PACT RENEWABLES
A RENEWABLES COMPANY PTY LTD

Dr Aharon Arakel
Director & Principal Technologist
PO Box 92, Thornleigh, NSW 2120

July 22nd, 2025

Submission to the Australian Select Committee on PFAS

Executive Summary

Pact Renewables Pty Ltd, the inventor of a first-of-its-kind mineral-based hazardous waste solidification and stabilisation technology (known as MBC technology), welcomes the opportunity to contribute to the Committee's inquiry into the regulation and management of PFAS in Australia. Our submission focuses on an unspoken and often-overlooked challenge: the urgent need for safe, scalable, and regulator-verifiable **containment of PFAS residuals.** These residuals are concentrated waste streams generated by primary and secondary PFAS treatment technologies and in the absence of a national policy or endorsed PFAS technology pathways they have emerged as a growing **'third wave' of PFAS risk - no longer in the environment, not yet destroyed, and not safely contained**. Drawing from our appropriate technology development efforts and decades of applied R&D, we propose a practical near-term solution using our MBC-cement encapsulation technology for safe landfill containment until PFAS residuals destruction technologies become viable.

Introduction and Statement of Credentials

I am the Director and Principal Technologist of Pact Renewables Pty Ltd, a Sydney-based environmental technology company with extensive expertise in sustainable saline waste management, mineral recovery, and intractable waste containment. I hold a PhD in earth sciences and have over 30 years of industry and applied R&D experience advising governments, communities, and private enterprises on product recovery from saline wastewaters as a measure for offsetting costs associated with disposal of generated residuals. Pact Renewables has pioneered the development of MBC, a unique technology platform for the manufacture and application of a suite of proprietary formulated mineral-based composites for diverse industrial and environmental applications. The technology was recognised at 2023 World Economic Forum held at Davos, earning the Company status of "Top Innovator Company'.

Complementary to the MBC technology, is our long-proven and licensed Salpro technology with its latest commercial application related to a €50M plant in Sweden, which commenced production of potassium- and calcium-based mineral products in 2023 from the leachates of fly ash generated by energy-from-waste (EfW) plants. The

PACT RENEWABLES
A RENEWABLES COMPANY PTY LTD

technology was optimised for effluent-specific applications through further RD&D, and involved research team training and systematic test works under my guidance.

Context: Residuals Management Gaps and International Drivers

Insights from the outcomes of recent overseas surface water PFAS treatment pilot projects underscore the growing challenge of PFAS residuals, as utilities operating the treatment plants are now reporting:

- Larger surface water treatment capacities of utilities, reflecting scale-up from earlier groundwater-only responses;
- More complex water matrices, requiring aggressive treatment methods;
- And consequently, higher costs, especially around the handling, storage, and disposal of the residuals, including spent media, brines, sludges, and foam concentrates.

These finding on the challenge of sustainably managing PFAS residuals has become a regulatory and economic bottleneck:

- Land application of biosolids containing PFAS is now restricted or banned in many U.S. States and EU Member States.
- Landfill acceptance of PFAS-laden materials is increasingly subject to leachate-based thresholds, limiting disposal of concentrate solids, ashes and filter residues.
- Incineration capacity is limited, costly, and remains subject to community concern and scientific scrutiny regarding PFAS breakdown by-products.

These developments have collectively driven up costs, created stockpiling pressures, and raised serious questions about the sustainability and responsibility of PFAS lifecycle management - even as treatment technologies proliferate.

Defining PFAS Residuals and Our Containment Approach

PFAS residuals are end-of-process byproducts, typically saline, chemically reactive, and contain mixtures of PFAS, other persistent organics and heavy metals. Known examples include:

- Brines from RO processes and foam fractionation
- Sludges from GAC and IX regeneration
- Fly ash and APC residues from EfW incineration
- PFAS-contaminated biosolids and industrial process sludges

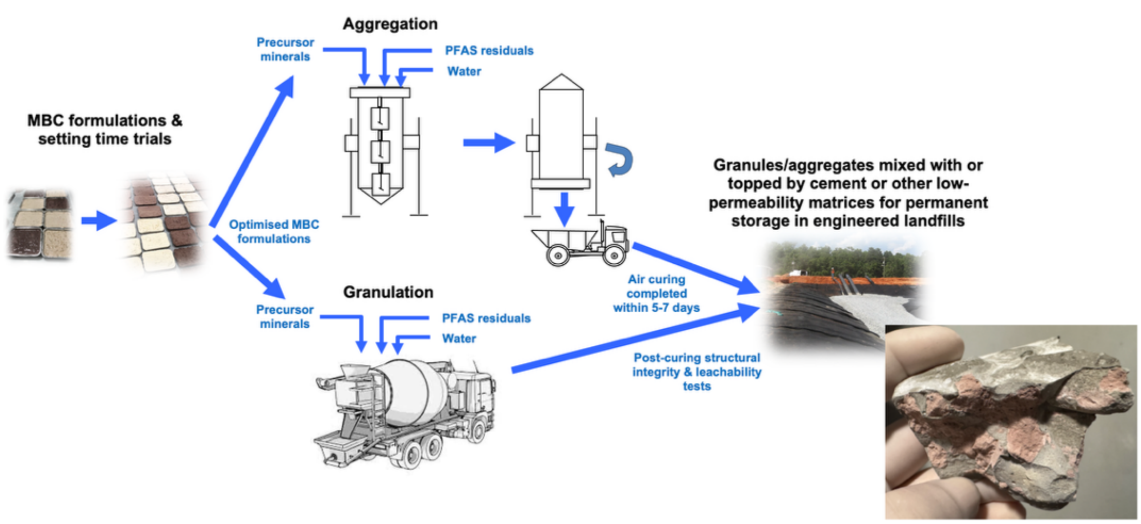
PACT RENEWABLES
A RENEWABLES COMPANY PTY LTD

These materials pose multifactorial risk and are currently accumulating in Australia without a validated, regulated pathway for containment or destruction, despite long knowledge of their presence to hazardous waste treatment technology developers/suppliers and landfill operators. Consequently, they have been overlooked in technology assessments, often leading to misleading cradle-to-grave lifecycle analyses and risk assessments that ignore the fate of PFAS post-removal. Regardless**,** in absence of any proven and independently verified PFAS residue destruction technology, safe containment currently offers the only viable PFAS residuals risk management option, until such time as scalable, economically feasible, and regulator-verified destruction technologies are developed and deployed.

Against this background, Pact Renewables' integrated MBC-cement encapsulation technology offers a low-emissions, mineral-based, and scalable solution option for safe long-term containment of intractable end-of-pipeline waste streams, including PFAS residuals.

As diagrammatically shown in Figure1, proprietary MBC formulations prepared from widely available precursor minerals, once mixed with residuals in the presence of water at ambient temperature, interact generating new mineral assemblages that lead to permanent entrapment of the residues in the lattices of recrystallised minerals. The recrystallisation process is fast, removes free water molecules and irreversible, enabling rapid aggregation and granulation of the mass before curing. Further, the generated composites are fully compatible with ordinary cement (OPC) and supplementary cementitious materials (SCMs) for application at scale, thus, having no adverse impact on structural integrity of the cement-encapsulated materials stored in engineered landfills.

Figure 1



The history of MBC technology development for encapsulation of various intractable saline waste streams dates to early 2000s, when the first systematic field trials, supported by controlled leachability and engineering test works, were performed at the site of a Ramsar-listed salt interception scheme in Victoria (Figure2). Apart from evaluating the performance of selected MBC formulations as a geotextile liner replacement for safe storage of saline irrigation effluents, additional trials were also undertaken to assess methods for onsite MBC production and application to effluent holding ponds.

Figure 2

Comprehensive encapsulation trials and performance evaluations (form stability and leachability under controlled conditions) have since been undertaken by Pact Renewables using an expanded range of proprietary mineral formulations and preparation methods for encapsulation of a variety of hazardous waste streams, including fly ash from EfW incineration and coal power storage dams, asbestos dust, COVID-contaminated masks and textiles, and concentrated effluents from water treatment processes. These efforts culminated in 2024 confirmation of the technical and operational feasibility, and lifecycle cost efficacy of the MBC technology application for sustainable solidification and stabilization of a wide range of hazardous waste streams.

PACT RENEWABLES
A RENEWABLES COMPANY PTY LTD

The Need for Integrated PFAS Management Solutions and The Way Forward

Beyond the current collaborative preliminary assessment of the identifiable key air, health, and PFAS residuals-related risks to stakeholders, as stepping step, we are actively pursuing further optimisation of our MBC technology through establishing mutual strategic partnerships for its timely market adoption as a safe, cost-effective and low-risk containment solution for hard-to-abate PFAS residuals. Although well-positioned to lead in technology-based PFAS residuals containment, Pact Renewables, as the sole developer of the MBC technology, currently faces a number of innovation barriers, common to other Australian PFAS technology developing companies. The most critical ones, and directly relevant to current Australian environmental technology ecosystem, are:

- Lack of national recognition of PFAS residuals as a distinct regulatory category;
- Absence of a validation framework, and facilitated access to stockpiled PFAS residuals for case-specific technology trials; and
- Absence of regulatory sandbox and a national PFAS innovation fund to support Australian companies involved with developing appropriate technology solutions for integrated PFAS management.

If unaddressed, Australia risks becoming a net importer of expensive foreign treatment services or reliant on interim storage of hazardous PFAS residuals - a situation that is bound to burden the Australian utilities and waste handlers and potentially becoming another legacy waste.

Recommendations

Pact Renewables submits the following practical and forward-looking recommendations:

1. **National recognition of PFAS residuals** as a distinct and urgent waste category requiring safe interim containment.
2. **Commonwealth-led PFAS innovation fund**, including streams for destruction and containment technologies, with staged support based on performance metrics and independent validation.
3. **Regulatory sandbox** to allow for supervised piloting of PFAS residuals containment technologies, modelled on international best practices.
4. **Access to PFAS residuals** currently held by utilities, EPA contractors, or at remediation sites for site-specific MBC-cement trialing.

5. **Support for MBC-cement encapsulation validation** under NATA-accredited leaching protocols and landfill acceptance tests, to establish robust scientific evidence for policy inclusion.
6. **Inclusion of cradle-to-grave PFAS lifecycle assessment responsibility** in all future PFAS policy instruments, requiring treatment technology or solution providers to address residuals in risk and related cost assessments.

Conclusion

PFAS treatment may start at the molecule, but it ends in the material; as such, until PFAS residuals destruction technologies are proven and deployed at scale, the responsible course of action is safe, cost-effective, and verifiable containment of PFAS residuals. Australia has both the innovation capability and environmental imperative to lead on this front and Pact Renewables welcomes the Committee's attention to this matter and our readiness to collaborate with regulators, industry, and researchers to develop real-world solutions for the PFAS residuals crisis.

We respectfully request that the Select Committee consider this submission as part of its final deliberations and would welcome the opportunity to provide technical clarification or appear before the Committee.

Yours sincerely,

Aharon Arakel, BSc, PhD