Best Practice Advice on the Use of Recycled Materials in Road and Rail Infrastructure

Funded by the Commonwealth Government's Department of Climate Change, Energy, Environment and Water (DCCEW)

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The Australian Road Research Board (ARRB) is the source of independent expert transport knowledge, advising key decision makers on our nation's most important challenges.

MISSION
To create knowledgeable, innovative and impactful mobility solutions for our community through the intellect, experience and integrity of our people.

OUR VISION
An Integrated Mobility Future that is safe, sustainable and a driver of economic well-being.

OUR VALUES
Transformative, Collaborative, Energy and Passion, Integrity

Acknowledgements

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Agenda

Purpose

Context

About the project

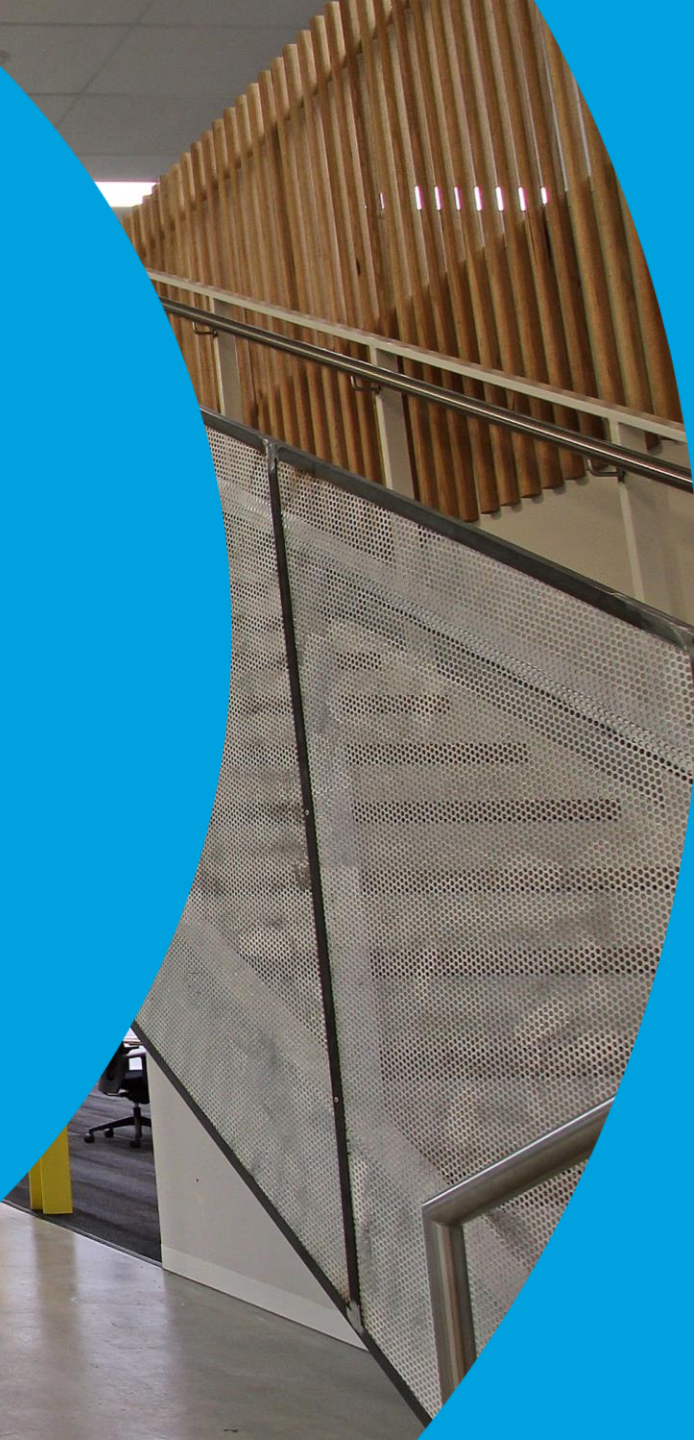
Sample findings

Questions

Purpose

Support the Australian Government's commitment under the National Waste Policy Action Plan 2019 to significantly increase the use of recycled content by governments and industry.

Context



The National Waste Policy and Action Plan

National framework for waste and resource recovery endorsed by all levels of government

1. Ban the export of waste plastic, paper, glass and tyres.
2. Reduce total waste generated by 10% per person by 2030.
3. Recover 80% of all waste by 2030.
4. Significantly increase the use of recycled content by governments and industry.
5. Phase out problematic and unnecessary plastics by 2025.
6. Halve the amount of organic waste sent to landfill by 2030.
7. Provide data to support better decisions.

Vision: the Circular Economy

About the Project

Objectives, Scope and Deliverables

Objectives

Best Practice Research

- Summarise government policies and actions that support the use of recycled materials in road and rail infrastructure
- Produce technical examination of the application and uses of recycled materials in road and rail infrastructure
- Assess environmental, economic and social impacts of recycled materials
- Identify barriers to adoption and opportunities to improve uptake
- Produce case studies of best practice use of recycled materials

Knowledge sharing

- Provide advice in various formats for different audiences
- Consolidate key findings in information sheets
- Promote research through social media and presentations

Recycled Materials

CRUSHED CONCRETE AND CRUSHED BRICK

Recycled products derived from construction and demolition waste. Contaminants such as timber, steel and plastics are removed, and the materials are further crushed and screened before incorporation into road infrastructure.

RECYCLED CRUSHED GLASS

Sourced mainly from glass food and beverage containers. Waste glass is processed and crushed to produce a sand-sized material.

RECLAIMED ASPHALT PAVEMENT (RAP)

Obtained from excavating road pavements or from milling existing asphalt surfaces. RAP usually has a high moisture content and comprises high-quality aggregates coated in bitumen. Asphalt pavements are considered fully recyclable as RAP.

Recycled Materials

CRUMB RUBBER

Recycled rubber produced from end-of-life (ELT) truck and car tyres.
Comprises several materials, such as elastomer compounds, textile fibres, carbon black and steel cords.
Rubber can be processed into different sizes, from crumb rubber to larger sizes such as rubber shreds.

FLY ASH

A by-product of coal-fired power generation.
When coal is combusted, ash is generated.
Lightweight fly ash constitutes about 90% of the total ash generated.
Fly ash also be generated through waste to energy incineration facilities.

GROUND GRANULATED BLAST FURNACE SLAG (GGBFS)

A by-product of steel and iron manufacturing.
Ground granulated blast furnace slag (GGBFS) is a white powder comprising calcium oxide, known as quick lime, silica and alumina. When ground to a powder and blended with water, it binds and strengthens granular materials.

Recycled Materials

BOTTOM ASH

A by-product of coal combustion in power plants. When coal is combusted, the coarse particles that fall to the bottom are called bottom ash. Other sources of bottom ash include waste-to-energy incineration facilities.

SOLID ORGANICS

Solid organics are biodegradable and encompass many products recycled from organic plant or animal products, including green waste, food waste, food-soiled paper, nonhazardous wood waste, timber and prunings.

BALLAST

Rail ballast that has been used, removed and cleaned to remove fines or fouled material to return it to a suitable level for reuse.

PLASTICS

Sourced from household, commercial and industrial streams. Common plastics are high-density polyethylene (HDPE), low-density polyethylene (LDPE), polypropylene (PP), polystyrene (PS), polyethylene terephthalate (PET) and polyvinyl chloride (PVC).

Deliverables

TECHNICAL REPORTS

FACT SHEETS & CASE STUDIES

https://www.arrb.com.au/recycled_materials_best_practice_advice

Technical Content

Material Overview

- Product descriptions
- Sources
- Processing

Market Maturity

- History of use
- Supply and demand
- Barriers
- Acceleration strategies

Supply

- Material flows
- Production
- Quantities generated

Current Uses

- Standard practices
- Alternative (non-infra) uses

Opportunities

- Road
- Rail

Specifications

- Applications
- Jurisdictions

Comparative Performance

- By application

Estimated Recycled Content

- Specified content % by application

Sustainability Impacts

Replacement Potential

- Estimated potential of recycled materials to replace virgin materials in specific road and rail applications
- Identify best practice replacement opportunities and replacement rate
- Quantify replacement potential

Environmental

- GHG emissions
- Overall environmental impacts (IS Enviropoints)
- Resource consumption

Economic

- Material cost estimates
- Job creation benefits

Social

- Positive and negative social impacts
- WH&S impacts

Sustainability Impacts: Highlights

Environment

Significant environmental benefits for most recycled material applications in road and rail infrastructure

- Greenhouse gas (GHG) emission reductions: from 47% to 98%
- Overall environmental improvements: from 59% to 99%

Best performing recycled materials

- RAP in surface and base layers as a replacement for asphalt made with virgin aggregates and binders
- Fly ash as a replacement for hydrated lime and cement in stabilised asphalts and concrete pavements

Sustainability Impacts: Highlights

Economy

Economic benefits for most recycled material applications in road and rail infrastructure

- Cost savings range from 2% to 83%
- RAP is the most cost-effective recycled material
- Wider adoption of recycling materials in infrastructure projects will create more jobs in the recycling market

Social

Positive and negative social impacts

- Positive: employment opportunities, community and civic pride, intergenerational equity and preservation of natural resources for future generations
- Negative: dust, noise and odour during the recycling process
- Mixed impacts for health and safety, although most health risks can be managed

Barriers to Adoption

- Awareness
- Prescriptive specifications
- Availability of materials
- Procurement
- Perceived inferior performance
- Perceived health, safety and environmental concerns
- Costs

Opportunities to Increase Adoption

- Increasing industry awareness and confidence
- Addressing data and evidence gaps
- Developing specifications
- Improving sustainability procurement
- Addressing WHS concerns
- Improving cost efficiency

Sample Findings

Sample Content: Recycled Crushed Glass

Material overview and performance

- RCG is waste glass processed and crushed to produce a sand-sized material
- Used an aggregate replacement
- Similar performance to natural sand
- Care needs to be taken when incorporated in concrete to avoid alkali aggregate reactions

Sample Content: Recycled Crushed Glass

Supply and Market Maturity

- RCG is primarily sourced from glass factories, demolition waste and glass bottles
- Barriers for market entry include processes for collection systems and contamination
- Recycling of glass back into glass products is fully realised but other applications are underdeveloped

Generated (tonnes)	Currently recovered (tonnes)	% recovered
1.16 million	688,000	~60

Sample Content: Recycled Crushed Glass

Current Uses

RCG can be used in:

- Asphalt, as a fine aggregate replacement
- Road base and subbase granular blends
- Railway capping with recycled concrete
- Drainage, as bedding and backfill
- Landscaping and embankment fill
- Non-structural concrete and concrete pavements

Opportunities

- Continued and increased use as aggregate replacements or partial aggregate replacements

Sample Content: Recycled Crushed Glass

RCG Content Allowances (by Mass)

- Up to 100% as bedding and backfill material and in certain drainage works
- Up to 50% in granular subbase
- Up to 40% with recycled concrete aggregates for use as a capping material in railway structures
- Up to 20% in granular bases and non-structural concrete
- Up to 15% of the fine aggregate component in concrete pavements
- Up to 10% in asphalt bases
- Up to 5% in asphalt wearing course

Sample Content: Reclaimed Asphalt Pavement

Environmental benefits

- Virgin aggregate and bitumen replacement
- 98% fewer GHG emissions
- 99% lower overall environmental impact (IS Enviropoints)
- 85% reduced diesel use
- Reduced materials to landfill

Cost reduction

- 83% lower material costs
- Additional savings from reduced need for landfill

Social benefits

- Preservation of virgin quarry materials and imported bitumen
- Recyclable at end-of-life, promoting circular economy outcomes


QUESTIONS

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Thank You