Feasibility Study

Feasibility Study of alternatives to Expanded Polystyrene Waffle Pods used in residential construction

This report was compiled by RMIT as part of the circular economy engagement program in partnership with the City of Casey. This program is commissioned by Circular Economy Victoria (CEV) and funded by Sustainability Victoria.

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1. Background

Between September 2021 and March 2022, Circular Economy Victoria (CEV) engaged the City of Casey under the Collaborate to Thrive program as part of the Victorian Circular Activator Recycling Victoria Innovation Fund (now Circular Economy Communities Fund). The outcomes of the program were a Circular Economy Opportunities Paper for Casey. The City of Casey reviewed the opportunities paper, which highlighted several key circular economy opportunities for the City and decided to further investigate circular/sustainable alternatives to expanded polystyrene waffle pods used in residential projects.

Virgin expanded polystyrene (EPS) waffle pods are being used extensively in residential housing developments, even though local, more sustainable alternatives are available in the market. Even with a national Pod Scrap1 Bag program in place, EPS waffle pod waste is still being sent to landfill, and microplastics from EPS is one of the most prevalent and pervasive pollutants in the Yarra River and beyond2. This report presents a feasibility study conducted in the collaboration with developers, suppliers, manufacturers, researchers and City of Casey to identify and test viable local alternatives to EPS waffle pods.

The research for this report is based on a six-month circular economy engagement and research project, which was conducted by RMIT University and RMIT Activator between July and November 2022. The project was structured as an applied research project to test the technical feasibility and economic viability of alternatives to EPS Waffle Pods. The feasibility study included targeted focus group sessions, interviews with key Council stakeholders and mapping of key barriers to adoption, as well as extensive background research to complement these phases. This report presents the key findings of the research and includes a series of recommendations to Council. These recommendations will be applicable to other local government areas and Councils, as well as offering learnings for state government regarding policy and regulation of the built environment sector.

NB: please note that de-identified quotes from the engagement sessions have been included throughout this report.

“EPS is a great commercial product. But it has negative effects on the environment – waterways, livestock, native animals etc."

2. Introduction

In the City of Casey, illegal dumping and litter caused by EPS waffle pods during residential construction is a significant environmental concern. EPS waffle pod waste is often blown away during high wind and can easily break down into small particles, which are near impossible to remove from the local environment. These EPS particles litter vast areas of landscape making it an eye sore, a significant pollutant and a harm to any livestock or other animals who consume it. The EPS particles also end up in waterways, contaminating natural ecosystems and causing water pollution.

This project aims to understand and evaluate the viability of alternatives to EPS waffle pods and thereby reduce the amount of EPS waste that is being sent to landfill and polluting local environments, as well as stimulate the market for sustainable locally made alternatives. The City of Casey has already invested resources into exploring circular transition options for the built environment sector and is interested to better understanding and addressing the root cause of negative impacts seen from EPS waffle pod products.

Traditionally, EPS waffle pods have been commonly used as they provide economic benefits to both builders and homeowners, as their use significantly reduces the overall cost of foundation slabs for residential developments. Initial market research outlined in this report has suggested that there are multiple local alternatives to EPS waffle pods produced in Australia, that are made from recycled content. Therefore, the primary benefit of this project is to increase awareness of more sustainable alternatives to EPS, and to increase the volume of recycled material being used in building products.

This also has the secondary benefit of reducing the amount of EPS waffle pods being used, reducing the EPS waste currently sent to landfill and reducing the amount of EPS that is currently polluting local farmlands and waterways.

Objectives of this project:

- To identify market ready alternatives to EPS waffle pods
- To understand the technical and financial feasibility of alternatives
- To understand stakeholder desirability to adopting alternatives in building projects
- To propose recommendations to City of Casey and Sustainability Victoria to switching to sustainability alternatives from EPS waffle pods

The remaining sections of this report will start with an outline of the methodology used to better understand the feasibility for the uptake of alternatives to EPS waffle pods in the City of Casey, and provide an analysis of the key findings including summary of barriers and enablers to adoption. The report will conclude with both a series of recommendations as well as guide for suggested future research directions around EPS and available alternatives, to support the drive to stimulate the market for alternatives.

3. Methodology

The research project used a mixed methods approach comprising both quantitative and qualitative methods for collecting and analysing data. The research was designed in five phases:

1. Stakeholder Engagement
2. Market Research
3. Technical Feasibility Analysis
4. Financial Viability Analysis
5. Desirability research

The five phases were conducted in a sequential process, whereby the findings of each stage informed the next, and an overall extraction of findings and analysis were conducted to generate insights and recommendations. Each phase will be outlined in more detail below, and the corresponding full preliminary report is available in the Appendices:

3.1 Stakeholder Engagement

The stakeholder engagement phase involved consultation sessions with key local developers identified by the City of Casey, engaged to provide feedback via semi-structured interviews. Developers were asked about current practice, barriers to adoption of alternatives, and the drivers and enablers that they could identify to encourage a systemic shift towards more sustainable practices.

3.2 Market Research

The market research phase aimed to identify the alternatives to EPS waffle pods using secondary research methods, whereby desktop data was gathered from external resources. This phase focused on identifying commercially available alternatives to EPS void formers currently manufactured and available within Australia. Material specifications of these products, including material content, manufacturing location, and Australian standard ratings were also collected at this stage.

3. Methodology cont.

3.3 Technical Feasability Analysis

The technical feasibility analysis aimed to understand how the alternatives comply with Australian Standards and their performance in foundation slabs of residential projects. This phase was undertaken by approaching multiple waffle pod suppliers/manufacturers to obtain technical specifications and structural requirements for these alternatives.

The technical information of alternatives was analysed using the content analysis method, with the development of a matrix to compare technical criteria against these alternatives (see Appendix 3). The technical criteria analysed included load testing, shear load, stress distribution, product shapes and dimensional stability, installation at site and insulation properties for foundation slabs.

3.4 Financial Feasability Analysis

A financial cost comparison study of typical EPS waffle pods and technically viable alternatives that were identified in the previous stage was conducted. A total of 18 suppliers, including 6 waffle pod suppliers and 12 alternatives suppliers, most of whom were identified in the previous stage were contacted to obtain quotes. Quotes were successfully obtained from 4 waffle pod suppliers and 6 alternatives suppliers.

Square meterage cost of each of the materials were obtained and compared with the cost of the conventional EPS waffle pods. The lowest-cost alternative was used for a detailed comparison of the construction of a slab for a standard single-story house.

3.5 Desirability Research

To understand the barriers and enablers, it was essential to recognise the perspective of various stakeholders with direct decision-making responsibility around the procurement of waffle pod alternatives.

Due to time constraints to the project timeline, as well as challenges in engaging stakeholders, targeted consultations were not carried out with key informants for the desirability phase. All qualitative data gathered throughout the above phases were instead analysed to identify recurring themes and inform recommendations for the development of innovation pathways.

4. Limitations

4.1 Stakeholder Engagement

Due to time constraints around the phase as well as challenges in securing engagements, only a small number of developers were interviewed under the Stakeholder Engagement phase. Discussion with additional developers could lead to greater understanding of the appetite and decision-making power for adopting use of sustainable alternatives.

4.2 Technical Viability Analysis

Technical evaluation was based on technical specifications provided through discussions with suppliers/manufacturers and information available on company websites.

4.3 Financial Viability Analysis

- Analysis is based on cost details provided by suppliers/producers
- Obtaining pricing details was challenging as it was required to provide architectural and structural drawings with material specifications to get detailed quotes from suppliers/producers.
- Comparison between alternatives is challenging given variations in product dimensions and setting up costs.
- Cost of labour, handling and equipment required for installation has not been considered.

4.4 Desirability Analysis

- Lack of access to various essential stakeholder involvement and, therefore, input from builders and direct decision-makers produced a dearth of multiple feedback.
- Site visits that aimed to observe EPS waffle pod management and installation were not utilised.

5. Findings

5.1 Engagement Research

EPS waffle pods are widely used in residential projects. They can assist in speeding up construction on site and reduce the concrete needed for a pour. EPS is made up of 98% air and 2% product so the air pocket created by EPS can aid to achieve insulation requirements and reduce the movement in reactive soils. EPS had been used in Australian construction industry for over 40 years (since 1980) due to its cost savings and the reduction of excavated rubbles from trenches. They can work on natural soils and are highly recommended to use for non-reactive, slightly and moderately reactive soils but not for highly reactive soils (Class H1 and H2). The insulating layer between the ground and structure can support meeting insulation requirements of sustainability tools such as Green Star Homes and NatHERS energy efficiency.

Despite these advantages, EPS waffle pod waste has been identified to have negative impacts on the environment. They can be easily blown out in high windy conditions and end up in waterways causing contamination of water and natural ecosystem. The quotes from the engagement sessions demonstrate these issues as below:

”One of the main issues with polystyrene waffle pods is [that] on a windy day if pods are not secured, they impact animals both on land and in the water. I have heard of cows dying after ingesting the foam.”

5.2 Market Research

This research phase resulted in the identification of 11 Australian alternative void formers constructed from plastic, cardboard or a combination of cardboard and plastics. These alternatives were compared against the following eight criteria:

1. Material
2. Manufactured in Australia
3. Easily Transportable
4. Lightweight and easy to handle
5. Adjustable system
6. Built in interlocking system
7. Polystyrene free
8. Recyclable

5. Findings cont.

5.2 Market Research continued.

Material type, polystyrene free, and recyclablability were among the selected criteria as the key focus of the research was to identify material solutions that support the achievement of sustainability ratings under the material category, and reduce the negative environmental impacts caused by the utilisation of expanded polystyrene.

The use of locally sourced materials, Australian manufacturing, and transportability were the next criteria to be considered to encourage the use of local products, and minimise risks related to material import, (e.g., product manufacturing standards) and reduce freight costs.
Other criteria such as weight and system functions were selected for construction considerations regarding installation process, time and cost, as well as structural requirements.

Table 1: List of commercially available alternatives to EPS waffle pod

		MATERIAL	MANUFACTURE IN AUSTRALIA	EASILY TRANSPORTABLE	LIGHTWEIGHT AND EASY TO HANDLE	ADJUSTABLE SYSTEM	BUILT IN INTERLOCKING SYSTEM	POLYSTERENE FREE	RECYCABLE
Clayform	Alternative No.1	100% Recycled carboard with cellular core	✓	✗ * Large volume	✓ * Waste from installation	✓	✗	✓	✓
Expanded Paper Honeycomb	Alternative No.2	Carboard with cellular core	✓	✗ * Large volume	✓ * Waste from installation	✓	✗	✓	✓
Supavoid	Alternative No.3	Recycled carboard with fibreboard core	✓	✗ * Large volume	✓ * Waste from installation	✓	✗	✓	✓
Filavoid	Alternative No.4	Expanded paper honeycomb core with face sheet	✓	✗ * Large volume	✓ * Waste from installation	✓	✗	✓	✓
Qpod	Alternative No.5	100% Recycled polypropylene	✓	✗ * Large volume	✓	✓	✓	✓	✓
NuPod	Alternative No.6	100% Recycled plastic	✓	✓ * Stackable	✓	✓	✓	✓	✓
Dome Pods	Alternative No.7	100% Recycled plastic	✓	✓ * Stackable	✓	✓	✗	✓	✓
BIAX	Alternative No.8	100% Recycled Reprolene™	✓	✓ * Stackable	✓	✓	✗	✓	✓
Pod Sale Slabs	Alternative No.9	100% Recycled EPS foam	✓	✗ * Large volume	✓ * Waste from installation	✓	✗	✗	✓

5. Findings cont.

5.3 Technical Viability

Technical analysis was undertaken for all sustainable alternatives. Sustainable alternatives can be categorised into Cardboard void former and Polypropylene waffle pods based on their materials and technical features.

Cardboard void former:
Products are made from 100% recycled cardboard and light to easily install on site. These products comply with Australian standards (AS3600 and AS2870) for residential foundation slabs. The void former operates well in reactive soils (Classes H1 and H2) and reduces the force applied on the ground from the above house structure. It minimises risks related to the ground movement under moisture conditions.

Polypropylene waffle pods:
Products are made from 100% recycled and processed plastics. They are easy to transport and store on site. Like Cardboard void formers, these products comply with Australian standards (AS3600 and AS2780). The most outstanding feature of these products is the built-in interlocking spacers using biaxial system to increase the strength of foundation as well as locking the waffle pod system by itself. These products also create space between foundation slabs and the ground which can reduce the force transmitted upward from the ground to the house structure.

Technical advantages of these products are identified in dot points below.

- *Improved durability and stability on Australian soil conditions*

Reactive soils extensively occur across Australia. Such soils can expand or contract under the impact of moisture (water conditions), therefore, reducing the forces of soil movement on buildings are vital. The technical viability phase highlighted the advantage of sustainable alternatives compared to EPS waffle pods. In fact, as opposed to traditional EPS products, most alternative products identified seem to be more suitable for most soil conditions due to their ability to reduce the upward force transmitted to a building structure.

- *Alignment with sustainability rating tools*

Sustainable alternatives are designed with the void forms to reduce weight, increase air circulation and improve thermal insulation, enabling builders to acquire sustainability credits related to energy efficiency, carbon footprint and recycled materials use.

5. Findings cont.

5.3 Technical Viability continued.

- *Improved waste management*

The use of alternatives can resolve the issue of waste and waste responsibility amongst stakeholders. Polypropylene waffle pods can reduce waste on site by adjustable system to fit with different foundation sizes. Their weight also reduces the chances of waste being blown out due to high wind conditions. Cardboard void former products with their degradable nature can mitigate their waste impact to the environment when they are spread out in the wind conditions.

“EPS waffle pods also cause the issue of waste cleaning amongst different stakeholders when they are blown in the wind and land at different construction sites which impacts the construction processes of other projects.”

- *Material efficiency in foundations*

Polypropylene waffle pods can make interlocking spacers to create a stable system locking itself during concrete pouring, utilising biaxial instead of monoaxial system to increase the strength of foundation slabs. This feature can allow foundation slabs to utilise lighter steels for their structure and increase the strength of bearing load system in the residential foundation slabs. Some alternatives provide better engineering outcomes with adjustable systems to work for different foundation sizes.

5.4 Financial Feasibility

A financial feasibility analysis between traditional EPS waffle pods and the alternatives identified in the previous stages was conducted. The main aim of this project phase was to determine whether the use of alternatives was financially justifiable.

A total of 18 (6 waffle pod and 12 alternatives) manufacturers/suppliers were contacted to obtain quotes. Quotes were obtained only from 4 Waffle pod suppliers and 6 alternatives suppliers, as most suppliers required additional information to provide detailed quotes, while others do not service Melbourne, proving a barrier to access required costings.

A true financial comparison between EPS waffle pods and alternatives cannot be conducted as products have varied dimensions and differences in the complementary material that is used for setting on site. Therefore, the comparison was conducted based on the cost per m2 for the products.

5. Findings cont.

5.4 Financial Feasibility continued.

Table 2: cost comparison of EPS Waffle Pod suppliers

Based on the quotes obtained it was calculated that the average cost of EPS waffle pods was $13.06/m2, which excluded GST and other charges like freight and delivery costs.

Supplier	Size (m2)	Cost per pod ($)	Cost per m2 ($)
E1	1.21	14.91	12.32
E2	1.19	18.57	15.63
E3	1.19	13.77	11.59
E4	1.19	15.10	12.71

Table 3: Cost comparison of alternatives

Product	Size (m^2)	Cost per pod ($)	Cost per m^2 ($)
Alternative No.8	0.56	10	17.78
Alternative No.4	2.88	67.77	23.53
Alternative No.3	1.21	43.23	35.73
Alternative No.6	0.98	31.00	31.63
Alternative No.1	2.88	40.00	13.89
Alternative No.2	1.92	42.08	21.92

Comparing the costs of alternatives to the average cost of typical EPS pods it was identified that clayform was the only comparatively priced alternative. However, this product is not a direct substitute for EPS pods, as it is used in highly reactive soils where EPS is not used.

A comparison of the average costs of products shows that the average cost of alternatives is $24.08m2, which was nearly 2 times the average cost of EPS pods. The quotes obtained were also used for a case study to estimate the total of waffle slab using EPS pods and alternatives based on the per m2 rate.

5. Findings cont.

Table 4: Cost comparison for case study

Type of pod	Cost of pods	Variation from EPS
E3	2,481.40	-
Alternative No.8	3,377.78	36%
Alternative No.4	4,470.70	80%
Alternative No.2	4,164.17	68%
Alternative No.6	6,009.59	142%
Alternative No.3	6,788.18	174%

The lowest cost alternative was then used for a detailed comparison, which included freight costs, disposal costs and the cost of complementary material for installation for the case. Through this case study it was estimated that the cost of EPS waffle pods contributed to approximately 23% of the total cost of the waffle slab.

The total cost of an EPS waffle slab was only marginally lower than the lowest cost alternative. A 5% reduction in the cost of the alternative would make the alternative financially desirable in contrast to EPS pods. Although the per m2 cost of the alternative is higher than EPS, the savings arise from reduced use of steel bars and the lack of delivery charges and environmental levies.

Through the financial feasibility analysis conducted, it could be concluded that there are potential market ready alternatives to EPS pods, which could be used in residential construction projects, without having major financial setbacks. However, these alternatives would need to be presented to architects, engineers and builders to understand if there are other practical challenges faced for their use.

5. Findings cont.

5.5 Desirability of Alternatives

Due to challenges in engaging stakeholders involved in decision-making around products chosen for the build, this research was limited in a deeper exploration of how to improve the desirability of the most promising alternatives to EPS waffle pods.3 The following findings were extracted from data and feedback gathered during the initial four phases of the research.

Feedback from developers made it clear that a two-pronged approach to leveraging and encouraging uptake of alternatives is necessary for sustained system change. Greater regulation from local Councils, and financial disincentives can reduce the appeal of EPS products, whilst alternatives are introduced to the market. A greater cultural shift occurring toward sustainable and recycled products under a circular economy driven at the macro level can further catalyse uptake of market alternatives.

“No commercial recycling system is in place. [We} discussed with builders [on] having a drop-off area for EPS waste.”

However, for these alternatives to truly represent a viable option, they must be both technically and financially feasible, with the research identifying the latter as the main concern for many decision-makers in the construction process. As scalability is a major factor for many developers and builders, any alternative on the market must be able to be financially viable at volume.

Involving both builders/developers and manufacturers of alternatives in the transition to sustainable and recycled products will ensure that the specifications and cost adjustments of these products represent value for money for those with purchasing power in the sector. Again, a space for state and local government is identified in creating open forums for these practical discussions to be carried out, and strategic relationships to be developed.

As EPS is commonly used in residential construction projects, phasing out waffle pods from slab construction may not remove EPS entirely from builds – i.e., it is likely that EPS will still be used in other areas of construction such as insulation. Whilst beyond the scope of this report, there is room for innovation of sustainable/recycled-content products in each phase of construction – leaving great opportunity for circular approaches to product development, construction management, and design specification. Increasing the uptake of these sustainable alternatives requires active participation and commitment from stakeholders across the construction chain, including developers and builders, as well as local and state governments, for example in supporting trials and establishing procurement targets.

6. Conclusions

The research has identified several locally made products on the market that are made of sustainable or recycled-content materials and offer a feasible alternative to EPS waffle pods in a similar application. Whilst these alternatives represent a technically viable product that at scale is economically feasible, significant measures must be taken to improve the desirability of these products for the local construction market.

When evaluating alternatives via holistic assessment criteria, including technical viability and stakeholder appeal rather than solely cost differential, this research found that many alternative products perform comparably to EPS waffle pods. For industry stakeholders, the design of new alternatives will require a level of detail around material specifications, to provide potential buyers with the necessary technical information to inform adoption.

Efforts to support a systemic and cultural shift toward use of alternatives, including outlining both environmental incentives and supply chain resilience inherent in local offerings, is now required to continue to leverage this analysis.

Considering the financial scalability imperative for the built environment sector, when costs are estimated for whole of foundation slabs including steel, concrete, and waffle pods components rather than only waffle pods, several alternatives become financially practicable. From a technical and financial feasibility viewpoint, the use of polypropylene waffle pods can create financial savings from steel systems when using lighter steels. This means that cost differences can be minor for whole of slab construction.

This research also found that builders and sub-contractors have long-standing relationships with EPS manufacturers, so any meaningful shift must require ‘upstream’ establishment of similar commercial relationships with alternatives manufacturers. Council and state government can play a role in creating the environments for these strategic relationships to develop.

The recommendations below include several suggestions regarding on-site waste management to ameliorate impacts of EPS waffle pods, as well as a series of short-term recommendations for Council to enable a transition from current EPS products to alternatives. Recommendations also outline actions toward longer-term systems and cultural change to improve the desirability of locally made sustainable products.

7. Recommendations

The following recommendations are structured via a set of themes, designed to enhance the usability of each as a tool for catalysing change.

Waste management on site:

Below are some recommendations and key areas for council to action in the short-term.

1. A detailed plan or roadmap for switching to sustainable alternatives needs to be developed to reduce and finally eliminate EPS waste in Casey. During this transition, a plan to manage EPS waste on site needs to be developed by Council.
2. Council to develop working relationships with ESP Australia5 to continue establishing responsible distribution and clean-up with builders and site management to ameliorate waste and pollution from EPS.
3. Council to explore other opportunities to collaborate with reverse logistics partners in the private sector that can enable collection and appropriate recycling or waste valorisation of EPS in construction sites, linking the waste streams to manufacturers with the technology to develop new recycled-content products from the collected material and under a circular approach to waste management.
4. Council to ensure that builders and contractors operating on-site secure EPS with netting and anchoring points before use. It is also recommended for Council to provide guidelines for waste to be bagged and secured to the site for removal. Removal should be completed within 48 hours to avoid waste dispersion.
5. Council to increase the use and scale of financial incentives and/or deterrents to encourage use of alternatives. For example, Council currently enforces a $300 fine for onsite EPS pollution, however increasing the figure or stricter enforcement by Council officers may result in the overall cost of a waffle slab being higher than an alternative, creating a financial deterrent.

Focus on alternatives:

6. Council to provide the list of feasible alternatives identified by this research to architects and builders, through an online database6. Such a tool can help decision-makers identify potential alternatives and contact suppliers.

7. Alternatives producers to highlight through their communication and marketing the cost comparison to EPS waffle pods of their products when considered at scale and/or within whole of slab cost estimates.

8. Additional innovation into sustainable alternatives and promotion of these options on the market can increase the likelihood of uptake, with a lack of awareness of existing sustainable alternatives to EPS waffle pods cited as a key barrier. Council can play a key role to enable uptake by incentivising or providing subsidies for manufacturers to develop more sustainable alternatives and for subcontractors to use and adopt them.

7. Recommendations cont.

Roles in Systems Change:

The Recommendations in the following section are structured via the core conditions of systems change, to highlight how change can be instigated and leveraged across the broader built environment ecosystem, as well as the various roles stakeholders can play.

Policies:

9. Councils to support the broader adoption of sustainable alternatives by:
- trialling newly developed products in collaboration with innovative businesses to validate solutions and enable scalability of tested alternatives.
- Establishing targets and strengthening sustainable procurement guidelines via programs like Eco Buy https://www.ecobuy.org.au/.

Practices:

10. Following a bottom-up approach, builders and sub-contractors must begin to recommend alternatives in their tendering options. These measures represent a systemic move toward greater uptake of sustainability alternatives for residential foundation slabs.

Power Dynamics:

11. Top-down approaches are recommended to lead a high-profile shift toward sustainability alternatives. EPS alternatives to be recommended by Council for council projects (e.g., capital works program, Design Excellence Program) as well as innovative developers for other projects.

Resource Flows:

12. Alternatives to EPS waffle pods to be considered in the initial design phase of projects (architectural and structural drawings), with developers to endorse the use of more sustainable alternatives during the planning controls process. This means that developers and designers must be aware of viable alternatives on the market and view them as quality product options to propose to clients for a build.

Figure 1 on the following page outlines the expected design and construction process, with the research suggesting that intervention toward EPS alternatives must begin at the initial concept stage, with developers playing a key role.

7. Recommendations cont.

Roles in Systems Change continued:

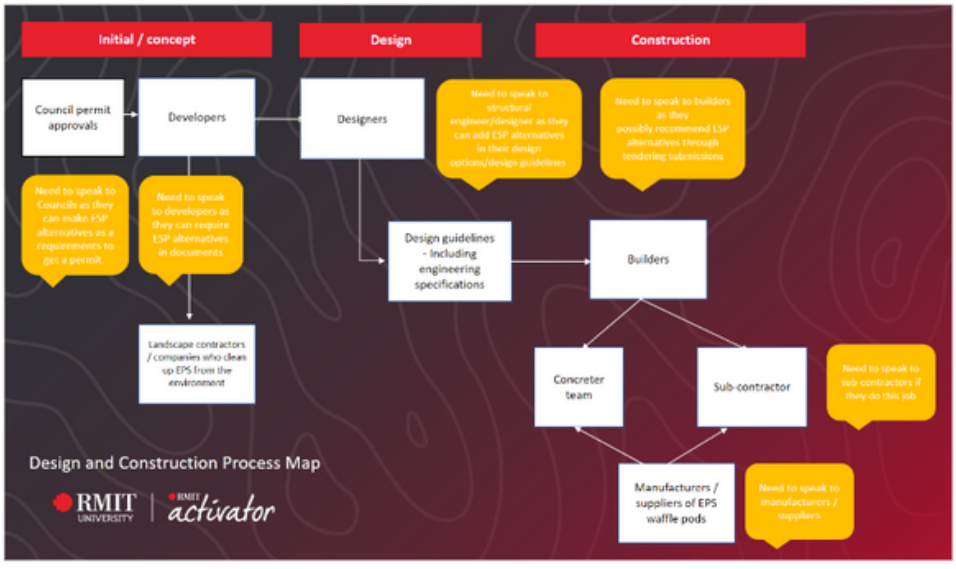
Relationships and Connections:

13. It was clear from analysis on the data that there are specific intervention points that most key stakeholder groups in the design and construction process can leverage (see the process map in Figure 1). Therefore, any substantial transition to EPS alternatives necessitates a coordinated and collaborative approach, working at multiple levels of the system and encouraging leaders at each level to proactively champion these products. Developers and designers can lead strategic conversations and recommend alternative products within their design guideline packages, highlighting emerging innovations that meet environmental goals within budget constraints.

Mental Models:

14. A widespread transition to alternatives requires a mindset and cultural shift. This also applies to a broader and necessary transition towards using more sustainable practices (beyond materials) in construction, and therefore could be led by more environmentally minded builders who are able to demonstrate to peers the desirability of such alternatives.

Figure 1: Design and Construction Process Map



7. Recommendations cont.

Leveraging Research:

15. Socialising research outcomes can act as an incentivising modality, with a key role for government in encouraging the uptake of alternatives, including showcasing the full list of local alternative options. State and local government to hold further engagement sessions, including workshops, seminars, or webinars, to encourage stakeholders including developers, designers, builders and sub-contractors to engage with findings.

“Behavior change requires incentives for both developers and builders, particularly regarding increasing costs.”

16. The outcomes of this research, once validated via on-site testing of the most feasible alternatives, can enable the creation of industry case studies which can inform critical amendments to the National Construction Code to include standards and specifications for recycled-content products. This would reduce the hesitancy in the construction industry to transition to more sustainable alternatives.

8. Future Research Directions

- **Undertaking evaluation of the life cycle cost (LCC) and life cycle environmental assessment (LCA) of alternatives in comparison to EPS waffle pods.**
- **Engagement with architectural and structural designers to understand how best alternatives could be included in initial designs, including drawings and specifications**
- **Interviews with builders and sub-contractors to understand challenges in using alternatives within tendering and construction processes.**
- **Conducting a case study with an alternative material to understand practical barriers to implementation.**
- **Conducting a detailed cost comparison between alternatives using Quantity Surveying techniques and Building Information Modelling tools.**

Appendices

1. Engagement Report
2. Market Research Report
3. Technical Feasibility Report
4. Financial Feasibility Report
5. Desirability Report
6. Matrix (List of Alternatives)