RMIT UNIVERSITY

Post-Carbon Research Centre

Decarbonising Prefab Housing

Post Carbon Research Centre
RMIT University

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Objectives

- To identify and evaluate the critical gaps and barriers to decarbonisation within the prefabrication industry in Australia, with a focus on technological, workforce, and supply chain dimensions.
- To explore opportunities for collaborative engagement to drive progress toward decarbonisation and foster systemic transformation in the sector.

Skills and Training - Challenges & Opportunities

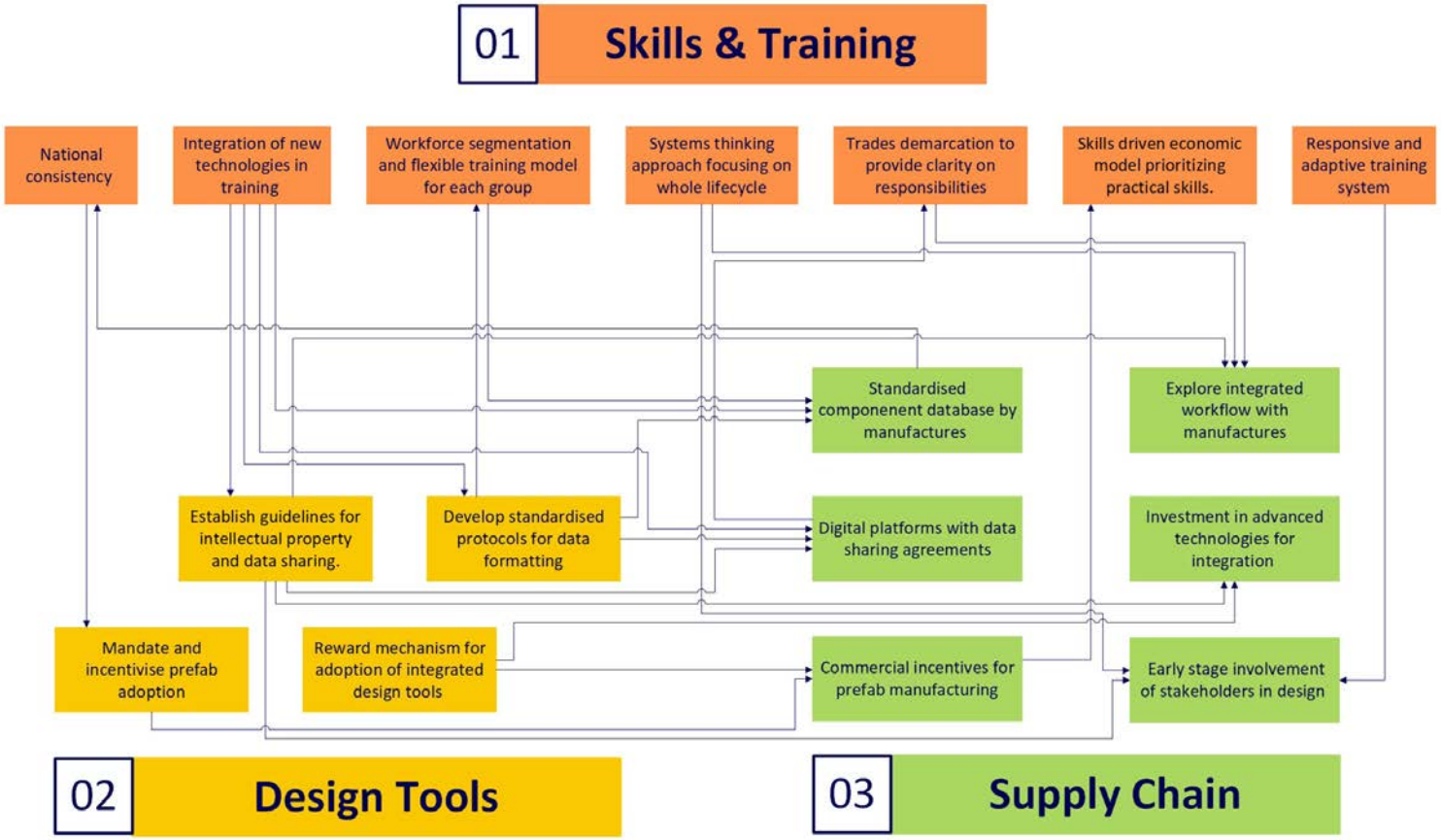
The prefab construction industry faces significant challenges in developing effective skills and training programs, primarily due to fragmented decision-making and the lack of integrated educational frameworks. Key stakeholders - manufacturers, educators, and policymakers- often operate in silos, hindering the creation of unified training programs. There is a pressing need for curricula that incorporate advanced technologies like Building Information Modelling (BIM), virtual simulations, and IoT-enabled workflows to align with realities of modern prefab processes. The current initiatives are primarily focused on tertiary education sector, and additional measures are required within Vocational Education (VE) to ensure effective implementation. Current vocational training programs fall short in addressing emerging concepts such as Non-Structural Elements (NSE) and Design for Manufacturing and Assembly (DfMA), both critical to prefab innovation. Moreover, educators often lack exposure to prefab construction practices, highlighting the need for specialised training initiatives to familiarise them with cutting-edge techniques and technologies. Additionally, prefab construction is often perceived as a low-quality, cost-cutting measure rather than a high-precision, code-compliant method. Overcoming this stigma requires concerted efforts to educate stakeholders and the public about the durability and efficiency of prefab solutions. It will create workplaces more attractive to women workers within a growing industry, and younger workers will be attracted to opportunities for applying digital capabilities. Future workers will gain new skills in manufacturing and digital technologies, with multiskilled workers performing tasks traditionally assigned to specific trades. This approach enhances existing trade roles without reducing skills. Overcoming challenges requires systemic change, fostering collaboration, and promoting prefab's value, ultimately creating secure, rewarding career paths and supporting industry growth and job creation as outlined below:

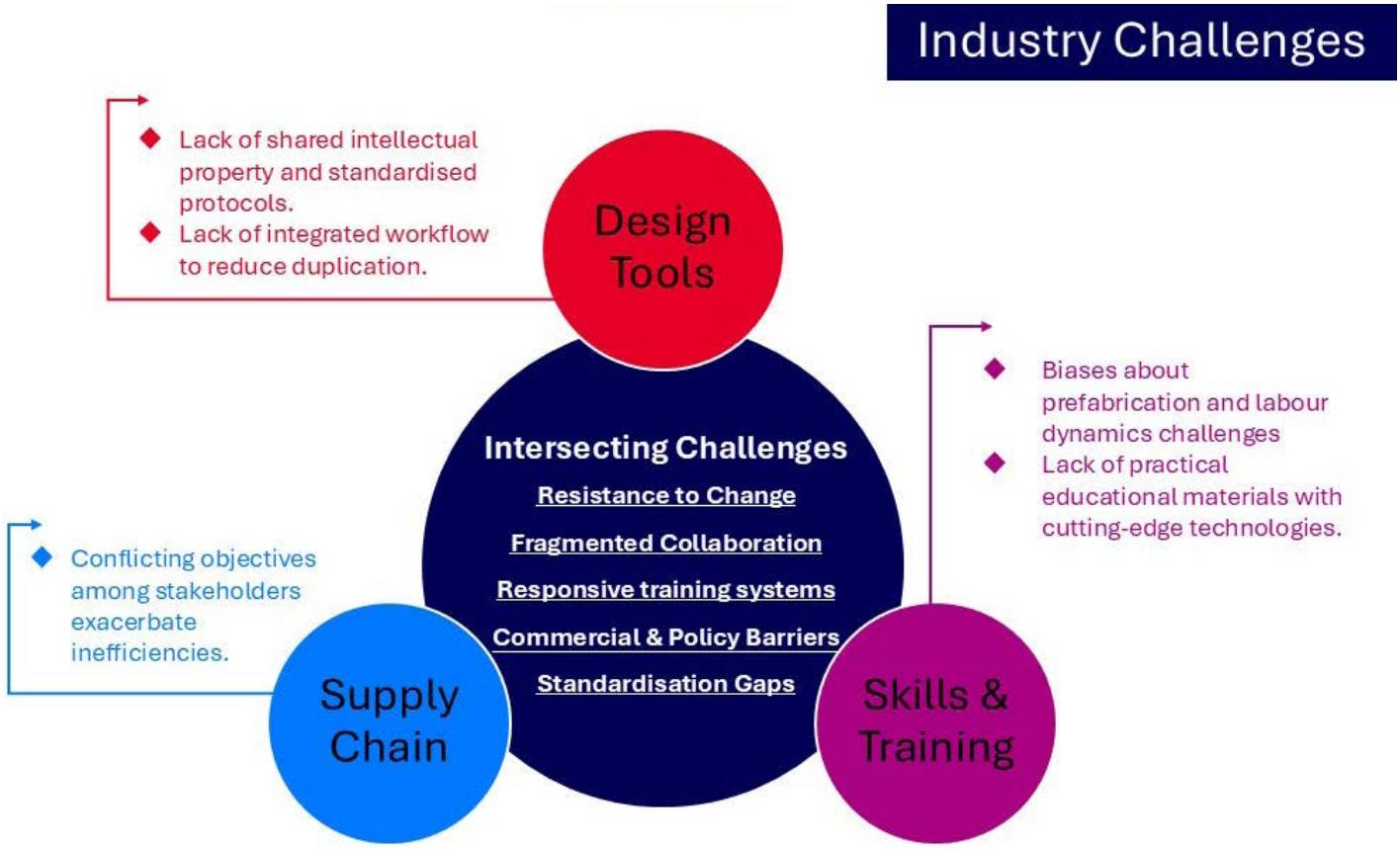
- Integrating new technologies such BIM, Virtual and Augmented Reality (VR/AR), robotics, and digital twin in skills development will enable precise planning, immersive training, and seamless collaboration.
- Continuing Professional Development (CPD) courses should offer a modular and flexible approach to ensure workers stay updated on industry trends.
- Curricula should include both traditional and prefab construction methods promoting hybrid skills for easy sector transition.
- Clearly defined trade responsibilities using tools like BIM will prevent workflow conflicts, with role-specific certifications for residential projects.
- A responsive training system that adapts to evolving industry needs will ensure the curriculum remains relevant and agile, incorporating real-time feedback to update modules effectively.
- Workforce segmentation—differentiating between factory-based, design/engineering, and site-based roles—requires a flexible training model that caters to each group's specific needs. Promoting workplace safety, innovation, and cleanliness will attract talent, particularly in factory environments.
- National consistency in policies and curricula is essential, alongside educating planning professionals on prefab technologies.

Design Tools - Challenges & Opportunities

The integration of design tools in prefabrication and decarbonisation faces significant challenges, including collaboration barriers and technical limitations. A major issue is the lack of shared intellectual property (IP), which forces contractors to redesign projects, leading to duplication of efforts, increased costs, and reducing trust. Siloed workflows and fragmented communication between design, engineering, and construction teams further hinder seamless effective collaboration. Despite the potential of 3D design tools to enhance precision and efficiency, their adoption remains low due to resistance to change, skill gaps, and the high cost of technology, particularly for small-to-medium enterprises (SMEs). The reliance on 2D tools results in reduced precision and inefficient workflows. Additionally, data management inefficiencies and the lack of standardised protocols, and limited incentives for optimisation contribute to delays and errors. The complexity of decarbonisation and limited awareness of its tangible benefits deter stakeholders. Overcoming these challenges requires a more collaborative, standardised approach with targeted training as outlined below:

- Shared intellectual property (IP) frameworks and open-source design models promote innovation, reduce costs, and enhance stakeholder trust, with government bodies playing a key role in establishing policies, and incentives, particularly in public infrastructure projects. Ideally, these frameworks should be defined at the tendering stage, ensuring clear IP ownership and data sharing terms. Many government contracts now emphasise collaborative digital environments, leveraging platforms like BIM to centralise data and streamline communication, with the Australian BIM Strategic Framework promoting national consistency in IP management.
- Transitioning to 3D design tools can enhance efficiency and precision, supported by upskilling programs, CPD courses, and financial support for SMEs.
- Standardising data protocols and leveraging cloud-based platforms can enhance data storage and accessibility, while analytics aid decision-making.
- Reward mechanisms such as tax incentives and grants, and awareness campaigns can drive adoption.
- Lifecycle assessments and government policies promoting sustainable practices will encourage a more collaborative, innovative, and environmentally conscious prefab housing industry.





Supply Chain - Challenges & Opportunities

Offsite prefabrication offers the potential to integrate Industry 4.0 technologies into construction, enhancing the prefab value chain through digital adoption and supply chain integration. However, many challenges remain, especially in stakeholder communication. The traditional linear production approach lacks the collaboration needed for seamless integration, with designs often finalised before materials are specified, leading to late procurement decisions that increase costs. Conflicting priorities between architects, who focus on quality and customisation, and manufacturers, who prioritize cost efficiency, create inefficiencies and reduce economies of scale. Standardisation and commercial barriers further hinder progress, with no universal standards for data exchange, leading to data silos and communication gaps. Inconsistent tool usage and lack of incentives for stakeholders limit supply chain integration. Furthermore, the high upfront costs for adopting advanced technologies like IoT and blockchain restrict technological adoption, particularly for SMEs. Outlined below are some supply chain integration related strategies:

- Stronger stakeholder collaboration and standardisation can improve supply chain integration in prefabrication. Involving manufacturers early in the design phase streamlines decisions, aligns specifications, and reduces time and costs.
- Digital platforms can facilitate real-time information sharing and collaboration among stakeholders, though intellectual property concerns must be addressed through clear data-sharing protocols.
- Standardised component databases and unified drawing formats, supported by a Common Data Environment (CDE), streamline processes, minimise redundancies, and enhance communication across planning, design, and manufacturing teams.
- Commercial incentives and policy support are vital for sustaining prefabrication and promoting technology adoption. Government subsidies or tax breaks can boost local production and reduce reliance on imports.
- Investing in technologies like IoT and blockchain improves supply chain efficiency, but SMEs may need funding support.

Next Steps – Collaborative Action

PrefabAUS and the Post Carbon Research Centre aim to jointly address gaps in prefab housing by fostering collaboration, advancing research, and supporting workforce development.

1. Creating **platforms** for knowledge sharing and enabling cross-sector partnerships among builders, prefab product manufacturers, designers, VE educators, academics, and government. Align priorities and develop solutions for decarbonisation, supply chain challenges, and innovation. Some examples of such platforms include:

    - An online “Prefab Innovation Hub” featuring webinars, white papers, and live Q&A sessions on sustainable materials and automation.

    - A “Prefab Living Lab” to test automation, design optimisation, and material efficiency.

    - A “Prefab Research Portal” to share tools, frameworks, and project data for decarbonised prefab housing.

2. Creating **pilot projects** showcasing scalable prefab solutions and highlighting the potential of prefabrication. These real-world demonstration projects will test and showcase scalable prefabrication solutions, providing tangible evidence of their benefits, such as reduced construction time, lower costs, and smaller environmental footprint. Pilot projects will also help build confidence among stakeholders, encouraging broader adoption of prefab methods.

3. Building a **conceptual model** that integrates various prefab components in tools such as Revit, creating a digital representation of a building that incorporates modular elements, streamlining the design, visualization, and documentation processes.

    - Develop Modular Prefab Components - Use tools such as Revit Family Editor to create reusable prefab component families.

    - Collaborate and Iterate - Use tools such as Revit Cloud Worksharing or Autodesk BIM 360 to collaborate with architects, engineers, and manufacturers.

4. Developing **targeted training programs** for planners, building surveyors, decision makers and other built environment professionals that incorporate advanced technologies like BIM and IoT, as well as prefab-specific workflows. These can upskill the workforce, while certifications can ensure consistency and quality across the industry.

- Short-Course Certification Programs - Practical, intensive courses on technologies and workflows relevant to prefab housing.

- Micro-Credential Programs - Specialized, bite-sized modules that professionals can stack for broader qualifications. Eg. *"Digital Prefab for Building Surveyors: IoT and BIM Essentials"* – short, stackable credentials for continuing professional education.

- Executive Training Programs - Upskilling decision-makers and senior professionals on the integration of digital tools and prefab workflows for sustainability goals.

5. **Advocating** for prefab-friendly policies and regulatory support is crucial for industry growth. PrefabAUS and Post Carbon Research Centre will engage governments to harmonise building codes, provide financial incentives, and integrate prefabrication into national housing strategies. They can also promote decarbonisation initiatives through measurable carbon reduction metrics and incentives like tax benefits or green certifications.

    - Harmonising Building Codes and Standards - Engage with government bodies and regulatory agencies to align building codes and streamline approvals for prefabricated housing. Advocate for national uniform standards for modular construction to eliminate inconsistencies across states.

    - Financial Incentives for Prefab Adoption - Propose financial support mechanisms such as tax benefits, subsidies and loans that encourage builders, developers, and homeowners to adopt prefabrication.

    - Streamlined Planning and Approval Processes - Work with state planning authorities to simplify and fast-track the planning and approval process for prefabricated housing projects.

6. Supporting local manufacturing and advocating for standardisation in prefab components will build resilient supply chains.

    - Strengthen local production capacities to reduce reliance on imports and enhance supply chain resilience. Partner with local manufacturers to develop prefab components tailored to Australian standards and environmental conditions.

    - Advocating for Standardisation in Prefab Components - Collaborate with standards organisations (e.g., Standards Australia) to create uniform guidelines for prefab dimensions, materials, and assembly processes. Advocate for the inclusion of standardised prefab components in the National Construction Code (NCC) to streamline approvals and encourage adoption. Create a "Prefab Component Catalogue" with specifications and certifications to guide manufacturers, architects, and builders.

By championing technology integration and circular economy practices, PrefabAUS and Post Carbon Research Centre can position prefabrication as a leading solution for sustainable, affordable, and innovative construction.

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About this document

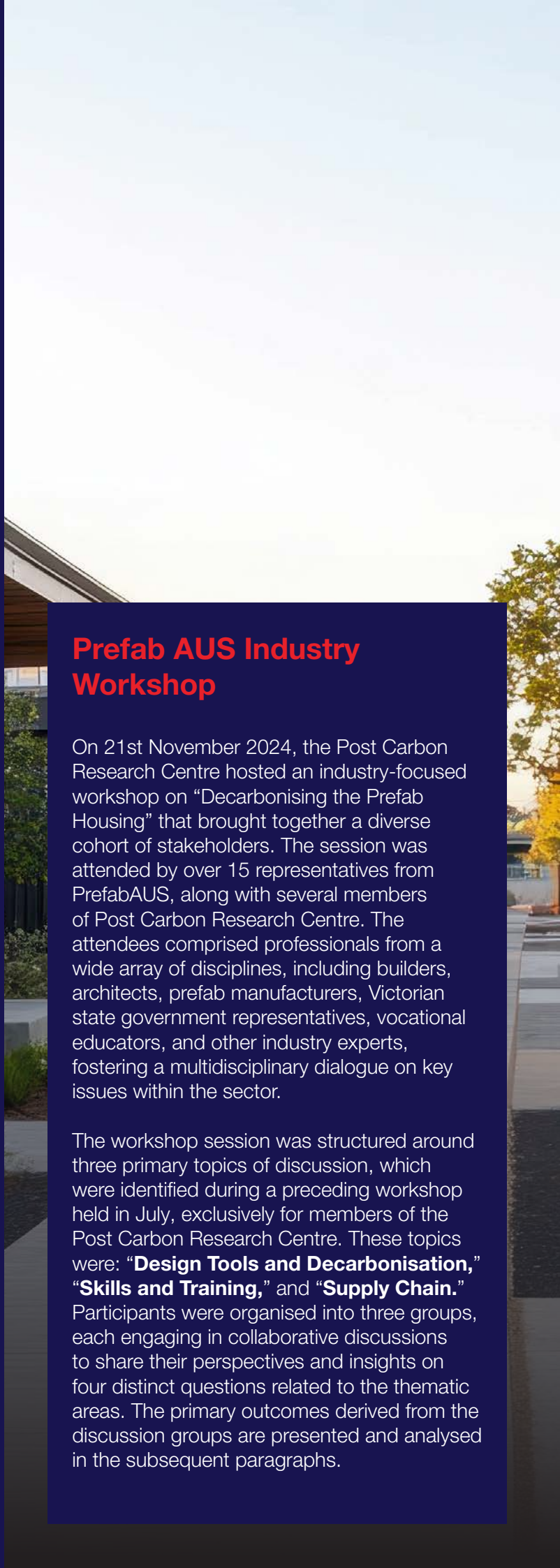
On 21st November 2024, the Post Carbon Research Centre hosted an industry workshop on “Decarbonising the Prefab Housing,” bringing together over 15 PrefabAUS representatives and diverse professionals, including builders, architects, government officials, and educators. Structured around “Design Tools and Decarbonisation,” “Skills and Training,” and “Supply Chain,” the workshop facilitated multidisciplinary discussions on key sector challenges. Participants collaborated in groups to address thematic questions, with key insights and outcomes analysed in this document.

Brief introduction to the Post Carbon Research Centre

The Post-Carbon Research Centre at RMIT University advances sustainable, carbon-neutral solutions for the built environment. Integrating architecture, engineering, and social sciences, it collaborates with industry to explore transition, design, and production. Focused on innovation, equity, and workforce development, it drives global leadership in regenerative, low-carbon construction and urban sustainability.

Purpose and significance of PrefabAUS

PrefabAUS, Australia’s peak body for prefabrication, drives research, collaboration, and standardisation to advance off-site construction. Addressing housing and sustainability challenges, it advocates for policy support and innovation. PrefabAUS promotes scalable, cost-effective solutions, mitigates labour shortages, and enhances sustainability through material efficiency, BIM, and automation, shaping the future of Australia’s construction industry.



Prefab AUS Industry Workshop

On 21st November 2024, the Post Carbon Research Centre hosted an industry-focused workshop on “Decarbonising the Prefab Housing” that brought together a diverse cohort of stakeholders. The session was attended by over 15 representatives from PrefabAUS, along with several members of Post Carbon Research Centre. The attendees comprised professionals from a wide array of disciplines, including builders, architects, prefab manufacturers, Victorian state government representatives, vocational educators, and other industry experts, fostering a multidisciplinary dialogue on key issues within the sector.

The workshop session was structured around three primary topics of discussion, which were identified during a preceding workshop held in July, exclusively for members of the Post Carbon Research Centre. These topics were: “**Design Tools and Decarbonisation,**” “**Skills and Training,**” and “**Supply Chain.**” Participants were organised into three groups, each engaging in collaborative discussions to share their perspectives and insights on four distinct questions related to the thematic areas. The primary outcomes derived from the discussion groups are presented and analysed in the subsequent paragraphs.