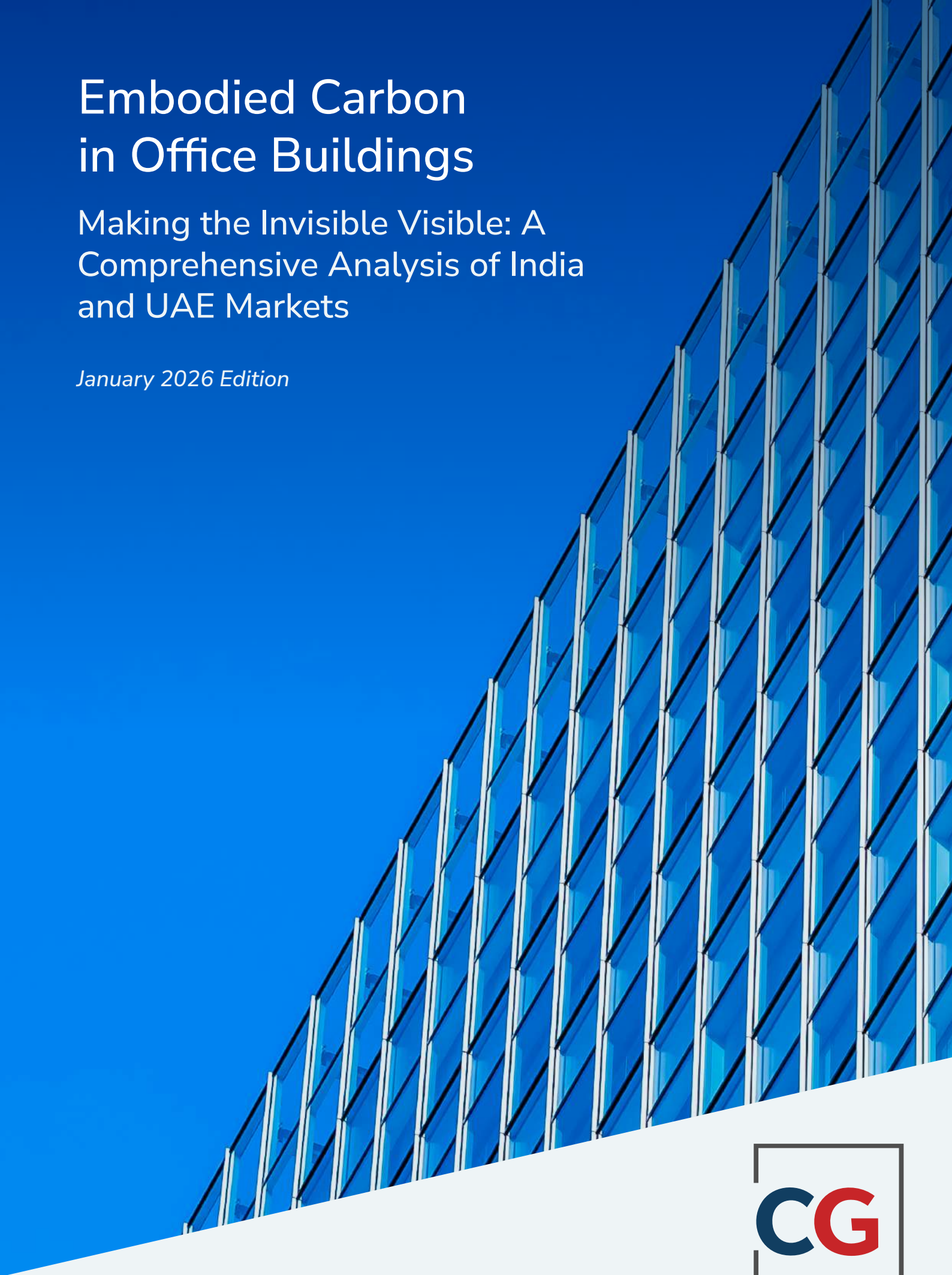
Embodied Carbon in Office Buildings

Making the Invisible Visible: A Comprehensive Analysis of India and UAE Markets

January 2026 Edition



Carbon Guardians

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Executive Overview

While the world focuses on operational carbon, embodied carbon—the invisible 30%—remains largely unmeasured and unmanaged. This report presents groundbreaking research on embodied carbon in commercial interiors across India and UAE, revealing both the challenge and the trillion-dollar opportunity in sustainable workspace transformation.

34%
Global CO_2 Emissions from Buildings
UNEP, 2024

40%
Reduction Target by 2030
WorldGBC

2.9 Gt
Annual Embodied Carbon
Global Buildings Sector

30–45%
Share in Interior Fit-Outs
Carbon Guardians Research

Market Opportunity

- $37.99 billion green building market in FY24 with potential to grow up to $85 billion by FY32
- Approx. 86 million sq ft office leasing in 2025
- Share of Green-certified buildings has touched an approximate of 75% of Grade A offices in 2025, which was approx. 65% in 2023
- 10–20% rental premium for sustainable spaces
- 150 million tonnes of C&D waste annually
- Current Recycling rate < 1%

- National commitment to Net Zero by 2050
- 215 kg CO_2e/m^2 average intensity
- Mandatory GHG measurement from 2024
- 75% C&D recycling target by 2030
- Estidama Pearl rating since 2010
- Current Recycling rate < 10%

Why This Matters Now

As operational carbon intensity approaches practical limits through energy efficiency, embodied carbon has become the critical frontier. Our research across 25+ projects reveals that interior fit-outs contribute 30–45% of whole-building lifecycle emissions, yet remain largely untracked. With India and UAE leading Asia's green building growth, the time to act is now.

"At Carbon Guardians, we've measured what others ignore. This report shares insights from 25+ projects and 5,000+ employees, proving that embodied carbon measurement isn't just feasible—it's profitable."

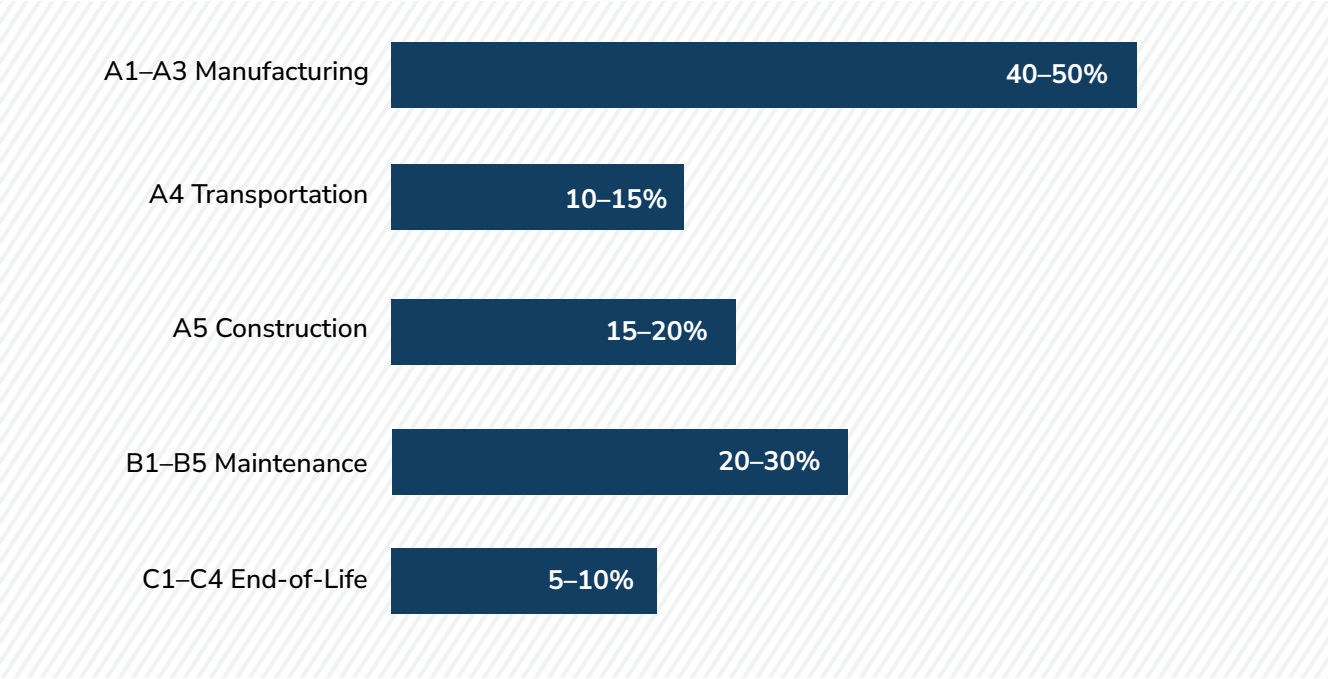
VIBHOR JAIN
Founder & CEO

Embodied Carbon Framework & Research

Understanding Embodied Carbon

Embodied carbon encompasses all greenhouse gas emissions from material extraction, manufacturing, transportation, construction, and end-of-life disposal. Unlike operational carbon (from energy use), embodied carbon is emitted upfront and permanent—making early intervention critical.

Lifecycle Breakdown



- A1–A3 are typically considered for carbon footprint calculations because it covers the cradle-to-gate product stage, which represents the initial and most significant portion of embodied emissions.
- Data for A1–A3 are also readily available, whereas stages beyond this point often lack reliable information and are more time-consuming to assess.

Why Interiors Matter

Interior fit-outs have 3–5 year refresh cycles versus 50–100 year building lifespans. This means:

- 10–20 interior renovations occur per building's lifetime.
- Cumulative embodied carbon can exceed the base building structure.
- Rapid intervention opportunities for significant impact.
- Immediate ROI potential through material optimization.

Measurement Framework

We employ a rigorous cradle-to-gate methodology aligned with ISO 14044 and EN 15978 standards, utilizing Environmental Product Declarations (EPDs) and regional life cycle databases.

Data Collection

- Bill of Quantities (BOQ) from all projects
- Material specifications and sourcing data
- Transportation distances and modes
- End-of-life disposal methods

Analysis Tools

- CG Platform (proprietary carbon calculation software)
- Regional EPD databases
- ASHRAE 189.1 benchmarks
- ISO 14067 carbon footprinting
- Sensitivity and scenario modeling

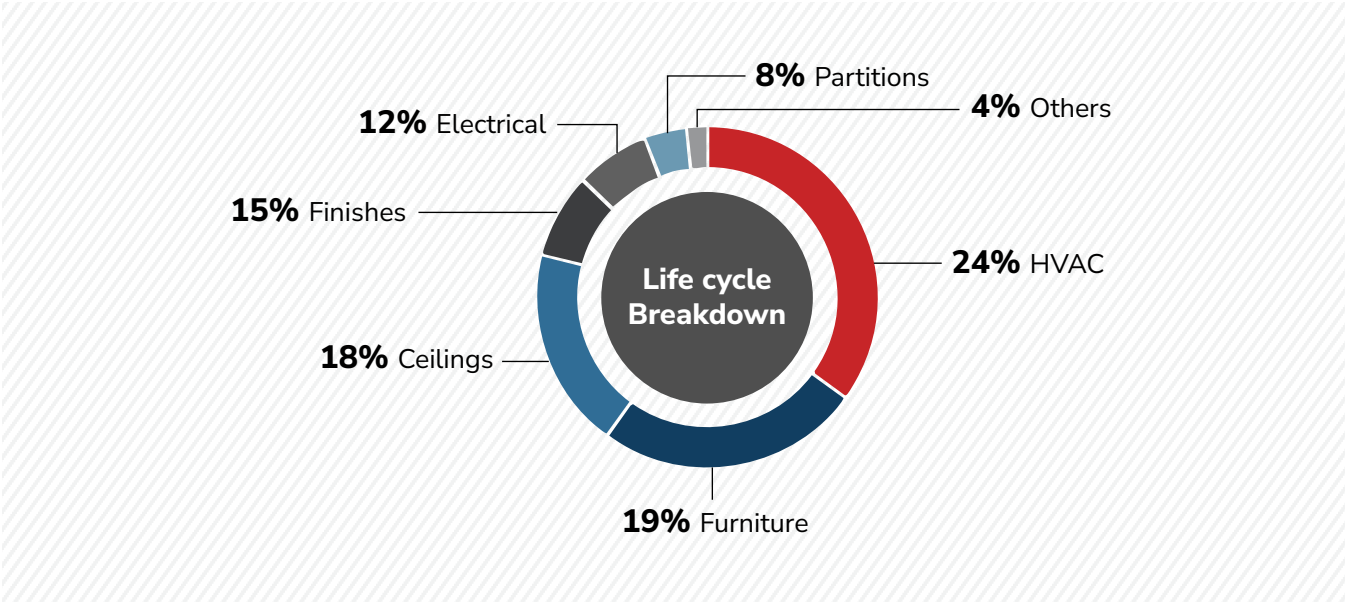
Key Findings Summary

- Interior fit-outs contribute to 30–45% of total embodied carbon emissions.
- **Component hierarchy:** HVAC (24%), Furniture (19%) and Ceilings (18%) dominate emissions.
- **Material hotspots:** Aluminum, steel, and cement-based products are primary contributors.
- **Design correlation:** Higher-grade fit-outs show 40–60% higher embodied carbon intensity.
- **Optimization potential:** 30–50% reduction achievable through material swaps.
- **Regional variations:** India shows 15–25% higher intensity due to supply chain factors.
- Reduction in emissions through material reuse.
- Reduction in emissions through engineered natural products/items & recycled products.

Interior Fit-Out Analysis

Component-Level Breakdown

Our analysis of 25+ projects reveals seven major component categories that account for 96% of total embodied carbon in interior fit-outs. Understanding this hierarchy is critical for targeted intervention.



Material Intensity Patterns

High-Impact Materials

- Aluminum: 8–12 kg CO_2e/kg (structural & cladding)
- Steel: 1.8–2.5 kg CO_2e/kg (frames, supports)
- Cement products: 0.8–1.2 kg CO_2e/kg (walls, flooring)
- Glass: 0.9–1.1 kg CO_2e/kg (partitions, facades)
- Plastics/Composites: 2–6 kg CO_2e/kg (various)
- High-VOC paints

Low-Carbon Alternatives

- Recycled aluminum: 0.5–1 kg CO_2e/kg (90% saving)
- Recycled steel: 0.4–0.6 kg CO_2e/kg (75% saving)
- Bamboo: 0.15–0.25 kg CO_2e/kg (compared to wood and PVC)
- Recycled gypsum: 0.2 kg CO_2e/kg (30% saving)
- Bio-based insulation: 0.1 kg CO_2e/kg
- Low-VOC paints

Design Grade Impact

Analysis across different fit-out standards reveals strong correlation between design grade and embodied intensity:

98–150 kg CO_2e/m^2
Grade B/C Fit-Out

300–450 kg CO_2e/m^2
Premium/Luxury

180–250 kg CO_2e/m^2
Grade A Fit-Out

30–50% Reduction Potential
Material Optimization

Insights from Carbon Guardians Case Studies

Case 1

Retention-First Fit-Out: Chennai

What we did:
- Retained existing ceilings, partitions, and workstations instead of full replacement.
- Conducted a rapid circularity assessment to identify reusable components.
- Emissions reduced by 5%.

Impact:
- By avoiding new manufacturing and transportation, we reduced embodied carbon by an estimated 5% versus a conventional fit-out.
- This approach demonstrates how even partial reuse delivers measurable sustainability benefits.

Case 2

Material Circularity: Gurugram, Haryana

Key Circular Interventions:
- Installed carpet tiles sourced through a manufacturer take-back recycling program.
- Introduced recycled-metal workstation frames in place of virgin steel.
- 40% of loose furniture and 5% of interior items were repurposed for reuse. This reduced transportation emissions.
- Waste channelled to recyclers instead of landfills.
- Material swaps: 30% reduction in emissions.
- 2.5 tonnes of waste diverted.
- Low-carbon selection: 20–40% reduction in emissions.

Impact:
- These targeted interventions alone raised the project's circular content to 35%, showcasing how flooring and furniture can significantly shift the carbon profile of a workspace.

Case 3

Material Circularity: Delhi

In one of our recent projects, a 10,000 sq ft office for a legal firm in Delhi we consciously integrated circular design principles across every stage of the fit-out process. Instead of starting from scratch, we began by auditing the existing space to identify reusable materials and furniture components.

- **Reuse and Modular Approach:** Nearly 35% of the loose furniture and 7% of the interior items were repurposed or reupholstered for reuse, instead of sourcing new pieces. This significantly reduced material inflow and transport-related emissions.
- **Responsible Demolition:** During strip-out, all dismantled elements were channelled to authorized recyclers and local scrap networks, ensuring traceable end-of-life management instead of landfill disposal.
- **Embodied Carbon Reduction:** Through targeted material swaps prioritizing recycled-content boards, lower embodied carbon alternatives, low-VOC paints, and regionally sourced materials we achieved an estimated 30% reduction in embodied carbon compared to a conventional new fit-out of similar scale.
- **Waste Diversion:** Overall, the projects diverted approximately 2.5 tonnes of furniture waste from landfill, demonstrating tangible circular outcomes even within the constraints of a leased workspace and tight delivery schedule.

Case Study 4: Dubai

- HVAC contributes the highest share to the overall carbon footprint, primarily due to the incorporation of an excessive number of Fan Coil Units (FCUs), followed by ceilings and furniture as the next major contributors to carbon emissions.
- Most materials and equipment were sourced internationally rather than locally, resulting in a high transport-related carbon footprint.
- No items were reused, refurbished, or recycled, leading to zero emission savings.

CG Recommendations:

We recommend optimizing HVAC design, prioritizing local procurement, and integrating reuse and recycling practices to achieve carbon emission reductions.

What These Projects Prove

Circularity is not a design trend, it is a practical, scalable pathway to lowering carbon in commercial interiors.

Through structured reuse, responsible demolition, and low-carbon material selection, we can reduce embodied emissions by 20–40% in many typical office fit-outs. Our approach shows that sustainability and functionality can coexist seamlessly when planned early and executed with the right ecosystem of partners.

"Embodied carbon is redefining how we think about interior environments. Designers and occupiers want to understand the real impact of what they build — and early carbon quantification gives them that confidence.

From our work in India and the UAE, it's clear that measuring carbon doesn't restrict design. It gives teams a stronger framework to create high-performing, climate-responsible spaces. The companies that embrace this today will shape tomorrow's workplaces."

MOHIT GAMBHIR
Co-Founder &
Executive Director

Global Case Studies: Low-Carbon Interior Fit-Out

Several organizations globally demonstrate that low-carbon interior fit-outs are not only feasible, but can also deliver measurable performance, flexibility, and long-term value. The following case studies highlight best-practice approaches to embodied-carbon reduction through design, material intelligence, and circular strategies.

Case Study 1: Hines Seattle Headquarters

Challenge:
Relocate Pacific Northwest headquarters while supporting net-zero carbon by 2040 commitment.

Approach:
Partnered with LMN Architects to track carbon impact of every material decision. Retained existing carpet (2 years old), repurposed conference room glazing, used wood offcuts for reception desk and feature wall, sourced discarded timber for doors and tables.

Result:
65% lower embodied carbon than typical fit-out.

Case Study 2: Brookfield Shanghai Office

Challenge:
Showcase low-carbon possibilities to support tenant net-zero ambitions.

Approach:
All materials assessed against RESET Standard for embodied carbon, circularity, and health. Selected carbon-neutral Milliken carpets, Saint-Gobain plasterboard, Porcelanosa ceramic tiles with high recycled content.

Result:
41% embodied carbon reduction. Achieved RESET Carbon Neutral Certification for embodied carbon.

Case Study 3: JLL London Office (20 Water Street)

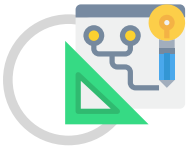
Challenge:
Deliver net-zero fit-out with 5-year lease, maximizing future reuse potential.

Approach:
Exposed ceilings, wireless Bluetooth lighting (saved hundreds of meters of cable), modular furniture designed for disassembly, "end-of-life management hierarchy" for every component planning reuse across portfolio.

Result:
42% upfront embodied carbon reduction. Easy space reconfiguration post-occupancy based on user feedback—no additional carbon impact.

Circular Economy Framework

The construction industry generates 2 billion tonnes of waste globally. Transitioning from linear "take-make-dispose" to circular "reduce-reuse-recycle" models is essential for embodied carbon reduction.



Design Strategies

- **Design for disassembly:** Modular systems with mechanical connections
- **Material passports:** Digital documentation for future reuse
- **Standardization:** Common dimensions enable interchangeability
- **Durability:** Longer lifespans reduce replacement frequency
- Bio-based, renewable materials
- Optimization for waste reduction

Procurement Strategies

- **EPR frameworks:** Extended producer responsibility
- **Take-back schemes:** Manufacturers reclaim end-of-life materials/ circular procurement
- **Certified recycled content:** Minimum thresholds in specs
- **Local sourcing:** Reduce transport emissions
- Prioritise EPD-verified products
- Green logistics and packaging

INDIA

- 150M tonnes of C&D waste per year
- <1% current recycling rate
- Growing EPR implementation
- Nascent material exchange platforms

UAE

- <10% C&D recycling currently, 75% target by 2030
- Active investment in infrastructure Regional circular economy hub ambition

Suggestions on C&D Waste Reduction in India

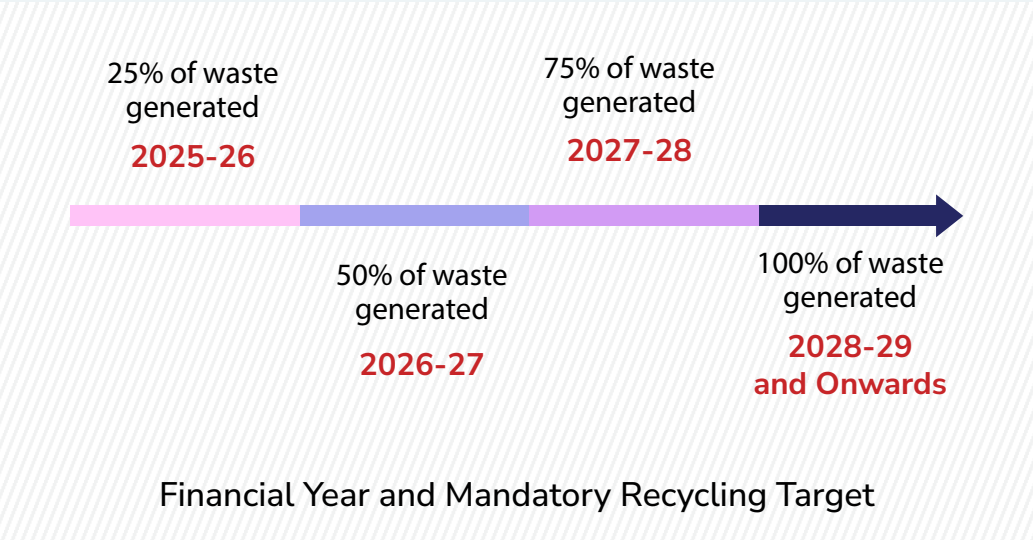
In India, Construction and Demolition (C&D) waste has reached a staggering 150 million tonnes per year, yet the recycling rate has historically been below 1%.

To bridge the gap between the current <1% rate and the government's ambitious 100% recycling target by 2028-29, a multi-pronged strategy is required.

Regulatory and Policy Shifts:

The Government of India has recently overhauled the regulatory landscape to enforce accountability.

The rules will take effect on April 1, 2026. They introduce Extended Producer Responsibility (EPR). Developers and builders for projects over 20,000 square metres are now legally responsible for the waste they generate.



Mandatory Utilization Targets (Schedule II & III)

To ensure there is a market for recycled materials, the government has also mandated that new construction projects must incorporate processed C&D waste.

- **Building Projects**: Must use at least 15% recycled materials by 2028-29, increasing to 25% by 2030-31.
- **Road Projects:** Must use at least 10% recycled materials by 2028-29, increasing to 15% by 2030-31.

Adoption of "De-construction" Over Demolition

The 2025 framework introduces De-construction as a legal concept, encouraging the systematic disassembly of buildings to salvage materials before crushing.

- **In-Situ Recycling:** The law gives higher EPR weightage/credits for on-site recycling. Mobile crushing units allow developers to reuse concrete aggregates immediately for sub-bases, avoiding the carbon footprint of transport.
- **Salvage Value:** Pre-demolition audits can recover 25% to 75% of value in the form of steel, wood, and fixtures before they become "waste."

Mandated Utilization in New Construction

To ensure the $85 billion green building market absorbs this waste, the government has set mandatory "Recycled Material" quotas:

- **Building Projects:** Must replace 5% of virgin materials with recycled C&D waste by 2026-27, increasing to 25% by 2030-31.
- **Road Construction:** The Indian Roads Congress (IRC) guidelines now permit/mandate 5–15% recycled aggregate use in pavements and road-sub bases.

Operational Best Practices

Strategy	Implementation
Source Segregation	Mandating the separation of waste into 4 streams on-site: Concrete, Soil, Steel/Wood/Plastic, and Bricks/Mortar.
Material Recovery Facilities (MRFs)	Establishing regional hubs where small-scale contractors can drop-off waste for a fee lower than illegal dumping fines.
Green Procurement	Government departments (CPWD, NHAI) must prioritize "Recycled Concrete Aggregates" (RCA) for pavements, kerbstones, and boundary walls.

Technology Enablers

Digital tools are transforming embodied carbon management from manual estimation to precise, real-time optimization throughout the project life cycle.

Key Technologies:

BIM Integration: Real-time carbon modeling from design quantities

EPD Databases: Automated LCA with manufacturer-specific data

AI/ML Optimization: Material recommendations for carbon-cost tradeoffs

Digital Twins: Scenario testing and life cycle simulation

Blockchain: Material provenance and circular economy tracking

IoT Sensors: Post-occupancy performance validation

Carbon Guardians CG Platform

Our proprietary platform integrates BIM models, regional EPD databases, and AI-powered optimization to deliver automated embodied carbon measurement. The platform enables:

- Component-level carbon breakdown with hotspot identification
- Material swap scenarios with cost-carbon tradeoff analysis
- Real-time reporting aligned with LEED, IGBC, Estidama frameworks
- Benchmark comparison against industry standards
- Suggestions / Low carbon alternative items for future

Implementation Best Practices

Successful embodied carbon programs integrate early measurement, collaborative design, and continuous tracking. Leading organizations establish baseline inventories, set reduction targets, and embed carbon considerations in procurement processes.

What We Serve

Corporate Offices

GCC

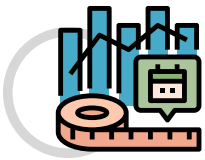
Startups

Carbon Guardians' Approach

Our Mission

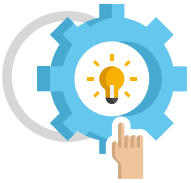
At Carbon Guardians, we make the invisible visible. We empower organizations to measure, manage and reduce the embodied carbon in their workspaces—transforming sustainability from aspiration to quantified impact.

Our Services



Measurement and Analysis

- Comprehensive embodied carbon assessment
- Component-level breakdown and hotspot identification
- Benchmarking against industry standards
- Life cycle carbon modeling



Optimization Solutions

- Material swap recommendations
- Cost-carbon tradeoff analysis
- Design for disassembly guidance
- Circular economy strategy

Carbon-Neutral Workspace Solutions

We design and deliver end-to-end sustainable fit-outs that minimize embodied carbon while maximizing occupant well-being and business performance. Our turnkey approach integrates:

- Low-carbon material procurement with certified recycled content
- Modular and demountable systems for future adaptability
- Local sourcing to reduce transportation emissions
- Waste minimization and on-site material recovery
- Post-occupancy performance validation
- Prioritize EPD-verified products
- Bio-based, renewable materials
- Optimize for waste reduction
- Prioritize Refurbished/Reused items

The CG Platform

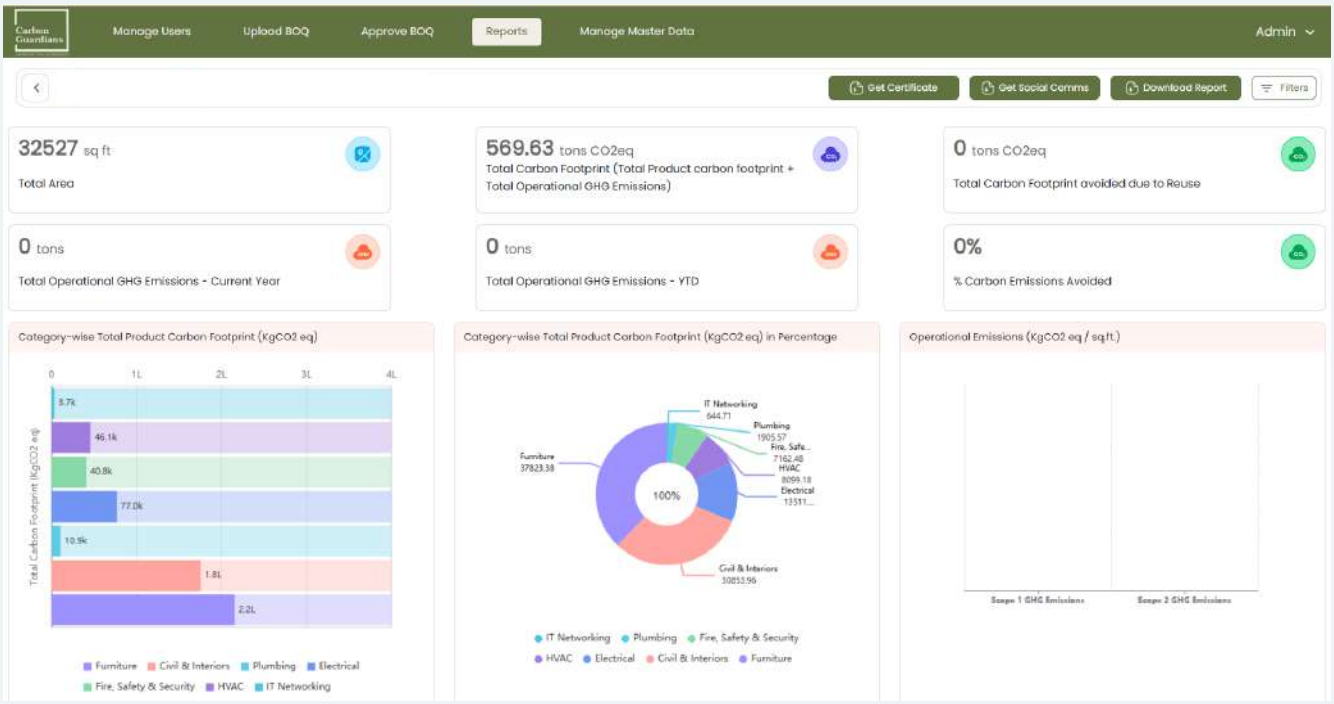
Our proprietary CG Platform is a cloud-based embodied carbon intelligence system that delivers:

Automated Carbon Emission: BIM integration for real-time carbon calculations for Scope 1 and Scope 2 emissions

Regional Databases: India and UAE-specific EPDs and material carbon factors

Compliance Reporting: Our report is compliant with LEED, IGBC, Estidama and GRESB.

Portfolio Tracking: Enterprise dashboard for multi-project carbon management and cataloguing of assets



25+
Projects Analyzed

30–50%
Average Carbon Reduction

5,000+
Employees Covered

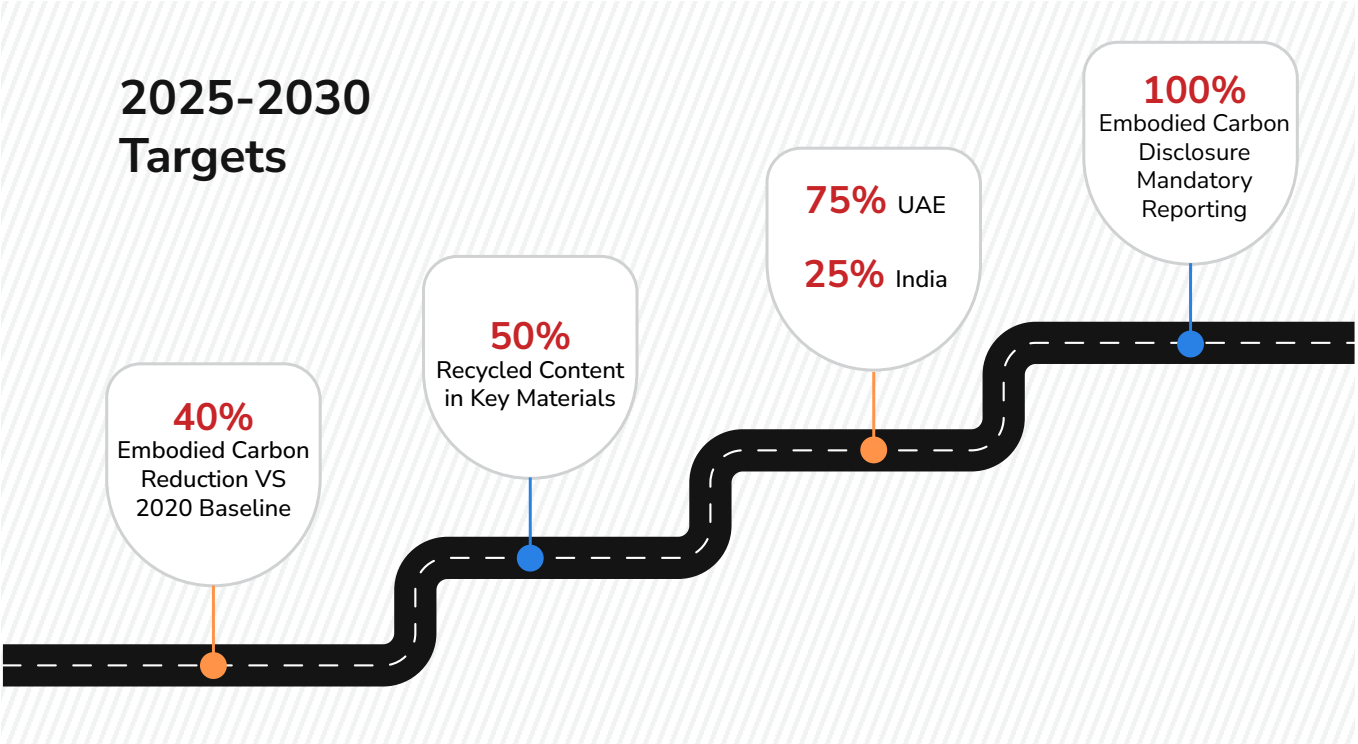
2 Markets:
India & UAE

"We don't just measure carbon—we eliminate it." Through rigorous science, innovative technology, and deep market expertize, Carbon Guardians is pioneering the future of sustainable workspaces in South Asia and the Middle East.

The 2030 Roadmap

The Imperative for Action

To achieve WorldGBC's 40% embodied carbon reduction by 2030 and net-zero by 2050, the industry must act now. Interior fit-outs, with their 3–5 year refresh cycles, offer the fastest pathway to cumulative impact.



Action Framework

For Developers and Asset Owners

Developers and asset owners hold the greatest leverage to drive embodied carbon reductions across portfolios. By establishing clear requirements and incentives, they can transform market practices and unlock value at scale.

Establish baselines: Measure embodied carbon across existing the portfolio

Set reduction targets: Align with science-based trajectories (1.5°C pathway)

Green procurement: Mandate embodied carbon limits in fit-out RFPs

Circular design: Require design-for-disassembly in all new projects

Tenant engagement: Share carbon data and incentivize sustainable choices

For Corporates and Occupiers

Measure Scope 3: Include tenant fit-outs in carbon accounting

Green lease clauses: Embed sustainability requirements in agreements

Life cycle thinking: Evaluate TCO + carbon in workspace decisions

Material reuse: Harvest and redeploy fit-out components during relocations

Vendor collaboration: Work with suppliers on low-carbon innovation

For Policymakers

Mandatory disclosure: Require embodied carbon reporting for commercial buildings

Performance standards: Set maximum embodied carbon intensity thresholds

Circular incentives: Tax breaks and FAR bonuses for material reuse

Waste infrastructure: Invest in C&D recycling facilities and EPR frameworks

Public procurement: Lead by example with low-carbon government projects

The Path Forward

Achieving the 2030 targets requires systemic collaboration across the value chain. Technology, policy, and market forces are aligning—creating a once-in-a-generation opportunity to transform how we build and retrofit our cities.

The question is no longer "why" or "when"—but "how fast." Organizations that move decisively now will capture competitive advantage, mitigate regulatory risk, and contribute to a livable planet for future generations.

"Real change begins in projects where carbon is measured from the start. With the right data, teams find opportunities they may not have seen before, from reuse strategies to modular systems and responsible procurement.

Across our work, one thing is consistent: when clients get transparent carbon data, their decision-making improves. Designers experiment more, vendors raise their standards and the whole ecosystem becomes more accountable. This is where sustainability and operations need to work hand in hand.

Low-carbon interiors aren't a future goal. They're already taking shape in India and the UAE, and momentum is building as organizations adopt verified data as a baseline."

Shruti Singh
Co-Founder & Director, Operations

Conclusion

Building the Invisible Advantage

Embodied carbon represents the greatest untapped opportunity in sustainable buildings. While operational efficiency approaches practical limits, embodied carbon in interior fit-outs remains largely unmeasured and unmanaged—despite contributing 30–45% of whole-building life cycle emissions.

This research across 25+ projects in India and UAE reveals that:

- **Measurement is feasible:** With modern tools and methodologies, embodied carbon can be quantified accurately and efficiently.
- **Reduction is achievable:** 30–50% savings are possible through strategic material selection, strategic design and circularity.
- **Business value is real:** Green buildings command 10–20% rental premiums and lease 1.7x faster
- **The market is ready:** With $85B of green building growth in India and Net Zero 2050 commitments in UAE, demand is accelerating.
- Reusing furniture cuts embodied carbon by 30–40%, compared to new.
- Reducing operational emissions leaves a significant impact on emission reduction.

The Way Forward

The transition to low-carbon interiors is not a distant aspiration—it is an immediate opportunity. With regulatory frameworks tightening, corporate ESG commitments deepening, and financial markets rewarding sustainability leadership, the convergence of forces makes this the optimal moment for action.

Carbon Guardians stands ready to guide organizations through this transformation—from initial measurement to full-scale carbon-neutral workspace delivery. Together, we can make the carbon we cannot see the carbon we control.

Challenges Faced:

Appendices

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Glossary

- Embodied Carbon: Total GHG emissions from material extraction, manufacturing, transportation, construction, and end-of-life disposal
- EPD (Environmental Product Declaration): Standardized document disclosing life cycle environmental impact of a product
- LCA (Life Cycle Assessment): Methodology for evaluating environmental impacts throughout a product's life
- C&D Waste: Construction and Demolition waste
- GCC (Global Capability Centers): Offshore technology and business services hubs

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Carbon Guardians

Carbon Guardians is a real estate workspace solutions firm dedicated to creating low-carbon, high-performance offices. With a presence across major metros in India and an expanding footprint in the UAE, the company partners with corporates, developers and operators to reduce embodied and operational carbon through data-driven design, responsible materials and measurable performance standards.

Its integrated approach spans carbon-tracked interior design and fit-outs, managed office solutions and a proprietary digital platform that enables real-time carbon measurement, reporting and optimisation. Carbon Guardians' analysis of commercial interiors across India and the UAE has contributed to industry insights on embodied carbon intensities, material impact and pathways for reduction.

Backed by a multidisciplinary team of designers, engineers, analysts and performance specialists, Carbon Guardians is committed to enabling organisations transition from intent-based sustainability to verified climate performance.

For more information, visit www.carbonguardians.in