsite construction. FWPA tried to "import it" in 2017, maybe now the time is right.
FLYING FACTORY (UK)	A mobile system for the on-site assembly of timber frame components, as a low-cost alternative to offsite prefabrication.	Having demonstrated profitable results in the UK, this is an additional pathway for our industry to be competitive in some projects.

The information collected through this project, and the opportunities to collaborate also with the organisations that have these experiences, will contribute to enabling the Australian forest and wood products industry to grow in value because of an increased demand for its innovative, sustainable, and competitive products and services.

The documents referenced as [x] throughout the text are all available from the Gottstein Trust and/or FWPA as PDF files, while other documents or information sources are referenced as embedded links, which were active at the time of filing the report.

## Project scope and activities

Synergic with the author's role in managing FWPA's Resilient Timber Homes program, but as a separate activity with its own contents and deliverables, this project was finalised to the following **scope**:

Understanding what approaches, experiences and case studies of resilient timber construction (or tools to offset any additional design and construction costs associated with a 'Code+' timber-based option) are available in countries where the risk factors, the socio-economic framework and the evolution of the timber industry are comparable with Australia.

After some initial exploration of what was available, and who was willing to collaborate and provide information, the project was focused on the following **activities**:

- Meeting some relevant people (regulators, designers, builders, developers, researchers) that have made significant experiences in this space.
- Visiting their premises and projects, to see and learn about their methods, limitations, and results.
- Informing them about our initiatives and discussing potential collaborations.
- Reporting to the Australian industry about the project's results, and additional opportunities for wood products within resilient building systems, through this report, webinar and other forms of communication as suggested by the Gottstein Trust.

It soon appeared that the best possible outcomes, within the project's timeframe and budget, would be achieved by meeting some key people at the main industry conferences, and then build up on those meeting and the further contacts that they generate. Therefore, travels were organised to attend the following:

- International Mass Timber Conference in Portland (USA, March 2023)
- World Conference on Timber Engineering in Oslo (Norway, June 2023)
- WoodRise Conference in Bordeaux (France, October 2023).

## Background

Over the past few years, the interest and determination of improving the resilience of communities and their built environment in areas subject to natural hazard has increased, both in Australia and overseas, as the effects of bushfires, floods, storms, and other extreme-weather events are becoming increasingly critical. The Insurance Council of Australia reports [1] that Australians are five times more likely to be displaced by a natural disaster than someone living in Europe, while the associated costs are significantly growing. And floods are by far the most critical factor [2].

The Federal Government has invested in this area establishing Natural Hazards Research Australia - a national centre for natural hazard resilience and disaster risk reduction, which is now up and running and currently actively seeking out partners.

A range of other agencies also other agencies also are focussed in this area including: The National Recovery and Resilience Agency, the Australian Institute of Disaster Resilience, and Australasian Fire & Emergency Services Authorities Council.

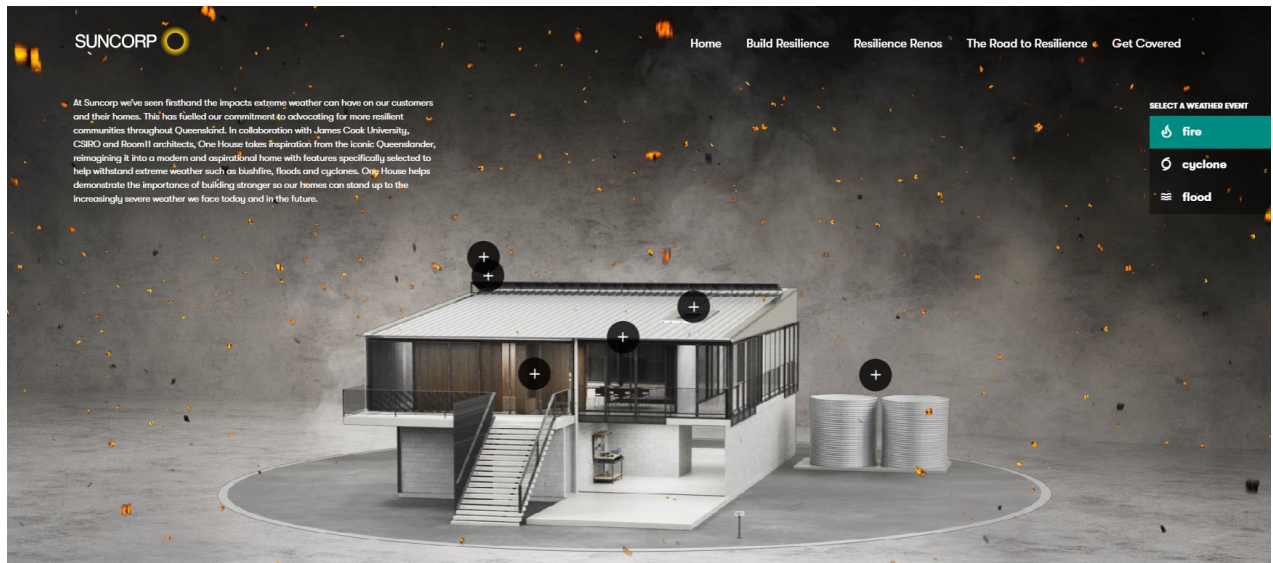
The insurance sector has started to invest in highly visible initiatives for the improvement of the resiliency of homes, such as:

- Suncorp Insurance's *Road to Resilience* and *One House* initiatives (<https://onehouse.suncorp.com.au/>) which refer only to non-combustible building materials.
- NRMA Insurance's *FORTIS* initiative (<https://fortishouse.org/>) in conjunction with Shoalhaven City Council and the Resilient Building Council of Australia (<https://rbccouncil.org/>), which is formally a not-for-profit and independent body, funded by the Australian Government and the NSW Government, . The building structure they recommend has only a steel framing option with no timber framing alternative, which is believed to be due to the overt influence of the steel industry.

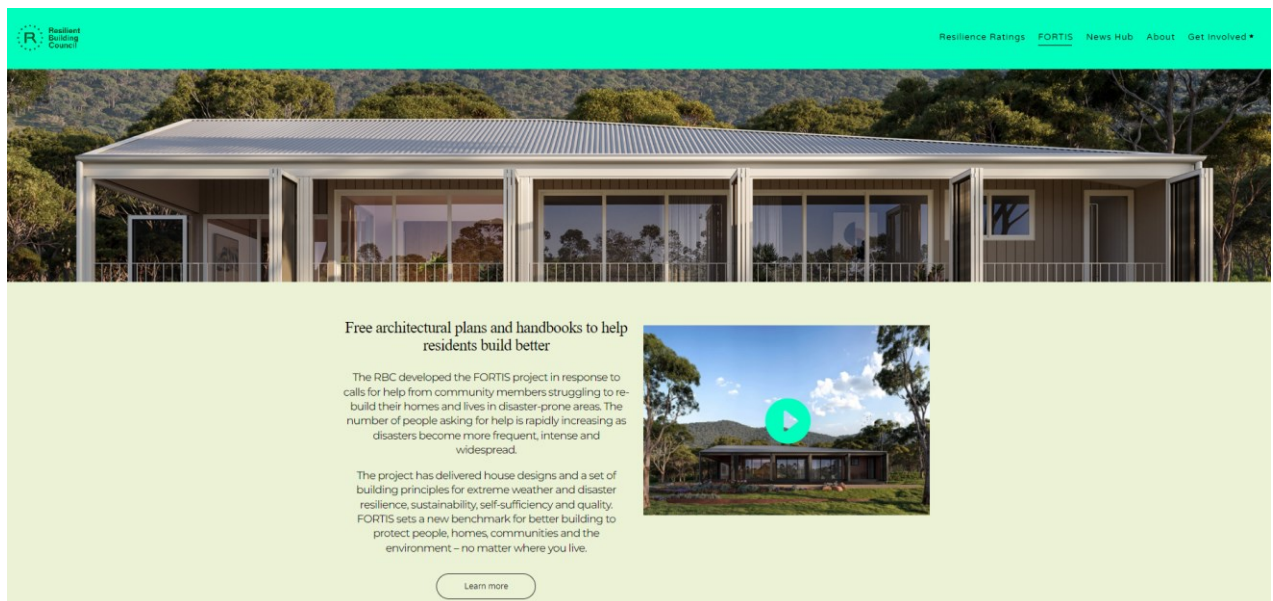
These and other current initiatives overemphasise the non-combustibility of the structural elements and the cladding, as a way to protect the whole building from ember ingress. But existing codes and standards already provide sufficient protection against embers, as summarised in WoodSolutions TDG 4 *Building with Timber in Bushfire-prone Areas. NCC Compliant Design and Construction Guide*, as well as in Australian Standard AS 3959 *Construction of Buildings in Bushfire Prone Areas*. There is at least one outstanding evidence of a house compliant with AS 3959 that has survived a bushfire that destroyed or severely damaged 18 surrounding homes, including some built with non-combustible materials.

While the bushfire "fake news" described above are just the most outstanding example of how the competitors of the timber homes industry create and leverage to their benefit wrong mindsets and bias, the problem still exists, and is bigger than that. Timber structures are combustible and hygroscopic, and as far as untreated timber is considered, the lower the density, the higher the moisture take-up when frames, claddings and furniture are exposed to liquid water, like in a flood. But there are also some possible solutions, which need to be turned into cost-effective products, to be recognised by standards and codes.





*Suncorp Insurance’s One House initiative is backed by a significant set of tests and a very accurate and pervasive media campaign, suggesting the resiliency features are at the core of their marketing strategy.*



*NRMA Insurance’s FORTIS initiative was developed in conjunction with Shoalhaven City Council and is now also proposed through the Resilient Building Council of Australia (which should be an independent and material-agnostic organisation) as “the” solution.*



*The Rosedale Beach House was designed by Thomas Caddaye Architects to be compliant with AS 3959 Flaming Zone requirements. When a bushfire destroyed or severely damaged 18 nearby homes, this one resisted, with very minor repairs (some window gaskets, an outside plastic light over the door and the external PVC plumbing pipes). There was no hint of smoke indoors. Construction costs (in 2017) increased by about 20-25%, but it was still an affordable house, and looking at the result it seems worth it.*

Inappropriate urban planning and climate change are putting an increased proportion of Australian homes at risk from natural disasters. This is causing many properties to become uninsurable, and additional planning problems.

Recently, the Climate Council issued a report [3] that pointed out how much insurance is becoming increasingly unaffordable, or even unavailable, in large parts of Australia, due to worsening extreme weather. According to the report, riverine flooding poses the biggest risk to properties. Of the properties classified as 'high risk' by 2030, 80% of that risk is due to riverine flooding. Bushfires and surface water flooding (sometimes called flash flooding) are the other major worsening hazards causing properties to become uninsurable by 2030. The affordability of insurance is particularly relevant for financially vulnerable people and increasing premiums will exacerbate existing inequities. Insurance companies may also decide that offering policies in some high-risk areas is not viable, withdrawing the option of taking out insurance entirely. For high-risk properties, banks may reduce access to credit, and credit risk for existing loans may rise, leading to declining property values.

In some severe instances, areas may even become uninhabitable, as banks [4] no longer consider high-risk properties sensible for lending. The Financial Stability Board (FSB), an organisation led by the G20 Finance Ministers and Central Bank Governors, created a Taskforce on Climate-related Financial Disclosure (TCFD) to develop recommendations on the types of information that companies should disclose to support investors, lenders, and insurance underwriters in appropriately assessing and pricing a specific set of risks, related to climate change. The TCFD 2021 report provided an increased market understanding of climate risk and demand for services to help identify and manage that risk. Consistently with it, the Australian Prudential Regulation Authority and Australian Securities and Investment Commission have stated that climate-related physical and economic transition risks are foreseeable and material financial risks that should be addressed by company directors alongside all other financial risks.

Mainstream investors are divesting from stock in exposed industries, credit rating companies are reassessing credit ratings to factor in climate-related risks, and several banks have commissioned analysis of their mortgage books based on location. The Investor Group on Climate Change, in its 2018 report [5], already predicted that the ability to differentiate investment opportunities by climate risks will be a key financial metric within the coming years.

Additionally, some risk factors like extreme heat waves (which cause more deaths than other hazards combined), droughts, raising sea levels, tsunamis etc., are all adding to the equation. And they seem to be clearly correlated with the climate change trend.

All these evidence and initiatives, combined with the growing pressure for reducing the carbon footprint of buildings, provide compelling reasons for Australia's real estate industry to take immediate action and contribute to the reduction of disaster risks by means of resilient timber homes, positioning themselves as providers of safety, wellness and future-proof sustainable value to their clients, and the broader community.



The 10 biggest insurance catastrophes in Australia since 1967, normalised to present values [6]. The 'normalising' process considers current property numbers and values and assigns to past insurance catastrophes the estimated costs.



On average, extreme temperatures contribute to the deaths of more than 1,000 people aged over 65 across Australia each year (from: [Heatwaves](#)). Better thermal insulation of buildings would help prevent that.

Based on the evidence that Australia is at growing risk from a range of natural disasters which, if unmanaged, will increasingly impact our life, the Australian Building Codes Board (ABCB), already pointed out that the National Construction Code (NCC) should be reviewed to ensure greater resilience to extreme weather is incorporated into building design and construction. The ABCB held a Climate Change Adaptation roundtable in 2013, and then a stakeholder consultation in 2014 [7], to assist develop a strategy for improving the resilience of buildings and plumbing systems in the face of extreme weather events and a changing climate.

The outcomes, which were updated in 2021 [8], have not been enacted by the ABCB yet, but have informed many subsequent Policy Recommendations, including the most recent from the ICA [6]: "The increased severity and frequency of extreme weather events requires more resilient and durable homes. To enable this, **the principle of resilience must be embedded in the National Construction Code**, taking account for current and future extreme weather events and projections."

Consistently with that recommendation, the ICA has proposed a **definition for building resilience** that shall be included in the NCC to provide a threshold test for the review of the relevant provisions and standards:

*“Climate Resilience of Buildings is the ability of a building, structure and its component parts to minimise loss of functionality and recovery time without being damaged to an extent that is disproportionate to the intensity of a number of current and scientifically predicted future extreme climatic conditions (i.e., wildfires/bushfires, storms, hurricanes/cyclones, flooding, and heat).”*

The ICA is also suggesting that the NCC should provide an explanatory statement and updated handbook for durability, adjacent to the definition for building resilience, based on the following definitions:

*“Durability...the capability of a building or its parts to perform a function over a specified period of time.”*

*“Design life is regarded as the period for which a building, a building element or sub-system is expected to fulfill its intended function.”*

To support that recommendation, the ICA published an independent, detailed economic analysis [9] which found that:

- costs directly related to residential buildings (repairing or replacing homes and their contents and disruption-related costs where dwellings become uninhabitable for an extended period) have increased significantly over the past 10-15 years, and **currently range in the order of \$4 billion per year** (see their breakdown in the table below).
- this trend is likely to continue due to climate change and new residential development in hazard prone areas.
- costs relating to long-term displacement (i.e. mental health impacts, loss of housing services and employment impacts) make up a significant share of the total costs (~20-40 per cent depending on the type of event). This also excludes potential disruptions to schooling.
- **avoiding the costs associated with long-term displacement is a key focus of improving resilience of residential buildings, although more resilient homes would also reduce building-related costs.**

	Bushfire	Cyclone	Flood	Total
	\$ million	\$ million	\$ million	\$ million
Insured losses <sup>a</sup>	247.58	584.04	794.56	1 626.17
Uninsured losses	61.90	146.01	198.64	406.54
Under-insured losses	60.11	431.29	190.03	681.42
Mental health impacts	80.47	577.12	200.31	857.91
Loss of housing service	23.07	165.47	57.43	245.98
Employment impacts	13.71	98.31	34.12	146.13
<b>Total</b>	<b>486.84</b>	<b>2 002.24</b>	<b>1 475.09</b>	<b>3 964.16</b>

<sup>a</sup> Averaged over the past 10 years, based on the ICA Historical Catastrophe list inflated to 2022 dollars using the National Consumer Price Index (CPI) published by the Australian Bureau of Statistics. <sup>b</sup> Based on catastrophe modelling for the Northern Australia Insurance Taskforce (as losses over a decade are unlikely to be an accurate indicator of risk).

Source: CIE estimates based on various sources. Further details on the approach to estimated costs are provided below.

Other costs that have not been quantified by the ICA’s economic analysis, but will be relevant to policy makers or investors, include:

- disruptions to schooling, where the location of temporary accommodation is not close the previous school,
- long-term displacement can delay community recovery, and
- carbon emissions associated with damaged and destroyed buildings and the emissions associated with repair and/or rebuild.

Clearly, Australia is moving slowly but steadily to tackle the resilience-related issues of construction: a NCC change may take several years but is likely to have a more significant impact than non-mandatory initiatives. And we are doing it with reference to the insurers’ approach to de-risking, which is not necessarily aligned with the priorities of the builders and their suppliers.

But luckily, **the performance-based definitions suggested by the ICA would suit the timber industry** much better than anything referring, i.e., to “non-combustibility” or “non-hygroscopicity”. That’s an additional reason why it is so interesting for our sector to proactively collaborate with the ICA, possibly through nation-wide representative associations like FWPA, AFPA and/or similar, and in synergy with other associations that although they are material-agnostic, have an interest to support the correct use of timber (i.e. Master Builders Australia, the Housing Industry Association, and the like).



## Industry needs and value

As mentioned above, the competitors of the timber industry are already significantly active in this field, working to influence attitudes and create mindsets, and promoting their product attributes to grow their market share. As often happens, the forest and wood products sector find itself simply responding to new market threats as they arise. This is not an Australian-specific approach, although other countries have a more proactive attitude towards reacting collaboratively and quickly.

Some urgent action is needed to counter these competitors' activities and to positively promote the benefits of resilient timber construction over the major three natural hazard areas, with a priority for detached houses (designed to AS 1684), which still are the largest market for our industry, although a significant growth in mid-rise construction is also taking place.

To combine a timely response with a durable outcome, the author assisted FWPA to manage a comprehensive Resilient Timber Homes (RTH) program, consistently with FWPA's Strategic Plan's Objectives, based on a two-phase approach:

- Phase 1 (1 July 2022 – 29 February 2024) to provide 3 readily achievable deliverables, and define the scoping for
- Phase 2, which is still to be defined in detail and will be aimed at achieving a measurable increase in demand for wood-based products and services.

To achieve its objectives, Phase 1 of the RTH program had to provide the following Deliverables:

- D1.1 – A *Resilient Timber Homes* Technical Design Guide, which is published [10]
- D1.2 – A specific design competition, which has also been completed (<https://resilienttimberdesign.com.au/>)
- D1.3 – The definition of Phase 2 RD&E activities, supported by a Technology Readiness Assessment and a Cost Benefit Analysis of selected ideas for RD&E projects, and indication of additional potential Partners (currently underway).

Within FWPA's broader RTH program, this Gottstein Fellowship project about "Overseas experiences in resilient timber construction" is an additional resource to D1.1 (Design Guide) and D1.3 (TRA & CBA of ideas for future RD&E projects) and will hopefully contribute to informing some of the further strategies and initiatives of our sector.

To estimate the **needs** of the Australian timber industry **from the perspective of its clients** (i.e. the developers and builders, as requested by the insurers and regulators), and therefore the **potential value** for our sector's stakeholders to align their strategy with their clients' objectives, we can refer to some of the key findings of the ICA's economic analysis [8], as follows.

### Cyclones

The costs associated with lack of resilience of residential buildings to tropical cyclones are currently estimated to be in the order of \$2.0 billion per year and could increase to around \$4.4 billion per year by 2050 under different emissions scenarios.

Water ingress, including through wind-driven rain, is a key driver of damage and common for homes with zero or minimal envelope damage. The main issue appears to be in circumstances where there is both rain and high wind, the pressure leads to water ingress via seals or pan lengths for windows, vents, doors, flashings and valley gutters.

Some potential options to address internal pressure in Wind Region B were also considered, and the main strategies to address this issue are: 1) keep the building sealed, with heavier doors/roller doors/door frames, and stronger glazing/window shutters; 2) designing for internal pressure (e.g. strengthening the roof connections etc.) to minimise damage if an opening does occur.

### Floods

Floods impose significant costs on the community, in the order of \$1.5 billion per year, and a significant share of these costs is related to the lack of resilience of residential buildings.

Floor elevation (1-meter elevation of ground slab above the defined flood level) provides better results than the 3 non-structural options considered in the study (alternatively: Polished concrete as habitable floor covering; Single skin wall systems; Installation of separate circuits to each level and elevation of power points) due to relatively cheaper cost and higher effectiveness. Anyway, the results are highly dependent on the frequency and intensity of flood events, within the 3 scenarios which were analysed.

Flood risk mitigation requires a combination of effective land use planning regimes and robust building standards. Land use planning plays a vital role in minimising risk exposure by addressing flood hazards at their root. However, there are instances where existing land use planning frameworks fail to adequately address the natural hazard risks. This inadequacy underscores the significance of risk-resilient building standards in mitigating costs associated with extreme weather events.

### Bushfires

The costs from bushfires are currently around \$487 million per year on average and are expected to increase significantly to around \$2.8 billion per year by 2050 under different emissions scenarios.

Several weaknesses have been identified in the current code arrangements, including the following:

- Buildings that have been built to bushfire construction standards may not be resilient because the current deemed-to-satisfy building standard does not, or cannot, address all factors contributing to property loss, such as: house-to-house ignition, maintenance, compliance, landscaping and storage of combustible materials.
- Although ember attack is the main source of ignition for houses lost to bushfires, there is no requirement for houses more than 100 metres from vegetation to include any bushfire protection measures, even if on bushfire prone land.

Some building-related measures to improve bushfire protection are relatively costly (including: non-combustible wall cladding; non-combustible fascias, barges and eaves; fire-resistant glazing; and raised and fully enclosed subfloors). However, some of these measures are more relevant to radiant heat protection.

The cost of several measures (or combinations of measures) that provide additional protection from ember attack is relatively low and likely to be within the 'budget' implied by the estimated benefits. However, the outcome of a full cost-benefit analysis would depend on the effectiveness of these measures in protecting dwellings from ember attack, which is currently not known.

Other measures are suggested in the ICA report to reduce fire risk, some of which may be relatively cost effective:

- separation distances between buildings (the NCC already states that a building should not pose a fire risk to another building)
- non-combustible fencing (although this is currently contrary to the interest of the timber industry)
- the materials used and location of retaining walls proximal to buildings
- fire-resistant water tanks
- storage of combustible materials (including firewood and gas cylinders).

As these options may be complementary to or a substitute for building-related measures, a comprehensive future Code revision could consider:

- how these approaches could be integrated into the NCC's regulatory approach (including how relatively expensive construction-related measures could be traded off against potentially cheaper and more effective alternatives); or
- these type of approaches (which could be applied through land use planning regulation) as alternative options to strengthening building-related measures.

Furthermore, there is significant cross-over between cyclone and bushfire resilience measures, therefore taking it into account would provide even more favourable outcomes from a cost-benefit analysis perspective.

## Summing up

The perception of most investors and real estate developers has evolved, and now they look at Engineered Wood Products (even a simple stud, when it's graded and used within a designed frame) not just as a cheap and easy way to build, but also as sustainable materials that allow to meet their decarbonisation targets. However, these products, and the buildings where they are used, must be resilient and durable in both practice and perception.

Insurers, but also the different levels of Government and their agencies that manage the post-disaster recovery, realise that the costs directly related to repairing or replacing homes and their contents after natural catastrophes have increased significantly over the past 10-15 years, and that indirect cost are even much bigger than the direct ones. Therefore, improving the resilience of new and existing homes would contribute to significantly reduce these costs and allow for better market growth opportunities.

Other Countries, where similar needs are present, seem to have addressed the problems from a wholistic point of view, with reference to their specific sets of conditions, and apparently with some interesting results. Understanding what these experiences are, and how they may be transferable to Australia, has been very useful.

The Australian timber industry is in general terms quite competitive when it harmonises the "local" approach, and its many advantages, with some openness to networking and collaboration. Working with several wood industry stakeholders for the last 7 years, the author feels that they are in general terms more risk-adverse than they should, compared to their European colleagues, or even to the local developers and builders (which experience stronger competition). Therefore, creating clear opportunities for innovation and commercialisation of new and existing knowledge, like the challenges to become the champions of resilient construction are suggesting doing, will thaw some of their potential, which is there already, but still a bit unexploited.

## Overseas experiences

There are many interesting experiences, and because “resilience” is a broad concept which is used in an extensive way as an attractive keyword that summarised very different objectives, they refer to a wide range of targets. The following sections provide a summary of the most relevant overseas experiences covered within this project.

Each paragraph also has some links and/or reference to external documents (available through The Gottstein Trust and/or FWPA) for further information, it provides a short comment on possible critical issues, and suggests how that experience may be transferable to Australia, with some comments on its relevance to the local timber industry’s success and resilience with respect to the pressure from its competitors and a volatile global business environment.

### Fortified program

The FORTIFIED construction methods and tools are part of a program developed by the Insurance Institute for Business & Home Safety (IBHS) in the USA. It is a voluntary construction standard backed by decades of research, that a roofing contractor or builder can use to help protect existing and new homes against severe weather. FORTIFIED is therefore a “Code+” construction and re-roofing program, and a commercial brand, designed to strengthen homes and commercial buildings against severe weather such as high winds, hail, hurricanes, and even tornadoes, based on 3 key components:

- Free access to the resilient construction standard, which is based on decades of scientific research by the IBHS.
- A network of contractors trained to provide the right upgrades to protect a home from the type of severe weather events it faces each year.
- Third-party verification that the upgraded construction materials and installation methods used on a home meet the standards required for a FORTIFIED designation certificate.

By conducting extensive field research, including several damage investigations of real homes after real storms, the IBHS identified common construction weaknesses and tests solutions in the only research centre in the world capable of subjecting full-scale houses to realistic storm conditions, including wind-driven rain, hail up to 2 inches in diameter and winds up to 130 mph. All data are georeferenced and focus on details such as terrain exposure, elevation and roof structures, finishes, openings, opening protection, attached structures, and damage to these building systems.



*Tests of FORTIFIED Homes at the IBHS Research Center, a unique facility that enables to evaluate residential and commercial construction materials and systems fully and accurately, under realistic re-creations of severe weather hazards.*

A major finding from their post-disaster investigations and research is that stronger building codes significantly improve the performance of houses during a hurricane. Several states, including Alabama, Georgia, Mississippi, and North Carolina, have recognized the benefits of this program by providing for insurance and other financial incentives (such as tax credits) that can reduce home ownership costs and/or retrofitting expenses. To provide a user-friendly experience, [their website](#) offers plenty of clear, plainly written information, videos and even a short self-assessment quiz.

Interestingly, the Cyclone Testing Station at James Cook University in Darwin (NT) has already collaborated with the IBHS for some [roof tile tests](#), and their facility can be accessed again, i.e. for full-scale test of Australian Resilient Timber Homes.

Their experience is certainly transferable to Australia, preferably with the support of the Insurance Council of Australia, because some of their members are large insurance companies which are also members of the IHBS in the USA. A program and toolset like FORTIFIED, that will provide the evidence of a better overall safety through improved knowledge and quality of construction, has the potential to fulfill a strong demand from our residential construction market.



In particular, the FORTIFIED **third-party verification approach** may work well also for bushfires and floods, thus creating a tangible evidence that design and construction is compliant with the specifications, in a way which would be more objective and credible than the <https://rbccouncil.org/resilience-ratings/> currently backed by the steel industry. If combined with a CodeMark (which is supported by the Australian Building Codes Board), and/or operated through a reliable certification body, it is logical to expect that a **“Resilient Timber Homes” quality mark** will provide significant benefits for our industry, and a **full-scale test** would be very effective for both a Code change request, and a stronger collaboration with insurers, developers, and local Governments.



*Not described in this report, because it’s already being considered within FWPA’s Resilient Timber Homes program for a possible R&D project starting soon, is the development of a “flood-ability” test method like the ASTM E3075-16, “Standard Test Method for Water Immersion and Drying for Evaluation of Flood Damage Resistance” illustrated here, which is applicable to every construction material and assembly, not just wood-based ones. The US Department of Homeland Security - Federal Insurance and Mitigation Administration (FEMA) have already developed some requirements, which can be used as a reference for Australia-specific ones. Maybe a first step towards a Resilient Timber Homes quality mark?*

## Habitat Strong

Habitat for Humanity has a [Habitat Strong](#) program, designed to promote the building of homes that are more durable, resilient, and physically strong. Habitat Strong’s “fortified codes-plus building practices” can strengthen homes’ building envelopes which enable them to better withstand natural disasters in every region of the country. This program was developed with the collaboration of the IBHS (see above) and specifically to develop affordable and volunteer-friendly designs, while offering benefits to partner families that will last for years to come. Their response to disasters and mitigation is articulated, as it:

- Focuses on housing needs resulting from natural disasters and rebuilding techniques.
- Uses a systematic approach to help mitigate against future natural disasters and build back stronger, using proven methods that are volunteer-friendly and affordable.
- Offers resources, technical assistance, and training in ways to improve the resilience and durability of homes.
- Provides support and information to communities prone to natural disasters to help protect them against future events.

Their experience is transferable to Australia, for instance in remote locations and communities and through the existing agencies (i.e. <https://secure.nt.gov.au/recover-from-an-emergency>), or even better with the support of an insurance company. As an example, at the time of writing an Australian startup is developing “Earth Pods” prototypes [11] in collaboration with Elders Insurance. And Habitat for Humanity is already partnering with OneFortyOne in NZ ([HfH/OFO](#)).



Six Habitat for Humanity houses came through Hurricane Michael essentially unscathed (from: [JLC](#) and [Strongtie](#)).



## Mobilizing Building Adaptation and Resilience (MBAR)

BC Housing is a Canadian agency that develops, manages, and administers a wide range of subsidized housing options across the province of British Columbia. They license residential builders, administer owner builder authorizations, and carry out research and education that benefits the residential construction industry, consumers, and the affordable housing sector.

Their Mobilizing Building Adaptation and Resilience (MBAR) program is a multi-year, multi-stakeholder building project with participation and contribution from over 30 organizations, including national, provincial, and local agencies; and industry partners. It revolves around pilot projects, which get access to resources and expertise about renovations and building design to help buildings remain comfortable, safe, and resilient even with heavier rainfall, hotter summers, wildfires, flooding, and windstorms.

Of some relevance to the scope of this report, are MBAR's:

- Successful initiatives to support changes to planning rules, in favour of timber structures.
- Support to selected Pilot Projects with some free consultation offered through a pool of consultants that was organised via an Expression Of Interest, and regularly meets to discuss and update the others.
- Well-written Design Discussion Primers on several topics.

For further information: <https://www.bchousing.org/MBAR>

Their experience may be transferable to Australia by collaborating with local Governments through a proactive approach and the appropriate organisations, like the AFPA plus the local State agencies (i.e. for VIC: <https://www.development.vic.gov.au/> and <https://www.housing.vic.gov.au/>), that can propose and support a suitable program of activities and legislative initiatives.

For an example of what they have done, and how, see for instance the by-law [12] which allowed them to obtain a different floor depth (of up to 18 cm per floor) when timber construction is used. A very similar approach was tried in Melbourne during the Mid-rise Advisory Program, but it wasn't accepted, and a case-by-case basis of optimised design was used instead.

The [QLD Resilient Homes Fund](#) is already active and may evolve into something similar (according to talks with their Director), while similar schemes are being organised by NSW and VIC. Not easy to influence that level of Government, but worth trying if our sector can act collaboratively.

## Forestry Innovation Investment (FII)

As a Crown agency of the Government of British Columbia (BC), FII is focused on expanding opportunities for BC's forest products and ensuring their forest sector continues to grow and prosper in a resilient way, by:

- Promoting wood's environmental merits as a preferred, sustainable, renewable building material.
- Expanding global markets by creating more opportunities in existing and new markets—especially in high-potential Asian countries like China, Japan, South Korea, India, and Vietnam.
- Showcasing BC's leadership in innovative wood use and manufacturing to advance the use of wood at home and abroad.
- Collaborating with government and industry partners to maximize our effectiveness in supporting the growth of the mass timber and engineered wood products sector in BC.

Amongst other initiatives, FII supported Renewable Cities' guide [Building Capacity: Local Prefab Mass Timber Solutions](#), which encourages local governments to develop policies and regulations that facilitate mid-rise mass timber construction. It also provides paths for senior levels of government and the building sector to contribute to successful mass timber projects and help scale this building form. The guide is primarily directed toward local government and the development sector:

- Local Governments: Gain a deeper understanding of how prefab mid-rise mass timber buildings lead to substantial economic gains, lower greenhouse gas emissions and thriving communities. Explore strategies related to land use, design guidelines and building permit processes to accelerate the transition.
- Development Industry: Learn industry solutions and how to support local governments in tuning policy to be more "prefab mass timber friendly."
- Senior Government: Learn how provincial and federal policies affect construction standards for municipalities and developers working on mass timber projects and ways to advance innovation in this space.

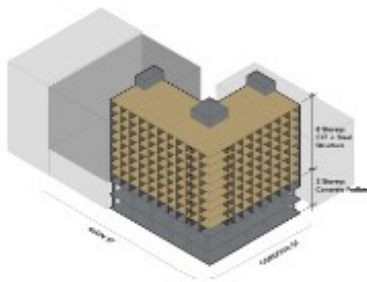
The experiences of FII may be transferable to Australia through an industry representative Organization, or the newly established Australian Forest and Wood Innovations (AFWI). The FII are open to a collaboration if it's also consistent with their mission to promote their timber industry.

## Mass Timber Demonstration Program (MTDP)

The Mass Timber Demonstration Program (MTDP) in British Columbia provides funding for incremental costs (as those typically associated with a resilient, 'Code+' approach) in the design and construction of buildings that demonstrate emerging or new mass timber or mass timber hybrid building systems and construction processes. The MTDP helps expand the use of mass timber in British Columbia and supports economic recovery and increased employment in the design, engineering, construction, and product manufacturing sectors. Additionally, the program will share any lessons learned, results, and research findings to help support future mass timber projects in the province. Further info: <https://www.masstimmerbc.ca/>

So far, the MTDP funded 20 development projects across British Columbia in three separate intakes. See below a few.

Their experience is indeed transferable to Australia, for instance as part of the activities that the Australian Forest and Wood Innovations (AFWI) and/or the Advance Timber Hub are undertaking, or even better within a specific program at an industry representative Organization (which doesn't need to be focused only on mass timber).



**Happy Harvest Inc. — Main & Cordova (\$475,000):** This 11-storey multi-family residential building will demonstrate the use of mass timber-steel hybrid for affordable rental buildings. The proposed design includes 120 affordable homes as well as a learning space and community theatre. See [Project Profile](#)

**P. Rock Ltd. — Monad Granville (\$500,000):** Located in downtown Vancouver, this nine-storey mixed-use retail and multi-family residential building will be the first of its kind to demonstrate the use of mass timber and advanced prefabrication techniques and scalable industrialized solutions to address climate change and housing affordability. See [Project Profile](#)



**Westbank — Prototype (\$500,000):** This 21-storey rental building will demonstrate mass timber-steel-concrete use in a tall building. The project will demonstrate cost-effective design solutions using materials for their highest value. Learning from the project will be shared as open source. The developers are aiming for the City of Vancouver's Zero Emissions Building Plan standard. See [Project Profile](#)

**\*NEW\* More Than A Roof Society — Vienna House (\$500,000):** With additional support from the National Housing Strategy Demonstration initiative, this seven-storey multi-family development in the heart of East Vancouver aims to establish best practices for affordable and sustainable housing. The building will feature mass timber and light-frame hybrid construction, making it efficient and replicable for new developments across B.C. See [Project Profile](#)



A glimpse from a few of the projects funded by the MTDP, see the whole list [here](#).

## Aureus Earth

Aureus Earth is a first-of-its-kind organization issuing carbon offsets to building owners who choose to use carbon-storing materials, such as wood. Their claim is to “*move beyond the carbon offset, to the carbon asset*”, by transforming biogenic carbon stored in mass timber construction into a real, transferable, and depreciable asset, as they believe that real-estate-backed, climate-positive financial instruments will become “*the next mineral rights*”.

Aureus Earth Carbon-Asset Backed Securities (CABS) are investments backed by carbon storage and reduction in construction projects, the associated real property created by Aureus Earth, and the associated carbon-based revenue. Aureus Earth provides equity funding for new construction based on the amount of carbon stored and reduced by the project.

Using its “vetted and accepted protocols”, Aureus Earth quantifies the amount of carbon stored and reduced in a mass timber project. Aureus Earth then works with developers to define carbon-based revenue streams for qualifying projects. Revenue is projected for 30 years, providing the basis for valuing the carbon impact. Aureus Earth and its capital partners invest in projects according to the carbon impact on a tonne basis, with payback based on future carbon revenue. Aureus Earth’s capital partners receive a return based on every tonne of CO<sub>2</sub> stored and reduced in qualifying projects.

Although it’s still a startup, apparently, Aureus Earth have already attracted a significant level of interest and collaboration from major stakeholders, because their approach looks very promising. As advertised on their website, the author requested their *Mass Timber Building Protocol v2.0* which, in their words “*provides a detailed presentation of the procedure to quantify the biogenic carbon stored and the carbon emissions avoided in new mass timber construction projects*”. Their CEO answered saying it’s not a public document, and adding also that they are “*working with some developers in Australia*”.

For further information: <https://aureusearth.com/>

The Aureus Earth experience is certainly transferable to Australia. Some of the growers are already selling Australian Carbon Credit Units (ACCUs) to the Australian Government or other business to generate additional revenue, since carbon farming (practices that increase storage of carbon in our landscapes or avoid release of damaging greenhouse gases) include “Planting trees to grow carbon stocks” as a method approved within the Australian Carbon Credit Unit Scheme. But in my view, **also the right to issue and market Carbon-Asset Backed Securities should belong to the supply chain** (or to their representative, independent body), not to a financial intermediary. It’s all about being organised to benefit from it, instead of adding an overhead cost like for the forest certification, for instance with the support of an investment fund, and/or the Clean Energy Finance Corporation that is already active in this space. The “highest and best use” of ACCUs or other similar derivatives would probably be to **sell them directly to the real estate developers, or even lease them** and become their co-developer, especially now that they are increasingly moving into the Built-To-Rent model. I believe large developers and REITs would already be willing to discuss collaborations in this area.

The <https://carbonmarketinstitute.org/> as an independent, member-based institute [13] and/or the <https://www.isfc.world/> may be good forums where high-level collaborations aiming at this result can be triggered and supported.

For a similar initiative, one key issue need to be addressed, though, in order to prove to a material-agnostic investor that Engineered Wood Products (EWPs) can store carbon after being disassembled from the building where they are currently installed: structural wood adhesives are and have been for decades based on plastics that get brittle with time because of thermal action combined with shrinkage and swelling, and therefore assessing the structural integrity of a GLT, CLT, LVL, OSB and plywood after a few decades of use is not easy. Neither it is easy to dissolve the glues and recover good boards, veneers, etc. for re-processing into new products. This may become very critical for our sector because the steel and concrete industry have put huge resources on recycling, and although their technologies are very energy-intensive, they work. While we don’t have much, right now, apart from a first, commercially viable example, which shows that this is achievable: <https://www.mdfrecovery.co.uk/>. Therefore, starting a robust (and possibly international) R&D project that involves the adhesive producers and aims at solving these problems, is probably a very forward-looking task that may pay off soon, and pave the way to a stronger claim that carbon sequestration from EWPs is very durable, that a timber building is a resilient asset also as a “material bank” of valuable wood, and that the timber industry is able to claim back and recycle all the EWPs. Even in this case, the [AFWI](#) may support such a project.

And for the fraction of construction and demolition waste that may go to the landfill, a [study](#) already confirms that disposal of wood in landfills in Australia results in long-term storage of carbon, with only minimal conversion of carbon to gaseous end products. The suggested factor for carbon loss for wood in landfills in Australia is only 1.4%.

## Agence Qualité Construction (AQC)

The Construction Quality Agency (AQC) is an association financed by a voluntary contribution from its members collected by insurers. It brings together all professional construction organizations (53 members) around the same mission: preventing problems in buildings and improving the quality of construction, by applying lessons learned from insurance claims.

With approximately 140 staff, their activity is articulated around 4 programs:

- The **Observatory** provides knowledge of recurring pathologies in existing constructions, anticipation of serial losses, evaluation of the potential for losses linked to performance developments, identification potential pathologies which could be brought about by new construction methods or regulatory or normative developments.
- The **Product Prevention** division focuses on pathologies relating to industrial products/processes and the texts that govern their implementation. The durability of products and knowledge of implementation techniques are the main issues for evaluating insurability and therefore the development of new processes. The Product Prevention division, thanks to its publications, supports professionals in controlling the risks linked to innovation.
- The **Construction Prevention** division deals with pathologies which have their source in defects linked to execution difficulties or interfaces between stakeholders. Thus, after identifying the causes of a pathology, tools on sensitive points are developed and made available to the various stakeholders. This may concern organizational difficulties between actors or technical choices (design and implementation).
- The **Secretariat**, in close collaboration with public authorities and the building sector, provides the coordination of major multi-annual national programs to support professionals around the issues of quality and environmental performance of buildings.

Having no power of enforcement on their decisions and outputs, the AQC operates through a “moral suasion” approach based on the cross-representation with their members (typically an AQC member sits on their boards, and vice-versa), in order to provide an evolution of standards, codes, sample contracts, and other types of documents and procedures, which is consistent with their findings. Apparently, this is working quite well because it’s providing the right level of confidence where it’s most needed: amongst the risk-adverse decision makers. Their “lessons learned” document [14] based on the feedback from 10 years of mid-rise timber construction, based on visiting 1,400 buildings and meeting 3,500 of the professionals involved with a group of 74 surveyors, is an excellent example of what an organisation like the AQC is able to do: a well-harmonised mix of evidence, consensus, and advice based on common sense.

France has always had a significant activity of timber construction, and the AQC has therefore played a significant role in its evolution, which has been comparable to the one in the UK over the last 10 years and is currently progressing even better because there has not been a ban for combustible materials, although sprinklers are not still mandatory. An interesting example is the large adoption of timber structures in social housing throughout France, and for the Paris 2024 Olympic athletes’ village.

Finally, according to a [recent survey](#), even within this unstable context, the activity of the 1,888 companies operating on the timber construction market in France increased by +2% in volume and by +10.6% in value in 2022, compared to 2020, reaching an overall turnover of more than 2.1 billion Euros (\$3.35 billion). Investments made in previous years have made it possible to cope with an increase in demand from large timber projects. To continue to meet market expectations, more than a third of companies surveyed (34%) plan to invest in the next two years to increase their production. Interestingly, manufacturers are over-represented in these intentions (55%). In addition, 61% of companies also planned to recruit new employees to strengthen their teams during 2023.

The experiences of the AQC are certainly transferable in Australia, although our federal structure may require an adaptation with respect to the historically centralised French government model (which still generates many organisations whose competences and activities often overlap).

In Australia, the Building Regulators Forum (BRF) provides a mechanism for state building regulators to share intelligence about potential areas of non-compliant building products or broader industry non-compliance which may have national implications, and to develop consistent approaches to such non-compliance where relevant. The BRF does already have an interface with the Australian Building Codes Board (ABCB) which is a joint initiative of the Commonwealth and State and Territory Governments, together with the building and plumbing industries, and is responsible for the National Construction Code (NCC).

The BRF and/or ABCB may be interested to talk with the AQC leadership. They are willing to collaborate with their Australian counterparts because products and services, like construction companies, investors, and insurers, are nowadays global.



## WoodRise Alliance

The WoodRise Alliance (26 organisations from 15 different countries) is a global network whose aim is to improve and promote medium to high rise timber buildings, not just limited to mass timber components. It's significantly different from the Mass Timber Conference in Portland, which is the product of a well-oiled proprietary, commercial organisation.

Being part of the WoodRise Alliance represents a commitment for each of its members to collaborate at a global level, exchanging views and experiences on low-carbon construction and the development of urban and rural territories. There's no fees or compulsory contributions, just a Memorandum of Understanding [15] describing the general commitments, the need to dedicate time to joint activities (mostly remotely), and an annual meeting to attend.

A quick overview:

<b>Members</b>	5 in America (CAN, US, BRA), 17 in Europe, and 4 in Asia (Japan and China).
<b>Members' activity</b>	9 Universities/Training, 11 Technical/R&D (public or private), and 6 Professional associations.
<b>Key Challenges</b>	Technological improvements, economical competition, and environmental issues.
<b>Objectives</b>	<ul style="list-style-type: none"> <li>• Help the WoodRise Congress and Conferences organizers to settle ambitious international programs</li> <li>• Propose new R&amp;D issues, support projects in between members and share experts' competencies, knowledge, and results,</li> <li>• Promote general information using scientific webinars and Newsletters.</li> </ul>

The experience of the WoodRise Alliance is very valuable, and the collaboration looks quite pragmatic and effective, therefore it would be useful for Australia to join it, with the aim to collaborate towards the bigger picture, build better local skills, and attract foreign investments.

At their recent [congress](#) where I was an invited speaker at the workshop organised by the AQC about "Securing innovation in wood construction. Comparison of national contexts." (with the other delegates coming from France, Canada, Japan, Sweden, and Austria), I had the opportunity to talk about this possibility with some of the WoodRise Alliance leaders, who are indeed willing to discuss about it further with any interested Australian counterparts.



*A few clips from the WoodRise Congress 2023 (from top left): strengthening collaboration, high-level panels, engaging with students, the seismic challenge, and the 2 Australians attending (the author and Julian Anderson from Bates Smart). And a few numbers: 4 000 participants from almost 40 countries, +100 international speakers, 189 exponents.*

## Ecoscale

The Scientific and Technical Centre for Building ([CSTB](#)) is a French public company, with approximately 1,000 staff, whose objective is to imagine the buildings and cities of the future by guiding and securing sustainable construction and renovation projects, to improve the quality of life of the people who use them by anticipating the effects of climate change. To reach these goals, it brings together multidisciplinary skills and focuses on five key activities: research and expertise, assessment, certification, testing and the dissemination of knowledge. Its field of expertise covers construction products, buildings, and their integration into neighbourhoods and cities.

Now that **certification** has become a crucial criterion to establish confidence, the CSTB is a key player in this field in France, and through the European free trade agreement, it has also a significant presence as a certification and assessment body in other Countries. Through its **innovation assessments** procedures, the CSTB provide construction professionals with reliable information about the performance and durability of components for well-defined usages and installation conditions, thus favouring the emergence of innovations and their access to the market, while securing them. On behalf of the public authorities, the CSTB examines applications for Technical Appraisals, with a procedure enabling them to focus also on the most innovative techniques.

Considering that a circular economy approach is urgently needed for the overall resilience of the building sector, the CSTB recently launched [Ecoscale](#), an environmental assessment service whose object is to define in a robust and independent manner the circularity level of the construction products, equipment and materials, through 4 indicators:

Recycled and renewable material	Evaluation of the quantity of recycled and renewable materials in the product.
Dismantlability	Ability of a product to be dismantled without damage in order to facilitate its reuse or recycling.
Re-employability	Ability of a product to be used again after its first life for a use identical to that for which it was designed.
Recyclability	Ability of a product to enter a recycling channel at the end of its life in order to be effectively recycled.

At the time of writing, Ecoscale lists 338 products, of which 12 are made with wood. It's based on simple appraisal criteria and calculations [16], like similar schemes (i.e. the Green Star ratings from the GBCA), with the aim to enable readiness and objectivity for comparisons. The evaluation of these indicators follows several years of R&D and is underpinned by the analysis of 17 criteria covering the different dimensions of circularity.

New environmental and regulatory challenges, as well as shortages of raw materials, higher production costs associated with rising energy and supply difficulties, are leading construction players to review their economic and industrial models and to strengthen the eco-design of their products, materials and equipment. That's why tools like Ecoscale are so valuable, and an early adoption, although it will require an investment, typically gives a leading edge.

One interesting example: our sector was caught by surprise a few years ago when the University of Melbourne presented the [EPiC database](#) where the data relative to wood-based products were significantly wrong, to our disadvantage, and the state of the art represented by FWPA's Environmental Product Declarations had been totally ignored. At least three years later, we are still struggling to fully overcome the effects of the early adoption of that tool by several key players in our market, and although it's finally happening, it has taken a much bigger effort than necessary.

## Buildoffsite Property Assurance Scheme (BOPAS)

While many recognise that offsite construction could be one of the most effective construction methodologies for sustainable development and may help solve systemic industry challenges such as fragmentation, skills shortages, and inefficiency associated with many methods of on-site construction, there still are significant barriers to its widespread adoption. One of the tools that has proven to be effective in lowering these barriers is the BOPAS in the UK.

Based on the well-known difficulty of assuring adequate finance and insurance for offsite construction, the BOPAS provides evidence to Lenders, Developers, Contractors, Housing Associations and Homeowners that construction systems designed, manufactured and installed by accredited Suppliers using Modern Methods of Construction (MMC) will conform to industry best practice in terms of durability and system integrity, and therefore will be readily mortgageable for a minimum of 60 years.

The BOPAS partners are:

- **Buildoffsite** (<https://www.buildoffsite.com/>, the UK equivalent of <https://www.prefabaus.org.au/>)
- **LRQA**, a leading global assurance provider bringing together unrivalled expertise in inspection, certification, brand assurance, cybersecurity and training.
- **BLP Technical Services**, a part of BLP Insurance (Building LifePlans Ltd), specialised in technical assessments on behalf of several latent defect (warranty) providers.
- **The Royal Institution of Chartered Surveyors** (the UK equivalent of <https://www.aigs.com.au/>). Although not a formal member of the BOPAS management and assessment teams now, the RICS played a significant role for the initial development of BOPAS.

Initially, the Lloyds Register was also a founder, in consultation with the Council of Mortgage Lenders and the Building Societies Association. One of the key BOPAS supporters since the inception has been Arch. Andrew Waugh, the UK pioneer of mass timber construction, who's well known also in Australia.

Currently, almost 100 suppliers are accredited or under assessment by BOPAS, including several from the timber industry. For more information: <https://www.bopas.org/>

The experience from BOPAS is indeed transferable to Australia, and it would be quite useful for our sector to do it.

In 2017 FWPA tried to encourage prefabAUS to “import” BOPAS in Australia, unsuccessfully. But we already had constructive talks with Lloyds Register Asia to organise and support it. The context is different now, **with prefabAUS mentioning BOPAS** within their Roadmap 2023-2033 [17] **as a good model to improve access to capital**, Standards Australia having launched a Prefabricated Building Committee (which the author has attended twice as an FWPA delegate), and especially a significant attention from different levels of Government, Tier 1 builders, and developers.



Examples of timber construction, both volumetric and flat-packed, from companies that have BOPAS accreditation.

Above: <https://www.enevate.co.uk/>; Below: <https://www.donaldsontimbersystems.com/>.



## Flying Factory

Switching part of the construction activity to off-site production of components is often pointed out as a solution to the building industry's lack of quality and efficiency, and prefabricated timber components like frames, trusses, and recently also cassette floors, are the most prevalent industrialised system used to build housing.

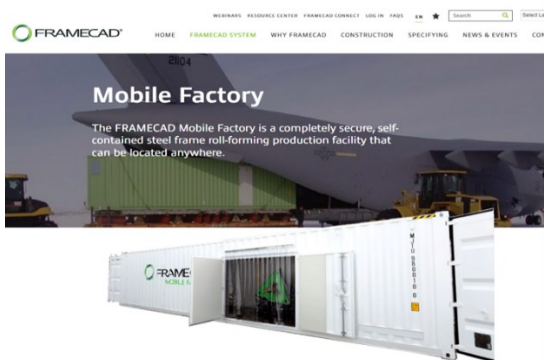
To help address these issues, a group of researchers and companies in the UK and NZ have prototyped an alternative method of production and assembly, with a different approach to traditional industrialised systems that involve large investments and fixed location factories. They have developed a small, low cost, portable micro-factory concept [18] that can be taken to a temporary location or construction site, where it can then be used to construct prefabricated closed panels. And there's two commercially sustainable applications, so far (with a third about to launch):

- a company that already has a rather large offsite facility capable of producing up to 900 volumetric modules per year ([Beattie](#)). They provide 5 weeks of hands-on training time and assistance in design, set-up, and operation, enabling their partners to use local labour and shorter supply chains.
- an award-winning design and build company dedicated to delivering contemporary, low carbon homes ([Facit](#)). Their core technology, the Facit Chassis, currently based on CNC-cut plywood, is described as "a robust, solid structure and a super-insulated, airtight building envelope, which allows the sort of creative freedom most home designers dream about."

Having demonstrated profitable results in the UK, a similar approach will provide additional pathways for our industry to be competitive in some projects, enhancing its resilience with respect to the pressure from its competitors, the shortage of skilled labour, the increase in defects and delivery times, the influence of weather, and a volatile global business environment.



Two examples of a Flying Factory in the UK, and of their projects. Above, from [Beattie](#) and below, from [Facit](#). Different configurations are indeed possible, specific for Australian conditions.



Both the steel and the concrete industries are offering different types of on-site mobile plants.



## Conclusions

In the last few decades, the Australian sawmillers and frame & truss manufacturers have had a primary focus on specific building elements (frames, roofing, cladding, decks, floors, sub-structures) to deliver discrete performance solutions in terms of structural integrity, thermal, durability and acoustics, rather than on a whole-of-house design to deliver an overall occupancy and performance outcome. This vision resulted in yield-efficient, cost-effective commodity products, rather than value-adding specialty products/services. But recently there are several initiatives, both in Australia and overseas, where forward-looking companies, even large ones, are progressively shifting their productions from ‘high volume’ to ‘high value’.

Meanwhile, the perception of most investors, insurers, and real estate developers has evolved, and now they:

- look at Engineered Wood Products (even a simple stud, when it’s graded and used within a designed frame) not just as a cheap and easy way to build, but also as sustainable materials that allow to meet their decarbonisation targets. In the words of CEFC’s CEO [19] *“Australian developers and builders do not have to choose between saving money and protecting the environment. Instead, they can take advantage of the latest in sustainable material and design innovations that will reduce emissions without incurring higher costs.”*
- realise that the costs directly related to repairing or replacing homes and their contents after natural disasters have increased significantly over the past 10-15 years, and currently range in the order of \$4 billion per year, therefore improving the resilience of homes would contribute to significantly reduce these costs and allow for better market growth opportunities.

In 2022 FWPA started the [Resilient Timber Homes](#) program to investigate and develop innovative and resilient construction solutions. Undertaken in a spirit of cross-sectorial collaboration and innovation, as reflected by the initial group of partners, this initiative has the potential to provide new market opportunities for our sector. We soon realised that the insurance industry is a primary stakeholder in relation to building resilience and will be a key proponent for change in building designs and codes. The cost of insurance premiums is already their main concern. Consequently, the insurance sector and/or the organizations of developers and builders should be an active part of any future steps carried out by our industry relatively to resilient timber homes and their components.

Using the information collected through this project, and leveraging the opportunities to collaborate also with the organisations that are running these initiatives, will enable the Australian forest and wood products industry to grow in value because of an increased demand for its innovative, sustainable and competitive products and services, by delivering on the following outcomes:

- Improve the specifiers and the consumers’ perception of forest and wood products and the understanding of their true economic, environmental, and social advantages,
- Increase the demand for, and value of, wood products and associated services that our industry can offer, and
- Attract talented and committed people to our industry to enhance our workforce capability and decision making.

**The time is right for further action, and FWPA’s Resilient Timber Homes program is ready to support industry partners interested in developing their approach and offer in this area.**



*The Chelmer Flood House designed by JDA Co. is an existing Queensland house that had a history of riverine flooding that was renovated and extended with a flood-resilient design. It’s currently a model for the “Design guidance for flood resilient homes” issued by the Queensland Government.*

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