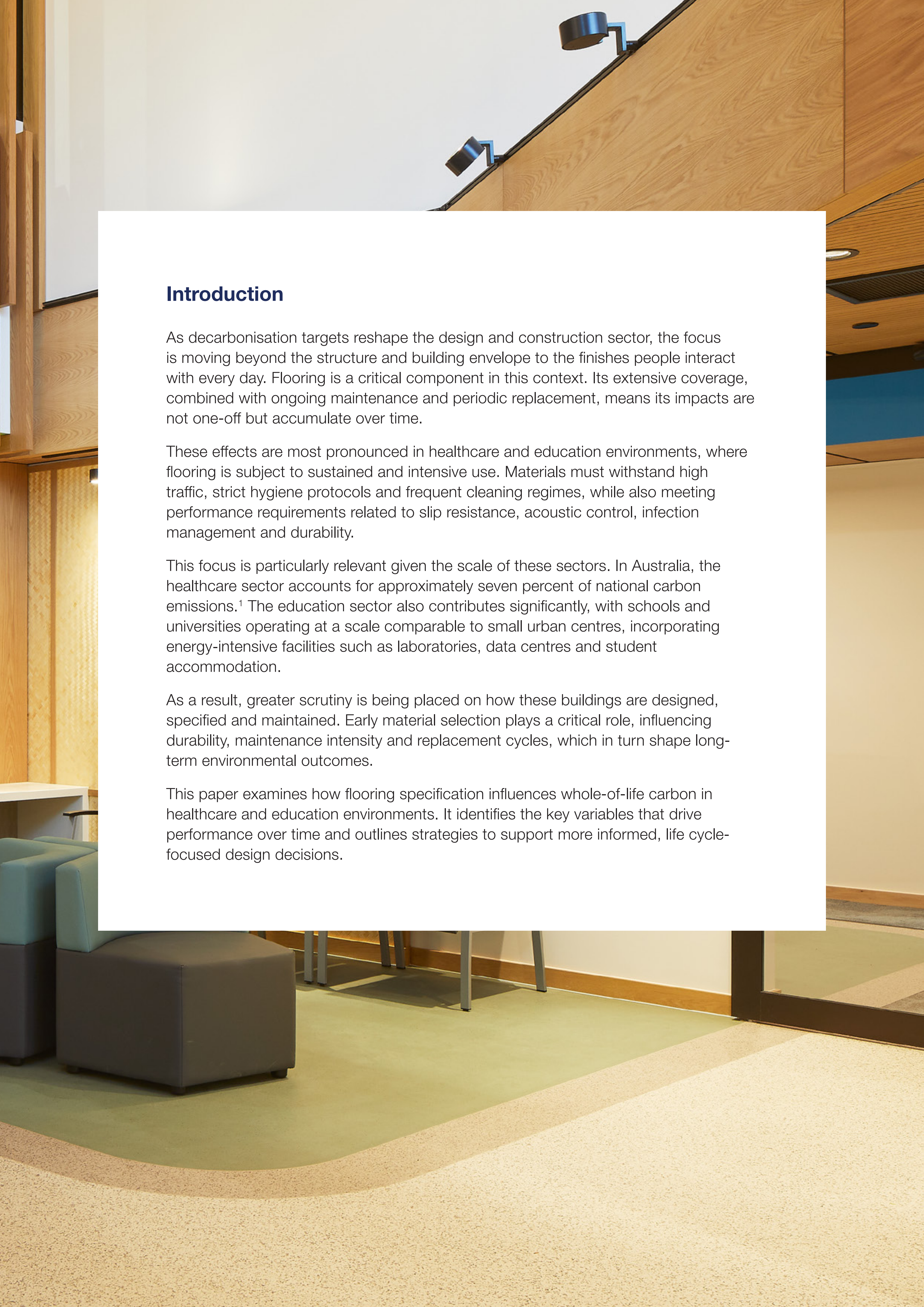
Surface Decisions

A Life Cycle Approach to Low-Carbon Flooring Specification
in Healthcare and Education Environments

Gerflor®



Introduction

As decarbonisation targets reshape the design and construction sector, the focus is moving beyond the structure and building envelope to the finishes people interact with every day. Flooring is a critical component in this context. Its extensive coverage, combined with ongoing maintenance and periodic replacement, means its impacts are not one-off but accumulate over time.

These effects are most pronounced in healthcare and education environments, where flooring is subject to sustained and intensive use. Materials must withstand high traffic, strict hygiene protocols and frequent cleaning regimes, while also meeting performance requirements related to slip resistance, acoustic control, infection management and durability.

This focus is particularly relevant given the scale of these sectors. In Australia, the healthcare sector accounts for approximately seven percent of national carbon emissions.[1] The education sector also contributes significantly, with schools and universities operating at a scale comparable to small urban centres, incorporating energy-intensive facilities such as laboratories, data centres and student accommodation.

As a result, greater scrutiny is being placed on how these buildings are designed, specified and maintained. Early material selection plays a critical role, influencing durability, maintenance intensity and replacement cycles, which in turn shape long-term environmental outcomes.

This paper examines how flooring specification influences whole-of-life carbon in healthcare and education environments. It identifies the key variables that drive performance over time and outlines strategies to support more informed, life cycle-focused design decisions.

Understanding the life cycle of flooring materials

Figure 1. Life cycle of flooring

01. Manufacture	02. Installation	03. Use Phase	04. End-of-Life
Raw materials	Adhesives	Cleaning	Removal
Production	Prep layers	Maintenance	Transport
Transport	Waste	Energy & water	Reuse / landfill

Flooring materials contribute carbon at multiple stages of the product life cycle, from manufacture through to end-of-life recovery or disposal. Life cycle assessment (LCA) has emerged as a key methodology for evaluating these impacts. It considers emissions across all stages of a product's life, including raw material extraction, manufacturing, transport, installation, maintenance, replacement and end-of-life processes.

This approach defines 'embodied carbon' and 'operational carbon'. Embodied carbon can be further divided into upfront carbon, in-use and end-of-life emissions. Upfront carbon arises during raw material extraction, processing, manufacturing, transport to site and construction. Flooring installation can introduce additional impacts through adhesives, levelling compounds, underlays and material waste. These upfront stages are often the focus of assessment, but they do not capture the full life cycle profile.

Beyond upfront impacts, flooring materials will contribute additional embodied carbon during the use phase through maintenance, repair, replacement and refurbishment.

Flooring systems require regular cleaning, maintenance and, in some cases, refurbishment. These activities consume water, chemicals and energy, particularly in environments with strict hygiene requirements. Maintenance intensity and product durability therefore have a direct influence on long-term carbon outcomes.

End-of-life impacts are generated when flooring is removed, transported and either recycled, repurposed or sent to landfill. In high-traffic environments such as hospitals and schools, shorter replacement cycles mean these stages are repeated multiple times over the life of the building, compounding their overall impact.

Embodied carbon accounted for approximately 10 per cent of Australia's built environment emissions in 2023.[2] Within this, flooring systems can represent a significant share due to their extensive coverage, relatively short replacement cycles and ongoing maintenance requirements. In high-use environments such as hospitals and schools, these impacts compound over time due to intensive use, strict maintenance regimes and shorter replacement cycles.

Comparing carbon performance across flooring products

Understanding life cycle carbon highlights the complexity of material impacts over time. Translating this into specification decisions requires access to reliable, standardised data. Environmental Product Declarations (EPDs) have emerged as a primary tool for this purpose. EPDs allow architects to quantify and compare the environmental performance of flooring products.

EPDs present LCA data in a consistent format, typically aligned with international standards, specifically EN 15804 and ISO 14025. They report embodied carbon across defined life cycle stages and are independently verified. Within the context of flooring, EPDs provide designers with a useful reference point to assess measurable differences between products.

However, EPDs are not directly comparable without careful review. They can vary in scope, system boundaries and reporting assumptions. Some declarations report "cradle-to-gate" impacts only (A1-A3), while others extend to the construction stage (A4-A5), use stage (B modules) and end-of-life scenarios (C modules). Differences in declared units, service life assumptions and maintenance scenarios can further affect results. This requires architects to take a critical and consistent approach when interpreting EPD data.

For flooring products, these variations are particularly relevant. Maintenance regimes, cleaning frequency and replacement intervals can significantly influence whole-of-life performance. An EPD that excludes use-stage impacts may understate the carbon associated with high-maintenance materials.

End-of-life scenarios, including whether materials are landfilled or recycled, may have a limited influence on reported embodied carbon within standard EPD system boundaries, but they carry broader environmental implications. For PVC flooring, recycling can contribute to reduced future emissions by displacing virgin material production, while also supporting resource conservation, circular design strategies and reduced reliance on landfill capacity.

Maintenance, durability and life cycle carbon

In healthcare and education environments, flooring is subject to intensive use and strict hygiene requirements. Cleaning regimes are frequent and often rigorous, incorporating machine scrubbing, disinfectant application and periodic refurbishment processes such as polishing or stripping. These activities consume water, chemicals and energy throughout the life of the floor. As a result, maintenance can represent a significant contributor to life cycle carbon in these sectors.

In healthcare settings, infection control requirements further intensify these impacts. Flooring must withstand repeated disinfection without degradation or loss of performance. Some materials rely on specialised maintenance processes to maintain appearance or slip resistance, increasing reliance on chemical treatments and energy-intensive cleaning methods. Surface technologies and protective finishes can influence how often cleaning is required and how materials respond to these regimes over time.

Durability is closely linked to these outcomes. Each cycle of new flooring introduces additional embodied carbon through manufacturing, transport and installation, along with emissions associated with removal and disposal of existing materials.

What are the implications for design and specification?

Extending service life is a primary lever for reducing life cycle carbon. Flooring that maintains performance over longer periods reduces the frequency of replacement. For architects, this requires prioritising long-term performance over initial cost or appearance. Abrasion, impact and moisture resistance are critical in high-use environments and directly influence durability under daily wear and cleaning regimes.

Flooring systems that rely on intensive processes such as polishing or stripping introduce ongoing resource use and carbon emissions. Preference should be given to materials that maintain performance with standard cleaning methods and reduced chemical use. Where possible, finishes and surface technologies that minimise maintenance frequency should be prioritised.

Service life assumptions should be tested against the specific building type. In healthcare and education environments, conservative estimates are often more realistic due to higher wear and stricter hygiene requirements. Aligning expected lifespan with realistic maintenance regimes allows for more accurate life cycle assessment and supports better comparison between products.

PVC and sustainability in flooring design

Durability and maintenance requirements are critical drivers of life cycle carbon, but they also expose limitations in how flooring sustainability is commonly assessed. In healthcare and education design, discussions are often reduced to material-based comparisons, particularly around PVC versus non-PVC products.

PVC-based resilient flooring is widely used in healthcare and education environments in Australia and internationally. Products such as vinyl sheet, luxury vinyl tile and homogeneous vinyl are commonly specified due to their durability, cleanability and ability to meet strict hygiene and safety requirements. In healthcare settings, PVC flooring supports infection control through seamless installation, resistance to moisture and compatibility with frequent disinfection. In education environments, it offers good wear resistance, ease of maintenance and acoustic benefits in high-traffic areas.

The prevalence of PVC flooring has made it a focal point in sustainability discussions. Concerns have historically centred on material composition, including legacy production methods and additives, as well as end-of-life disposal. In response, non-PVC alternatives have emerged and are often positioned as lower-impact options.

Legacy concerns around additives, particularly phthalate plasticisers and heavy metal stabilisers used in earlier formulations have also influenced perception, although these have been progressively phased out or replaced in many contemporary products.

A life cycle approach provides a more accurate basis for comparison, as environmental performance is driven by manufacturing processes, maintenance requirements and service life rather than material category alone. In some cases, non-PVC flooring products can exhibit higher environmental impacts. For example, comparative LCA studies have found that carpet flooring systems perform poorly across multiple environmental impact categories, ranking worse than PVC or similar surface materials in most measures.[3]

PVC-based systems demonstrate relatively predictable performance over time, which is a key consideration in high-use environments. This consistency supports more reliable service life assumptions during design and can contribute to lower life cycle carbon outcomes when assessed over the full life of the building. The European Resilient Flooring Manufacturers' Institute and industry LCA datasets show vinyl flooring service lives commonly in the range of 20–30+ years in commercial settings depending on maintenance.[4]

Maintenance regimes, cleaning frequency and replacement intervals can significantly influence whole-of-life performance.

Circularity and end-of-life considerations

End-of-life outcomes reinforce the life cycle impact of flooring. In Australia, approximately 60,000 tonnes of resilient flooring waste is generated each year, with the majority sent to landfill.[5] This reflects the limited recovery pathways that have been traditionally available to common flooring materials.

In response, circular economy principles are increasingly influencing specification decisions. Rather than focusing solely on disposal, circularity emphasises extending material use through reuse, recovery and recycling while minimising waste. For flooring, this depends on the ability to recover materials at the end of their service life and reintroduce them into new production cycles. However, this remains constrained in practice by factors such as adhesives, contamination and composite material structures.

Emerging manufacturer-led take-back and recycling programs are beginning to address these limitations. For example, programs such as Gerflor's "Second Life"[6] initiative enable the collection of installation offcuts and cleaning of end-of-life flooring for reprocessing into new products. These systems are typically most effective where materials are installed using methods that allow for clean separation, such as loose-lay or low-residue systems.

In Australia, ResiLoop is emerging as a national product stewardship scheme for resilient flooring. Established by the Australian Resilient Flooring Association with government support, it introduces a product levy to fund the collection and recycling of materials such as vinyl sheet and luxury vinyl tiles. The program is backed by major industry participants, including manufacturers and suppliers such as Gerflor, and is focused on recovering installation offcuts through a growing network of collection points.

Key takeaways: Strategies for lower-carbon flooring specification

Effective flooring specification requires a shift from short-term selection criteria to a whole-of-life performance approach that considers durability, maintenance and end-of-life outcomes.

- **Prioritise whole-of-life value over upfront cost:** Lower-cost products may increase life cycle carbon and operational costs due to shorter service life and higher maintenance demands.
- **Use LCA data and EPDs to inform decisions:** Assess impacts across multiple stages, not just upfront embodied carbon, to enable more accurate product comparisons.
- **Specify for durability and performance:** Select flooring suited to expected traffic and use conditions to reduce replacement frequency and associated embodied carbon.
- **Consider maintenance requirements:** Prefer materials that perform with standard cleaning regimes and avoid energy- or chemical-intensive processes.
- **Implement circular principles:** Evaluate end-of-life pathways, including recyclability, take-back programs and compatibility with recovery systems.
- **Engage with manufacturers:** Seek transparent EPD data, service life assumptions and information on recycling or take-back initiatives to support informed specification.

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A life cycle approach to low-carbon flooring

Reducing life cycle carbon in flooring requires a shift from product selection to system-based design. In response, manufacturers are developing innovative flooring systems that combine recycled content with long-term performance in high-use environments.

Gerflor has positioned its product range around life cycle performance, particularly in high-use sectors such as healthcare and education. PVC-based resilient flooring forms a core part of this approach due to its ability to deliver long service life and stable performance under demanding conditions. Homogeneous vinyl ranges such as Mipolam are designed for durability and chemical resistance, enabling consistent performance under intensive cleaning regimes. Heterogeneous and acoustic vinyl systems, including Taralay and Taraflex, are engineered to balance wear resistance with underfoot comfort and acoustic performance in education and sports environments. Surface treatments such as Protecsol® and Evercare™ reduce the need for polishing and stripping, lowering water, chemical and energy use over time. These systems are engineered to deliver extended service life, limiting replacement cycles and associated embodied carbon impacts.

While PVC production currently relies on fossil fuel inputs, Gerflor applies an eco-design approach aimed at reducing resource consumption and lowering carbon impacts across each stage of the product life cycle. On average, Gerflor flooring contains approximately 25% recycled material, with many products manufactured within closed-loop systems where production waste is reintegrated into new flooring. In parallel, the company is also increasing the use of bio-based content in selected product ranges, further reducing reliance on virgin fossil resources; this is explored in more detail in Gerflor's whitepaper Designing with Biobased Flooring Materials.

Circularity is further supported through Gerflor's recycling infrastructure. The "Second Life" program facilitates the collection of installation offcuts and clean end-of-life materials, which are processed through the Floor to Floor recycling platform and reintroduced into manufacturing. In parallel, product formulations are designed to meet strict environmental and health criteria, including compliance with REACH requirements and avoiding substances such as heavy metals, formaldehyde and other hazardous compounds

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REFERENCES

1 Arunima Malik et al. “The Carbon Footprint of Australian Health Care.” The Lancet Planetary Health, Vol. 2, No. 1 (2018): e27–e35.

2 Australian government. “Embodied Carbon Projections for Australian Infrastructure and Buildings.” Infrastructure Australia. https://www.infrastructureaustralia.gov.au/reports/embodied-carbon-projections-australian-infrastructure-and-buildings (accessed 8 April 2026).

3 Teresa Ros-Dosdá et al. “Environmental Comparison of Indoor Floor Coverings.” Science of the Total Environment, Vol. 693 (2019): 133519.

4 For more information, go to https://erfmi.com.

5 Australian Competition & Consumer Commission. “ACCC proposes to authorise flooring recycling scheme.” ACCC. https://www.accc.gov.au/media-release/accc-proposes-to-authorise-flooring-recycling-scheme (accessed 8 April 2026).

6 Gerflor. “Second life: our recycling program.” Gerflor. https://www.gerflor.au/category/second-life-our-recycling-program (accessed 8 April 2026).

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