Transitioning built infrastructure materials to zero net emissions by 2050. Why, rate of change and how?







Outline

- Current status, rate of change
- Research in progress
- Barriers to overcome
- Opportunities
- TREMS Network





Current Status

- \$13 billion a year construction materials industry in Australia is resource intensive
- Concrete consumption per annum is over 60 million tonnes per year, only second to water (3 tonnes per person per annum)
- Cement consumption is over 10 million tonnes
- Annual aggregate consumption in Australia is 130 million tonnes in 2018
- In 2050 this is expected to increase to 210 million tonnes
- 35% new quarries are needed to cater for this
- Climate change actions are expecting sector level pledges to reduce the environmental impact



Rate of change



Current funded academic projects in progress

- Recycled glass technology for cost effective green buildings', Sustainability Victoria Grant, (2019-2020). \$156,000,
- The use of brown coal ash as a replacement of cement in concrete masonry bricks (2017 to 2019), \$206,250, ARC, AGL Loy Yang, Adbri Masonry, Energy Australia,
- Using recycled glass as sustainable pavement base/subbase material', Sustainability Victoria Grant,\$149,465,
- High volume fly ash concrete for green construction Ph.D project, RMIT, (previously funded by Brookfield)
- Bio-char as coarse aggregate in concrete China research council grant



Current funded academic projects in progress

- 'Reinforced Crumbed Rubber Concrete for Residential Construction', ARC, Tyre Stewardship Australia (TSA), Tyrecycle, ResourceCO, FMG, AnconBeton.
- 'Plastic and Rubber Recycled Materials for Municipal Concrete Infrastructure', Sustainability Victoria Grant, (2019-2020). \$200,000, Office of Projects Victoria (OPV), Boral, City of Whitehorse.
- 'LDPE and Crumb Rubber in Asphalt', Sustainability Victoria Grant, (2019-2020). \$200,000, Office of Projects Victoria (OPV), City of Whittlesea.
- 'Manufactured Geopolymer coarse aggregate', Polyagg Pty Ltd research grant (2017-2019),\$100,000,





Barriers for translation of academic research

- Standards and specifications change requires an evidence base and stakeholder engagement (eg: US and Canada allows 12% mineral replacement in GP cement. AS 3972 allows 7.5%)
- Lack of assurance of a steady supply of recycled raw materials
- Focused research to support commercial deployment is not typically funded by grant schemes

 (eg: we can produce high volume fly ash concrete with 80% cement replacement – scaling up requires resources)
- Volume of available waste to be recovered is not known
- Up to 20% crushed glass aggregate is explored. Long term effect is unknown.

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Opportunities

- Expectation of sector pledges to achieve zero emissions by 2050
- Opportunity within the infrastructure boom
- Rise in community awareness and expectations
- Significant opportunity within local councils and state government agencies to utilise reclaimed resources
- Increase in cost of landfill
- 75% of Australia's energy is still from coal fly ash is available in abundance
- New industries and employment opportunities





ransformation of Reclaimed Resources int Engineered Materials and Solutions

TREMS





Objectives of TREMS

http://tremsnetwork.com/

- □ To create a forum for practitioners and academic researchers to jointly explore potential solutions for resource recovery and work towards a circular economy.
- To create a resource recovery roadmap, collaborative tools and resources to develop practical solutions for the benefit of all stakeholders.
- Secure benefits of scale and avoid duplication of research through co-design of a research program by stakeholders leading to an eco system for resource recovery





Why TREMS ?

- Opportunity to collectively identify barriers to translation of technologies
- Opportunity to connect a range of stakeholders and cross disciplinary research to cover the supply chain
- Ability to address economic viability, technical long term performance, legal status, environmental concerns and infrastructure
- Create investment opportunities for cross disciplinary solutions and multi sector partnerships
- Opportunity to develop an evidence base to support translation of scientific research through co-design of the research program
- Tap in to cross disciplinary academic expertise to address focused research to remove specific barriers to translation



TREMS Research Scope





Theme 1: Smart design of products to minimise waste

Ideas:

- Re imagine products design for reuse modular approaches
- Influence consumer behaviour and procurement decisions
- Tag green recyclable materials during facilities and asset management

Example Research Projects:

- Map the waste volumes, composition and recovery potential
- Demonstration project on design for deconstruction
- Novel construction materials designed for multiple reuse potential
- Develop a smart technology to label green building elements so that future procurement decisions can be influenced
- Products designed to be recycled/upcycled.

Potential Partners:

• Local councils, Sustainability Victoria, McDonald Lucas, VicRoads, Cross Yarra Partnership, BMD constructions, Aurecon



Theme 2: Separation at source, change behaviour, smart technology solutions

Ideas:

- Smart sensors to identify and separate recoverable material
- Educate community to support reuse
- Quantifying Social, Environmental and Economic impacts
- Learn and implement current world solutions, support SMEs in this space

Example Research Projects:

- Smart city applications to drive change
- Life cycle analysis to quantify the environmental impacts and benefits
- Social environmental and economic quantification of impact of waste to drive land fill levies
- Development of best practice targets
- Focus on self-awareness of industry and individuals to reapply products back to or for other areas.

Potential Partners:

• Local and state governments, Sustainability Victoria, Waste management associations, Bioelektra group, RepurposeIT





Theme 3: Waste treatment, processing, cleansing technologies

Ideas:

- Introduce new technologies to create a continuous supply of waste material, map waste streams generated to areas of need and barriers
- Explore international technologies of potential
- Biomass conversion to energy new technologies
- Plastic conversion to energy

Example Research Projects:

- Minimum treatment required for utilising waste
- Supply chain optimisation
- Map the techniques to treatment methods: autoclaving, washing, pressurising, sorting to applications

Potential Partners:

• Bioelektra, Repurpose IT, Alex Fraser Group, Downer, Local councils, Hyne Timber, Replas, Lycopodium Process Industries



Ideas:

- Multiple waste materials, catalysts, nano materials to create novel products
- Develop new generation solutions for materials and products

Example Research Projects:

- Crushed glass as coarse and fine aggregate in concrete
- Sand from coal mining as fine aggregate for concrete
- High volume fly ash in concrete
- Vortex treated glass fines as cement replacement in concrete
- Energy from non-biodegradable plastic waste for cement kilns
- Responsible introduction of waste plastic in roads: solving fuming and environmental concerns
- Recycled mining waste and fibre from shredded vehicle tyres to trigger magnetic healing of roads

Potential Partners:

 Bioelektra, Repurpose IT, Alex Fraser, Downer, AGL Loy Yang, Local councils, Hyne Timber, Major Road Projects Victoria, Office of Projects Victoria, Lycopodium Process Industries





Theme 5: Product implementation enablers, field trials, procurement decisions, Standards

Ideas:

- Field trials of solutions: concrete, asphalt, park infrastructure, storm water infrastructure, waste to energy
- Standards and specifications
- Procurement decision drivers

Example Research Projects:

- The use of glass coarse aggregate and crumb rubber in asphalt- field trial and smart monitoring using IoT
- Develop the evidence base to enable use of recycled coarse aggregate in concrete for local governments and road authorities
- Storm water pit lids using glass composites
- Energy from biomass technology demonstration projects
- Procurement policy changes user friendly data and matrix tool for procurement

Potential Partners:

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VicRoads, RMS, QTMR, Repurpose IT, City of Brimbank, City of Bendigo, BMD
 constructions, ARRB, Lycopodium Process Industries



Industrial Transformation Research Hub Program – Australian Research Council

- The Industrial Transformation Research Hubs scheme engages Australia's best researchers in issues facing the new industrial economies and training the future workforce. The scheme supports collaborative research activity, between the Australian higher education sector and industry, designed to focus on strategic outcomes that are not independently realisable.
- The Industrial Transformation Research Hubs scheme provides funding to Eligible Organisations to engage in cutting-edge research on new technologies and economic, commercial and social transformation which support the development of research outcomes that benefit industry partners in the Industrial Transformation Priorities.

TREMS will submit an application for funding in December 2019 with following contributions: \$3.75 m from industry partners, \$5 m from ARC, \$3 m from University partners





Benefits to partners - summary

Short term benefits

- Contribute to sector level pledges
- Solutions for accumulated materials
- Life-cycle assessment tools
- Translation of research to practice case studies
- Procurement decisions
- Filed trials to develop the evidence base
- Performance-based specifications for recycled materials in construction

Long term benefits

- Design for reuse
- New materials, technologies
- Demonstration plants
- New industries and employment in local council areas
- Carbon credits
- Branding, social impact and marketing



Expected Outcomes of TREMS

A resource recovery eco-system underpinned by :

- Knowledge of the magnitude and composition of resources going to land fill, current behaviour of stakeholders and opportunities.
- Opportunities for short term solutions and field validation for at least fifteen
 new technologies
- Policy changes and incentives within the local and state government sector to support the above
- A road map for long term solutions
- Developing and trialling at least twenty fundamental solutions which reimagine the landscape
- Sector pledges are developed with an underpinning evidence base



Thank You

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