July 2025

Accelerating Innovations in Green Building Materials in India

A Market Study Report

Habitat for Humanity®
Terwilliger Center for Innovation in Shelter

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SAINT-GOBAIN

terrarium

A building material can be considered ‘green’ if it is developed through an end-to-end approach that prioritizes carbon-neutral, low-carbon, or carbon-positive* processes. This involves minimizing environmental and human impacts by optimizing the use of natural resources, incorporating alternative and low-emission inputs, and enabling resource efficiency and lifecycle sustainability through strategies like reuse or repurposing.”

**Carbon-positive materials refer to those that sequester more carbon than they emit—for example, materials like hempcrete or biochar-infused blocks.*

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Foreword

Habitat for Humanity
Terwilliger Center for Innovation In Shelter

At Habitat's Terwilliger Center, we've spent the last many years working across the housing value chain - examining how we build, the materials we use, and how people access finance to make safe and dignified homes a reality. Much of this global work has been rooted in India's urbanization and development, where the demand for affordable and sustainable housing is high, but progress has been uneven. Traditional construction practices still dominate, even when they fall short on cost, quality, and environmental parameters.

To address these shortcomings, we have taken a market-driven approach to strengthening housing systems, while placing innovation at the core of our work – across both supply and demand. Recognizing this, we began identifying innovative ideas emerging from early-stage entrepreneurs, and in 2017, we launched the ShelterTech program in India to help bring those ideas to life.

Through ShelterTech, and in collaboration with partners such as IIM Ahmedabad's Centre for Innovation Incubation and Entrepreneurship (CIIE), Brigade REAP, Villgro Innovations Foundation, and Kerala Startup Mission, we have supported 22 ventures in India. While improvements are needed in many aspects of construction, we observed that one area remained especially underexplored: resource optimization and decarbonization using green and alternative building materials.

In 2021, we partnered with Villgro Innovations Foundation to address this critical need. Together, we launched an acceleration program to support startups developing construction solutions focused on sustainability. We saw several promising technologies emerge, and the pilots we supported made early gains. Yet, despite this initial traction, large-scale adoption remained limited.

This raised important questions for us - what was working, what wasn't, and what systemic barriers were standing in the way of these solutions being adopted at scale?

This report is a result of that journey. It captures insights from more than 100 voices across the housing and construction ecosystem - startups, developers, architects, investors, researchers, and policymakers. It unpacks key barriers, but more importantly, it lays out a path forward.

We believe this is a moment of opportunity. If we want sustainable construction materials to become the norm, we need coordinated action. This report is an invitation to collaborate, to learn from what is working, and to shape a future that is good for the people and for the planet.

Anoop Nambiar
Country Director, India
Terwilliger Center for Innovation in Shelter
Habitat for Humanity International

Foreword

India's built environment is undergoing a profound transformation. As the nation prepares to double its construction footprint by 2050, we stand at a critical inflection point, one that demands urgent shifts in how we design, build, and sustain our spaces. Amidst this transition, green building materials (GBMs) are emerging not just as a climate solution, but as a powerful lever to reimagine construction as a force for equity, resilience, and economic opportunity.

At Villgro, we have long believed that innovation from the grassroots, especially from startups operating on the frontlines of environmental and social change, holds the key to solving some of our most complex challenges. Over the past four years, we have worked closely with over 11 climate-tech and prop-tech startups, helping them unlock pathways to pilot, scale, and embed sustainability into India's infrastructure story.

This report, co-led by Habitat for Humanity's Terwilliger Center for Innovation in Shelter and supported by Saint-Gobain and Terrarium, is the culmination of months of collaboration, inquiry, and fieldwork. It offers a rare, systems-level view of the GBM landscape, highlighting not only the innovations under development but the systemic frictions that prevent them from reaching scale. Whether it is the lack of harmonized certification standards, the dearth of early-stage capital, or the invisibility of material-level emissions in public procurement, these challenges are deeply interlinked and demand coordinated action.

But what gives us hope is the momentum we have witnessed. From women-led startups building carbon-negative blocks, to industry leaders piloting pavers made from plastic in corporate campuses, there is a growing willingness to experiment, partner, and push boundaries. Our task now is to build the ecosystem scaffolding that can support and sustain this momentum.

We hope this study serves not just as a report, but as a call to action. To funders, corporates, policymakers, and ecosystem allies: the time to invest in green materials is now. Let us collectively shift the narrative, from innovation at the margins to innovation at the mainstream.

Let us build India, sustainably.

Ananth Aravamudan,
Chief Technology Officer,
Villgro Innovations Foundation

Foreword

Saint-Gobain is very happy to be a part of this report in accelerating innovation in Green Building Materials in India. Saint-Gobain's mission is to be a market leader in Light and Sustainable Construction. With the ambition of achieving net zero carbon emissions by 2030, our purpose - "Making the world a Better Home" aligns towards this cause.

We have been associated in various green building materials, certifications, codes and communication, and this market study report helps us to engage deeper with this purpose. We hope to see a transformation in the marketplace towards a low carbon infrastructure and a sustainable future.

Venkat Subramanian
Managing Director - Gypsum, Insulation & Mortars
Saint-Gobain

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Indian Green Building Council

RICH
Research and Innovation Circle of Hyderabad

IITB-Monash Research Academy
An Indian-Australian research partnership

Alliance for an Energy Efficient Economy

terrarium

Stakeholders Consulted

Academic Institutions

Mahindra University	School of Environment and Architecture	IIT Hyderabad	IITB - MONASH RESEARCH ACADEMY

Ecosystem Enablers

TCE Technology Business Incubator	Indian Institute for Human Settlements,	United Nations Environment Programme	IIT Madras Research Park
India Climate Collaborative	Alliance for an Energy Efficient Economy	National Institute of Urban Affairs	National Research Development Corporation India
Climate Asia	Confederation of Real Estate Developers' Associations of India	The Center for Study of Science, Technology and Policy	Development Alternative
Research and Innovation Circle of Hyderabad	EcoCollab	The Global Green Growth Institute	Habitat for Humanity
Purpose	Climate Policy Initiave	Earth Economics	Envint
TechnoServe	World Resources Institute	Dhrumataru	

Startups

Accacia.ai	Angirus	BambooCrete Green Building Systems	Biome Sustainability Ventures
Modulus Housing	C-DISC Technologies	CarbonCraft	CarbonStrong
PAVING +	RecycleX	Saltech Design Labs	Zerund

Startups

EnGin	Satiq Concrete Manufacturer	SHIFT Home	Smarter Dharma
Hubeco Green Ventures	Green Banana Environment Solutions	Hedrad Panels	

Architects and Real Estate Developers

Integrative Design Solutions	Assurity Climate Solutions	Kalaazodh Architecture	Bioenergetic Architectures
Biome Build	Blues Studio	Monkspaces	The National Association of Regional Councils
TripleO Studios	Studio Blending Opposites	Thakkar Popatlal Velji	

Building Managers

Brookfield Properties	Jones Lang LaSalle	Coldwell Banker Richard Ellis	Cushman & Wakefield

Certification Agencies

The Green Business Certification, Inc.	Indian Green Building Council		

Corporates

Infra Mart	JSW Cement	Kalpataru	Mahindra

Corporates

Mahindra Lifespaces	Radha TMT	Raheja Developers	CtrlS Data Centers
Saint Gobain	Systems, Applications & Products in Data Processing	Schneider Electric	Greentech Knowledge Solutions
Godrej	Signature Global	UltraTech	Infosys

Consulting Firms

McKinsey	Pricewaterhouse Coopers	Xynteo	

Investors

7th Gen Ventures	Avaana Capital	International Finance Corporation	Capital-A
Now Venture Studio	Pidilite Ventures	Climate Bonds Initiative	Climate X Capital
Rainmatter Foundation	Earth Fund	Green Artha Innovations LLP	Spectrum Impact
India Impact investors Council	Climake		

Government Bodies

Govt of TN - PMAY	Tamil Nadu Urban Habitat Development Board.		

Media

RealtyNxt			

Abbreviations

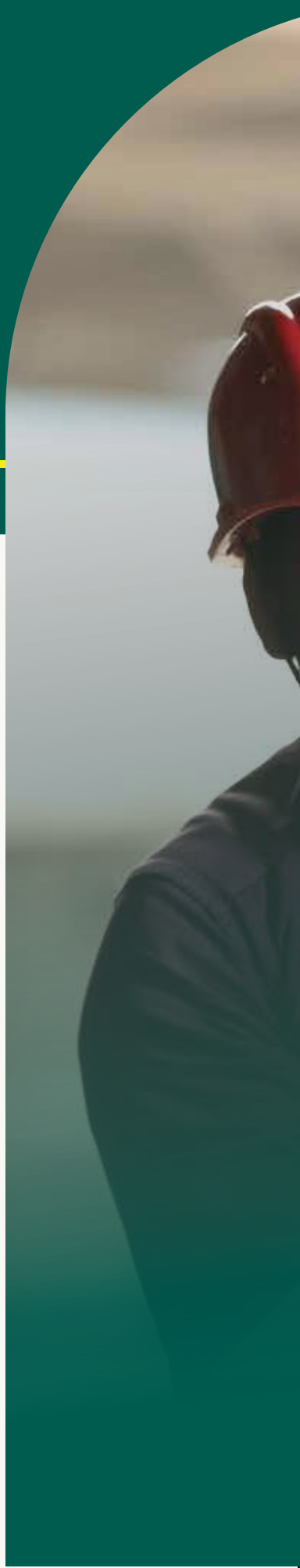
AAC Blocks: Autoclaved Aerated Concrete Blocks
AEEE: Alliance for an Energy Efficient Economy
BEE: Bureau of Energy Efficiency
BIS: Bureau of Indian Standards
BMTPC: Building Materials and Technology Promotion Council
C&D Waste: Construction and Demolition Waste
CAGR: Compound Annual Growth Rate
CLT: Cross-Laminated Timber
CoE: Centre of Excellence
DFIs: Development Financial Institutions
ECBC: Energy Conservation Building Code
ENS: Eco Niwas Samhita
EPD: Environmental Product Declaration
ESG: Environmental, Social, and Governance
GHG: Greenhouse Gas
GBM: Green Building Materials
GRIHA: Green Rating for Integrated Habitat Assessment
HDPE: High-Density Polyethylene
IIT: Indian Institute of Technology
IGBC: Indian Green Building Council
LCA: Life Cycle Assessment
LC3: Limestone Calcined Clay Cement
LEED: Leadership in Energy and Environmental Design
MoEFCC: Ministry of Environment, Forest and Climate Change
MOHUA: Ministry of Housing and Urban Affairs
NABL: National Accreditation Board for Testing and Calibration Laboratories
NBC: National Building Code
NSDC: National Skill Development Corporation
PMAY: Pradhan Mantri Awas Yojana
REIT: Real Estate Investment Trust
RICH: Research and Innovation Circle of Hyderabad
SEBI: Securities and Exchange Board of India
TCO: Total Cost of Ownership
TRL: Technology Readiness Level
VGF: Viability Gap Funding
VIF: Villgro Innovations Foundation
WGBC: World Green Building Council

Definitions

1. **Blended finance:** A funding approach combining grants, loans, and equity to de-risk investments in sustainability projects.
2. **Carbon Accounting:** Measuring and tracking carbon emissions associated with materials, processes, or organizations.
3. **Circular Economy:** An economic model emphasizing reuse, recycling, and resource efficiency to minimize waste.
4. **Cluster Models:** Regional hubs for manufacturing similar material types to reduce costs and improve supply chain efficiency.
5. **Embodied Carbon:** Emissions generated from the extraction, manufacturing, transportation, and disposal of building materials.
6. **Environmental Product Declarations (EPDs):** Standardized reports detailing a product's environmental impact, based on LCA data.
7. **Geopolymer Concrete:** A low-carbon concrete alternative made from industrial byproducts like fly ash or slag.
8. **Green Building (IGBC Definition):** A building that uses less water, optimizes energy efficiency, conserves resources, generates less waste, and provides healthier spaces compared to conventional buildings.
9. **Green Building (WGBC Definition):** A net-zero embodied carbon building or infrastructure asset that minimizes upfront carbon and offsets remaining emissions to achieve net-zero lifecycle impact.
10. **Green Premium:** The additional cost of using sustainable materials compared to conventional alternatives.
11. **Green Procurement Bonds:** Financial instruments to fund public projects using certified green materials.
12. **Hyperlocal Clusters:** Production systems using region-specific materials (e.g., bamboo in Northeast India) to reduce logistics costs.
13. **Life Cycle Assessment (LCA):** A methodology to evaluate environmental impacts of a product or system across its entire lifecycle.
14. **Net-Zero Building:** A building with net-zero carbon emissions over its lifecycle, achieved through offsets and reductions.
15. **Operational Carbon:** Emissions produced during the operational phase of a building (e.g., energy use for heating, cooling, lighting).
16. **Sandbox Model:** A testing environment for innovations to validate performance under real-world conditions.
17. **Technology Readiness Level (TRL):** A scale (1–9) measuring the maturity of a technology, from concept to market deployment.
18. **Total Cost of Ownership (TCO):** A financial estimate combining upfront costs and long-term operational expenses.
19. **Valley of Death:** The gap between pilot-stage innovations and scalable commercialization due to funding or technical challenges.

Executive Summary

Unlocking the Potential of Green Building Materials in India's Construction Boom



India is at the cusp of an unprecedented construction wave, expected to add over 35 billion ft² of built-up area by 2050, **twice the current stock** [1]. As the fastest-growing major economy, this expansion is not just about infrastructure, it is foundational to meeting India's demand for jobs, housing, and inclusive urbanisation. A significant portion of this growth is being driven by government-led affordable housing programs like PMAY [2], aimed at addressing a deficit of over 11.2 million homes for economically weaker sections and low-income groups. However, this growth comes at a cost: the **construction sector contributes 25% of India's emissions** [3] and is projected to emit 90 gigatonnes of CO_2 between 2020–2070 [4] if current practices continue.

While operational carbon, emissions from the energy used to light, heat, and cool buildings, has long dominated climate policy, embodied carbon is emerging as a silent crisis. **Embodied carbon** refers to the emissions released during the production, transportation, and installation of building materials like cement and steel. For example, the carbon emitted to manufacture a brick or transport a steel beam to a construction site all falls under embodied carbon. By 2050, e**mbodied carbon is expected to match operational** carbon in its climate impact [5]. Cement and steel alone contribute over **8% and 12% of national emissions** [6,7]. Without bold shifts in how we build, India risks embedding high-carbon choices into its infrastructure for decades, posing a significant challenge to its broader net-zero ambitions.

1. India: Transforming to a Net-Zero Emissions Energy System (a "scenario sketch" by TERI & Shell)
2. Pradhan Mantri Awas Yojana (Urban) - Government of India scheme for affordable housing
3. Role of Building Material Industry in Achieving Low-Carbon Growth - Shakti Sustainable Energy Foundation
4. Pathways to Steer India's Buildings Sector Towards a Net-Zero Future - CSTEP report on how India's buildings may overshoot its carbon budget
5. Tackling Embodied Carbon from India's Building Sector - AEEE (Alliance for an Energy Efficient Economy)
6. How Can India Decarbonise its Steel Industry - report by CEEW (Council on Energy, Environment and Water)
7. The Steel and Concrete Transformation: 2024 Market Outlook on Lower-Emission Steel and Concrete

The Role of Green Building Materials (GBMs):

Green building materials offer a compelling pathway to decarbonize construction while simultaneously fostering inclusive growth. These materials, ranging from carbon-sequestering blocks and fly ash bricks to bio-based panels and recycled concrete, can reduce emissions, enhance housing quality, and unlock new livelihoods through decentralised manufacturing. They hold particular relevance for low-income housing, where material choices directly impact thermal comfort, indoor health, and long-term affordability. Homes built with thermally efficient green materials can be 4–6°C cooler in summer, reducing heat stress in vulnerable communities.

India's green building material market is projected to grow at a **10–12% CAGR,** reaching **$70–80 billion** by 2030 [1]. This growth is taking two distinct paths: large corporate players are developing innovations within their existing value chains, such as low-carbon cement or circular glass, while startup-led disruptions are emerging in high-risk, high-impact areas like geopolymer concrete, waste-based pavers, 3D-printed construction, and agro-fibre panels. This study focuses primarily on the latter, recognising that while established manufacturers represent the bulk of current green supply, the startup ecosystem is vital for rapid innovation and inclusion.

About the Study:

To accelerate the green building materials ecosystem, **Habitat for Humanity's Terwilliger Center for Innovation in Shelter** and **Villgro Innovations Foundation,** with the support of **Saint-Gobain** and knowledge partner **Terrarium,** conducted a nationwide market study. This effort aimed to:

- Map the market landscape and emerging innovations in sustainable construction materials
- Identify key challenges to scaling and barriers to investment for green material startups
- Engage stakeholders across the construction value chain, from manufacturers to builders and policymakers
- Recommend actionable strategies to drive mainstream adoption of green building materials

Key Findings:

India has seen a rise in innovative GBM startups developing low-carbon materials, from carbon-cured concrete and recycled plastic pavers to straw panels and geopolymer blocks. However, these innovations often struggle to scale due to a lack of early-stage capital, unclear certification pathways, and limited avenues to test products in real-world housing or infrastructure projects. Without validation and procurement support, many stall in the "valley of death."

Certification remains fragmented, multiple rating systems, IGBC, GRIHA, BIS, offer varied definitions and benchmarks, especially for material-level sustainability. While building-level certification is relatively mature, individual material standards remain poorly aligned. Embodied carbon is still largely absent from most green mandates, even as public procurement and state SoRs fail to explicitly accommodate green materials.

Market awareness is also low. Builders and consumers often perceive green materials as expensive, unproven, or hard to source. This perception is compounded by a lack of comparative tools, pilot projects, or cost calculators that demonstrate lifecycle savings. Without clear economic or performance data, adoption remains slow, particularly in the price-sensitive affordable housing sector.

Although many large corporates are experimenting with low-carbon solutions in cement, glass, and steel, their risk appetite is limited by existing capex cycles and supply chain complexity.

1. Decarbonising India: Charting a Pathway for Sustainable Growth

Startups offer agility, but face challenges of scale, funding, and credibility. A large part of the green supply chain, especially for cement and steel, is thus evolving in silos, and is out of the scope of this study, which focuses instead on high-potential, early-stage material innovations.

A Framework for Scaling Green Building Materials (GBMs):

The study outlines a four-pillar strategy to build a resilient, investable GBM ecosystem. These pillars aim to address foundational gaps in innovation, validation, and market linkage, laying the groundwork for coordinated demand generation.

Coalition to Drive Market Demand: Bring together government bodies, corporates, and supply chain actors to align on green procurement norms, corporate net-zero commitments, and logistics networks. This collective action can create predictable offtake, reduce costs, and shift the market toward sustainable construction at scale.

Green Material Innovation Fund: Provide catalytic capital to support R&D, pilot deployment, and strengthen supply chain. This helps de-risk early-stage technologies and accelerate commercialization of new materials.

Centre of Excellence for Testing and Training: Establish national standards, low-cost testing labs, and capacity-building programs for architects, engineers, and masons. This will streamline certification, build trust in new materials, and strengthen the talent pipeline.

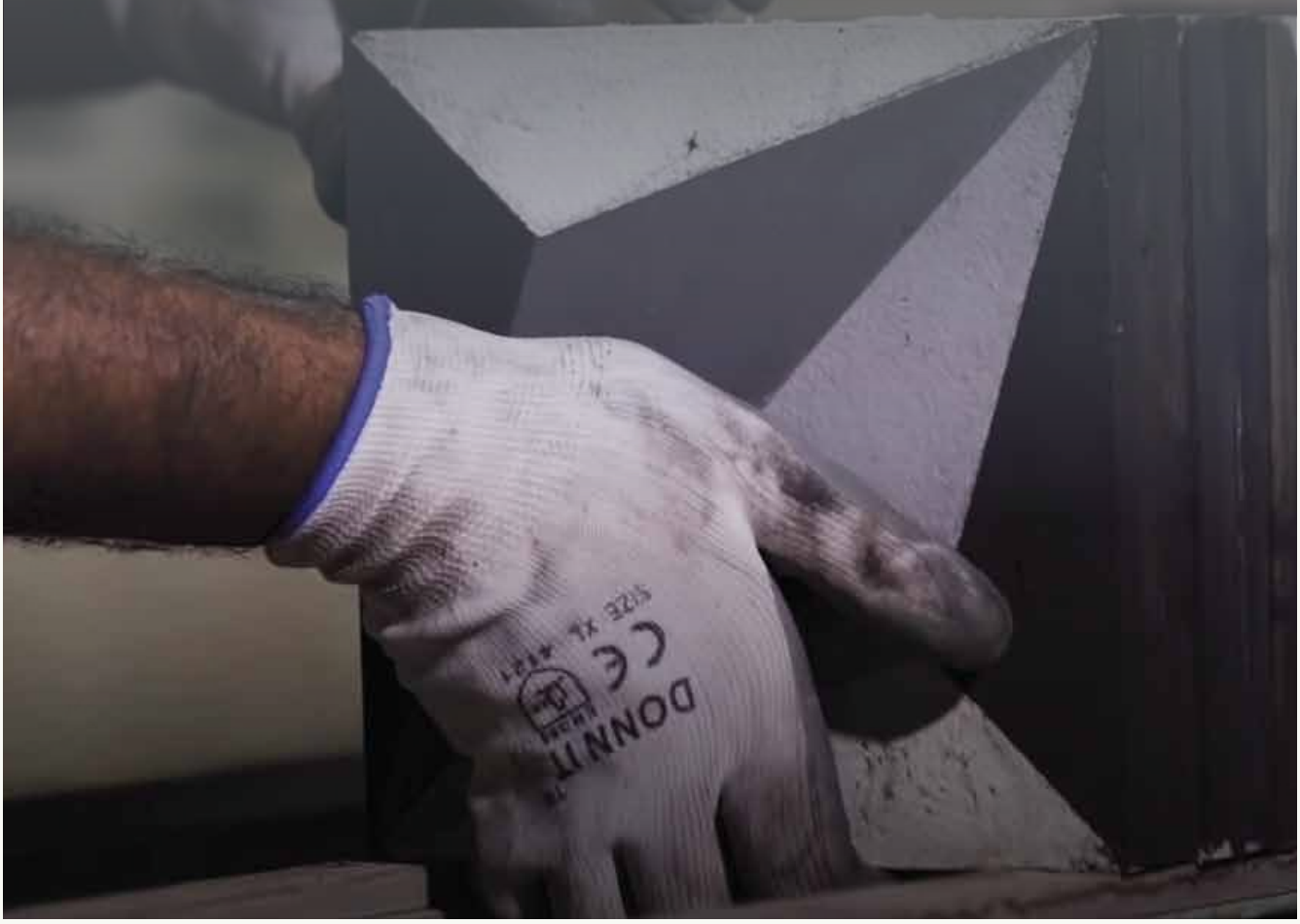
Marketplace Platform: Create a digital and physical marketplace to showcase verified GBMs, connect suppliers with buyers (developers, contractors, institutions), and promote transparent, performance-based procurement.

Conclusion & Call to Action

Green building materials represent a triple-win for India: advancing climate action, enabling greener economic pathways, and creating dignified green jobs. While economic growth and construction activity are already accelerating, integrating sustainable materials into this growth trajectory can reduce emissions, stimulate domestic manufacturing, and build a future-ready workforce.

The Terwilliger Center and Villgro, in partnership with **Saint-Gobain and Terrarium**, invite policymakers, corporates, developers, and investors to join a national working group to operationalize these pillars.

Together, we can reimagine India's construction sector, not just as a growth engine, but as a global leader in building material climate innovation.



1. Introduction

As India faces both an escalating housing deficit and intensifying climate risks, the need for sustainable, resilient construction has never been more urgent. Millions of low-income households still reside in thermally inefficient, resource-intensive homes that are vulnerable to heat stress, flooding, and rising energy costs. **Green Building Materials (GBMs)** offer a unique opportunity to address these vulnerabilities, enabling healthier, safer, and more climate-resilient housing while reducing the environmental footprint of construction.

Despite this potential, adoption of green materials remains limited across the country. Key barriers include low awareness among stakeholders, regulatory and certification gaps, perceived cost premiums, and limited demonstrations of commercial viability. The **Terwilliger Center for Innovation in Shelter**, a unit of Habitat for Humanity International, commissioned this study, to assess the state of the market for GBMs, and to gauge whether they can be the bridge between **climate action and affordable housing** in India. **Villgro Innovations Foundation** was engaged to lead this study.

The study aims to catalyse a robust innovation ecosystem around green building materials by identifying gaps, highlighting solutions, and designing initiatives that can enable promising startups to scale. This includes establishing a comprehensive support system that connects early stage enterprises to technical, financial, and market resources across the construction value chain.

To enhance the scope of the study, **Saint-Gobain** and **Terrarium** partnered as key collaborators. Their involvement helped expand stakeholder engagement across the ecosystem. Insights were gathered from developers, manufacturers, investors, architects, and policymakers, underscoring the importance of a systems level approach to accelerating green material adoption.

This report presents the key findings of the market study and outlines actionable pathways to strengthen the green building materials innovation ecosystem in India, supporting solutions that serve both the planet and its people

> **“ At the Terwilliger Center, we believe sustainable, circular construction has the opportunity to be transformational for the sector as a driver of green jobs, economic growth, and resilience-building. Green building solutions must be supported at scale to ensure affordability and accessibility to all . Our work focuses on empowering enterprises, supporting policy makers, and driving finance to together deliver climate-resilient housing markets.**
>
> *Jennifer Oomen, Senior Director , Technical Excellence*
> *Terwilliger Center for Innovation in Shelter, Habitat for Humanity International*

2. Market Study Objectives, Focus, and Methodology

This section outlines the specific objectives, scope boundaries, and methods used in conducting the market study on green building materials in India.

2.1 Objectives of the Study

The study was designed to generate ecosystem-level insights and identify strategic levers to accelerate the adoption of green building materials.

The four key objectives were:

Mapping the Market Landscape:

Assess current product offerings, emerging material innovations, and consumer preferences across use cases.

Diagnosing Scale-Up Challenges:

Identify key bottlenecks in pricing, supply chains, certification, and market acceptance that hinder mainstream adoption.

Identifying Strategic Opportunity Areas:

Highlight interventions needed from ecosystem enablers, such as technical assistance, public-private funding, and policy reforms.

Disseminating Actionable Insights:

Translate findings into targeted recommendations for startups, corporates, investors, and ecosystem partners to drive adoption.

Packing unit of M-Sand @PCS Industries

2.2 Focus Areas of the Study

The construction materials ecosystem in India is dominated by large, legacy firms that control much of the supply chain, from cement and steel to bricks and aggregates. While these players are beginning to experiment with low-carbon products, their scale often makes them risk-averse and slow to adopt disruptive solutions. In contrast, startups and early-stage enterprises have emerged as critical innovation nodes, particularly in areas that have historically received less corporate attention, such as circularity, bio-based alternatives, and decentralised material production.

This study focuses specifically on material-level innovations that improve the environmental performance of the construction sector. These include:

- **Substitutes for carbon-intensive materials** such as cement, bricks, and steel, through the use of alternate binders, low-carbon composites, or hybrid prefabricated systems.
- **Circular business models** that repurpose industrial, agricultural, or construction waste into high-performance construction products, helping reduce embodied carbon, extend material lifecycles, and minimise landfill pressure.

To maintain analytical depth and strategic relevance, the study **deliberately excludes:**

- **Direct energy-efficiency interventions,** such as solar panels, lighting systems, or HVAC solutions, which fall under operational carbon and not material innovation.
- **Process-level decarbonisation technologies** such as carbon capture in cement plants are typically capital-intensive solutions adopted by large incumbent firms. These interventions lie largely outside the startup innovation landscape due to high costs and scale requirements.

Material samples from ReMaterial's (Modroof) modular roofing system

By narrowing the lens to **startup-led innovation in green building materials,** this study seeks to understand not only the technologies being developed but also the **systemic barriers to their adoption,** from certification bottlenecks to supply-chain challenges and lack of financing pathways. Circular business models offer fertile ground for entrepreneurial disruption, enabling entrepreneurs to design solutions that embed circularity from the outset, rather than retrofitting existing business practices.

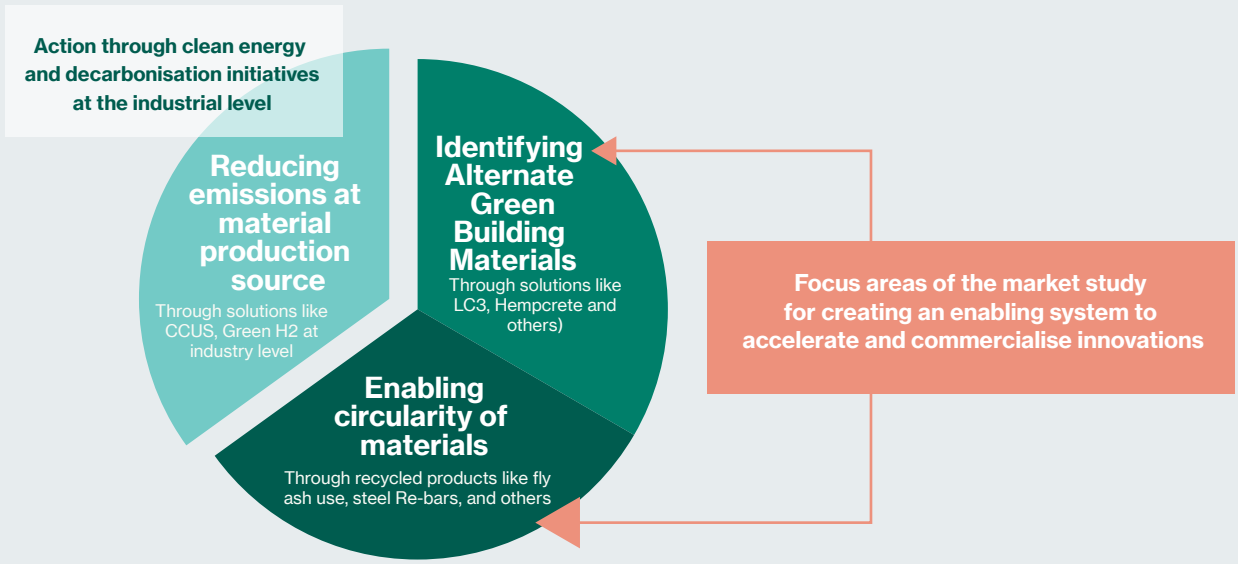


Figure 1: Scope of the Study – What's In and What's Out

2.3 Methodology

The study used a mixed-method approach, combining secondary research with primary stakeholder engagement to gather insights from across India's construction and materials ecosystem.

Key activities included:

- **Surveys** with a range of stakeholders including architects, developers, startups, and financiers
- **Expert interviews** with subject matter experts, investors, policymakers, and researchers
- **Roundtables** held in four cities to explore region-specific challenges and ecosystem dynamics, co-organised with Terrarium and local knowledge partners

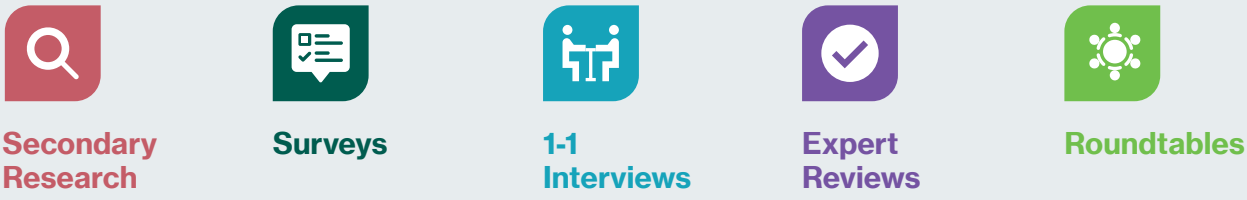


Figure 2: Stakeholder engagements for the market study at a glance

37 | **Survey Responses**
from value chain stakeholders

21 | **Expert Interviews**
covering policy, finance, industry, and innovation

04 | **Regional Roundtables**
across Hyderabad, Mumbai, Delhi, and Chennai

100+ | **Stakeholders Engaged**
through formal and informal channels

2.4 Regional Roundtables: Themes & Participation

To inform this study with on-ground insights, a series of regional roundtables were conducted across four key Indian cities - Hyderabad, Mumbai, Delhi and Chennai. These convenings brought together stakeholders from startups, corporates, research institutions, industry bodies, and government to discuss the most pressing barriers and opportunities for accelerating the adoption of green building materials (GBMs) in their respective regions.

Each roundtable was curated with a specific thematic focus aligned to the region's strengths and market dynamics. The objective was to deep-dive into value chain challenges, surface region-specific innovation needs, and explore actionable partnerships. These sessions provided critical inputs on policy misalignments, market access limitations, certification challenges, and early adoption hurdles.

Hyderabad

Knowledge Partners

Research and Innovation Circle Hyderabad **(RICH)**

Indian Green Building Council **(CII-IGBC)**

Participants

21 Organizations

Roundtable Themes

Exploring a sandbox approach to streamline testing, certification, and validation of green building materials

Designing a structured marketplace, both digital and physical, to improve procurement transparency and market access for verified GBMs

Accelerating early corporate adoption to build credibility and generate consistent demand signals across the construction value chain

Mumbai

Knowledge Partners
IITB-Monash Research Academy

Participants
25 Organizations

Roundtable Themes

Scaling sustainable manufacturing and supply chains to meet growing demand for green building materials

Developing financing mechanisms such as blended finance and viability gap funding to support early-stage innovations and de-risk adoption

Driving large-scale adoption through developer- and corporate-led pilot projects that demonstrate performance and commercial viability

Delhi

Knowledge Partners

Alliance for an Energy Efficient Economy (AEEE)

Participants

18 Organizations

Roundtable Themes

Driving policy alignment to accelerate adoption of green building materials across public and private sectors

Identifying actionable solutions for near- and medium-term integration of GBMs into national programs and procurement systems

Enabling ecosystem collaboration between government, industry, and startups to support innovation and implementation at scale

Chennai

Knowledge Partners
Terrarium

Participants
18 Organizations

Roundtable Themes

Enabling pilot projects and commercial procurement by large corporations and developers to catalyze market demand and accelerate adoption of green building materials

2.5 Expected Outcomes

The study is expected to deliver:

- Clear insight into gaps and opportunities in the green building materials ecosystem,
- Actionable recommendations for stakeholders across the value chain,
- Strategic direction for ecosystem enablers (e.g., Villgro, Terwilliger Center, Saint-Gobain, Terrarium) to support innovation pathways through funding, partnerships, and policy engagement.

> **"There is an urgent need to scale the adoption of green building materials for sustainable construction in India. Conventional construction methods are resource-intensive and environmentally unsustainable, contributing significantly to carbon emissions. The market research published in this report by Habitat for Humanity, Villgro, and Saint-Gobain would be pivotal in bridging the availability gap, encouraging innovation in manufacturing, and building confidence among stakeholders on mainstreaming green building construction in India. This is very closely aligned with our work at International Finance Corporation on green building investments and standard setting through our EDGE platform."**
>
> *— Autif Sayyed, South Asia Regional Lead - Green & Resilient Buildings Program, International Finance Corporation*

3. Overview of the Green Buildings Sector in India

India's construction sector is expanding at a pace few markets can match. The country is projected to add **35 billion ft² of built-up area by 2050, roughly double today's stock** [1]. Already, construction contributes **about 9 % of India's GDP,** and policy analysts estimate this share could rise to **15 % by 2047** as infrastructure spending accelerates [2]. In value terms, the sector is expected to grow from **US $1.4 trillion in 2025 to US $5.8 trillion by 2047,** making it one of the country's largest engines of economic expansion [3].

While this growth represents a vast economic opportunity, it also intensifies environmental and social pressures, most notably rising greenhouse-gas emissions, worsening urban air quality, mounting construction-waste streams, and the urgent need to upskill a workforce of more than 70 million people for a low-carbon future.

3.1 Growth of the Construction Sector

India is expected to add over 35 billion square metres of new built-up area by **2050** [4], making it one of the fastest-growing construction markets in the world. This growth spans across four major asset classes:

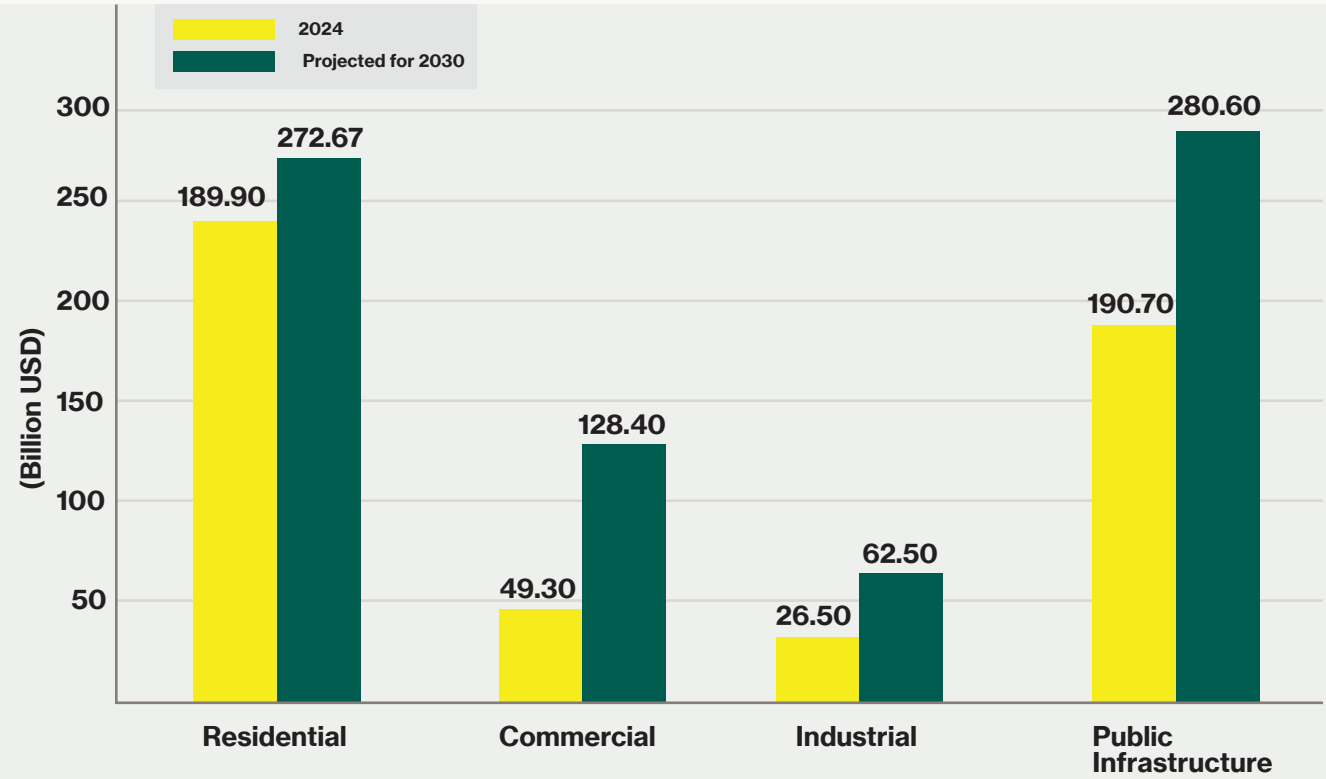


Figure 3: Construction Market Size by Segment – 2024 vs 2030

1. India's Building Stock and Its Carbon Footprint
2. Investment Opportunities in Construction by Invest India
3. Vision 2047 - joint report by NAREDCO and Knight Frank
4. Transforming to a Net-Zero Emissions Energy System - TERI & Shell scenario sketch

Source: Analysis using data from PIB India, Altois, PropFlo, KC & Hegde, Knight & Frank, Times Property, JLL, Global NewsWire, Commercial Real Estate – Modor Intelligence, Public Infrastructure – Modor Intelligence

As the sector expands, this growth will demand enormous quantities of construction material making it crucial to address sustainability at the material level.

3.2 Environmental Impact of Conventional Construction

India's commitment to achieving net-zero emissions by 2070, announced at COP26 [1], and its updated NDCs submitted to the UNFCCC [2], which include a target to reduce emissions intensity of GDP by **45% by 2030** and achieve **50% cumulative electric power capacity from non-fossil sources,** reflect a decisive national pivot toward low-carbon development. To deliver on these goals, high-emitting sectors like construction, responsible for a significant share of national emissions, must undergo rapid material transformation.

Conventional construction practices and materials, while cost-effective in the short term, are deeply misaligned with India's climate ambitions. Their environmental burden as follows:

- As of 2019, 17% of India's GHG emissions [3] are from buildings and construction sectors, and this has grown to 32% (including operational and embodied carbon) by 2021 [4].
- 11% of the global energy related emissions [5] are from construction and materials used for buildings in 2023.
- Brick kilns in India contribute to a total of 2.5% of India's emissions [6], releasing over 65 million tonnes of CO2 emissions every year.
- Overlay of the challenge of air pollution due to construction [7] activities, given its contribution to 20-30% of PM10 and 10-20% of PM2.5 levels in major Indian cities.
- India generates an estimated 150–500 million tonnes [8] of Construction & Demolition (C&D) waste each year, according to the Ministry of Housing & Urban Affairs. Despite this enormous volume, less than 1% of C&D waste is currently recycled [9],

These figures underscore the urgent need for low-carbon, resource-efficient construction materials that can reduce global emissions and local air quality. There is a strong case for supporting the widespread adoption of green building materials to meet India's growing construction needs while significantly reducing the sector's environmental impact.

1. National Statement by Prime Minister Shri Narendra Modi at COP26 Summit in Glasgow
2. NDC Registry (India's Nationally Determined Contributions)
3. India's Shift to Low-Carbon Construction Must Not Leave Anyone Behind
4. Tackling Embodied Carbon from India's Building Sector
5. Advancing Net Zero: Embodied Carbon
6. Tackling Embodied Carbon from India's Building Sector
7. How Can Indian Cities Plan to Curb Dust, Air Pollution Caused by Construction and Real-Estate Sector
8. Construction & Demolition Waste Management Manual
9. Construction and Demolition Waste (report by CSE)

3.3 Affordable Housing, Climate Resilience And Equity

India's affordable housing story is no longer just about closing the supply gap, it is increasingly about building **climate-resilient, dignified, and future-ready homes** for the millions living at the intersection of poverty and environmental vulnerability.

The numbers are staggering. As of 2023, India faces an urban affordable housing deficit of over 11.2 million units with nearly 96% of the unmet demand concentrated among Economically Weaker Sections (EWS) and Low-Income Groups (LIG). This shortage is projected to rise to over 31 million units by 2030, driven by accelerating rural-urban migration, population growth, and changing household dynamics. Government programs like the Pradhan Mantri Awas Yojana – Urban (PMAY-U) [1] have made meaningful strides, sanctioning more than 1.18 crore homes [2], of which over 93 lakh have been completed or are near completion as of March 2024.

Yet, even as this scale is commendable, questions of **climate performance, occupant well-being, and long-term material impact** are rising to the surface. A large share of affordable housing in India continues to be constructed using high-carbon materials like fired clay bricks and OPC cement, which not only contribute significantly to embodied emissions but also underperform in thermal regulation. Studies show that homes built without insulation or reflective materials can be **4–6°C hotter indoors** during peak summers, placing a significant heat stress burden on households that often lack access to reliable electricity or cooling appliances.

The convergence of climate vulnerability and housing inequality is most visible in dense urban informal settlements, where poor material choices exacerbate both environmental and social risks. Women, children, the elderly, and those with pre-existing health conditions are particularly at risk, not just from heat but from the broader lack of climate-resilient infrastructure.

Recognising this, the Government of India has begun to embed sustainability more directly into the PMAY framework. According to a 2024 PIB release [3], over **43 lakh homes** are currently being constructed using more sustainable alternatives like **fly ash bricks, AAC blocks,** and other certified green materials. These material shifts are estimated to help reduce over **9 million tonnes of CO_2** by December 2024. Complementing this push is the Technology Sub-Mission under PMAY-U [4], which has supported the identification and certification of more than 50 innovative and disaster-resilient construction technologies, through initiatives like the Global Housing Technology Challenge (GHTC-India) [5].

These moves signal an important shift, from a focus solely on housing quantity to a growing awareness of housing **quality,** not just in terms of structural integrity but also **climate responsiveness.** As India prepares to construct millions of additional homes under PMAY 2.0 and beyond, the choice of building materials will play a pivotal role in determining not just environmental outcomes, but also **health, comfort, and resilience for generations to come.**

1. Pradhan Mantri Awas Yojana (Urban)
2. Housing For All Scheme Reaches Major Milestone (GoI)
3. Housing For All Scheme Reaches Major Milestone (GoI)
4. Global Housing Technology Challenge - India
5. Global Housing Technology Challenge - India

3.4 Social Impact: Livelihoods and the Green Skills Gap

India's construction sector is the country's **second-largest employer,** engaging over 71 million workers as of 2023 [1], nearly half of whom work in the informal sector. With infrastructure and housing needs on the rise, an additional **45 million skilled workers** will be required by 2030, according to WRI [2]. This presents a critical moment to reimagine the sector not just as a source of jobs, but as a platform for **climate-resilient and inclusive economic growth.**

- **The shift toward green building materials demands a different skill set.** Newer solutions like geopolymer concrete, 3D printed construction, prefabricated wall systems, and thermo-reflective coatings require greater precision, quality control, and technical familiarity than conventional methods. Their adoption calls for upskilling masons, site engineers, and contractors in material performance, digital tools, and installation standards, capabilities that are not yet widely embedded in the existing construction workforce.
- **This transition offers a pathway to upgrade the quality of construction jobs:** Workers trained in sustainable materials and techniques are better positioned for higher-value roles, especially as developers and governments adopt more stringent climate-linked mandates. It also opens space for more formalised employment with clearer training pathways and safety standards.
- **Local entrepreneurship stands to gain significantly:** Many green material solutions can be manufactured using decentralised production models, making them accessible to small enterprises in rural and peri-urban areas. For example, low-capex units for fly ash bricks or precast panels can be operated by local entrepreneurs, women's self-help groups, or returning migrants, creating climate-aligned livelihoods at the community level.
- **The current system is not yet ready to support this transformation at scale:** Skilling institutions, certification bodies, and industry associations will need to align to support green jobs, update curricula, and improve access to market linkages for micro-manufacturers. Without this ecosystem-level support, the potential of green construction to drive social impact may remain under-realised.

The move toward green building materials is not only an environmental imperative but also a timely opportunity to reshape how construction jobs are created, distributed, and valued, placing dignity, resilience, and equity at the heart of India's infrastructure story.

1. India's Construction Sector – Second-Largest Employment Generator
2. India's Shift to Low-Carbon Construction Must Not Leave Anyone Behind

3.5 The Opportunity Ahead

Green building materials present a transformative opportunity for India's construction sector - environmentally, economically, and socially.

1. **A Climate Imperative:** By reducing embodied carbon, improving thermal efficiency, and minimising pollution during production and use, these materials can significantly lower the environmental footprint of India's construction sector. As buildings and construction already contribute over 30% of the country's greenhouse gas emissions, a shift in material choices is essential to meeting India's climate commitments.

2. **An Engine for Economic Growth:** Demand for sustainable construction solutions is fuelling new business models, ranging from recycled-material startups and biobased innovations to modular manufacturing units and low-carbon cement substitutes. This momentum creates space for a future-ready construction economy built on innovation, resilience, and environmental accountability.

3. **A Driver of Jobs and Local Enterprise:** As newer technologies gain ground, there is a rising need for trained masons, site engineers, and contractors who understand green materials and can deliver climate-smart construction on site. At the same time, decentralised production models for low-carbon blocks, panels, and coatings can empower rural entrepreneurs and micro-enterprises, making the green economy more inclusive.

Unlocking the Opportunity: Ecosystem Action Required

While the opportunity is immense, it cannot be realised in silos. A collaborative ecosystem, comprising startups, industry leaders, government agencies, training institutions, and certification bodies, is essential. Public procurement, innovation funding, and skill-building initiatives must work in tandem to mainstream green materials across markets. With the right support, India has the potential to emerge not just as an adopter but as a global leader in material-level climate innovation.

4. What is a Green Building Material?

Green building materials are essential to reducing the climate impact of India's rapidly growing construction sector, particularly by tackling **embodied carbon emissions**, which are increasingly recognised as a major contributor to the built environment's total emissions profile.

Workers assemble modular roof panels at ReMaterials (Modroof) facility

Unlike operational emissions (e.g., from lighting or air conditioning), **embodied carbon refers to emissions released throughout the lifecycle of building materials,** from raw material extraction and manufacturing, to transport, installation, use, and eventual demolition or reuse. These emissions are spread across:

- **Scope 1:** Direct emissions from on-site construction activities
- **Scope 2:** Indirect emissions from electricity used in production
- **Scope 3:** Upstream and downstream emissions, including raw material sourcing, transport, and disposal

Because **Scope 3** emissions are deeply embedded in supply chains, they are also the hardest to measure and reduce. This is where green building materials come in.

Why Lifecycle Matters

Traditionally, green buildings have been evaluated based on operational performance: energy efficiency, water conservation, and indoor air quality. But this leaves out a significant part of the emissions picture.

A **lifecycle approach** addresses this gap by evaluating a material's total environmental impact from cradle to grave (or ideally, cradle to cradle). This includes:

- **Upfront emissions** (manufacturing, transport)
- **Use-phase emissions** (maintenance, durability)
- **End-of-life impact** (reuse, recycling, or landfill)

As India moves toward net-zero buildings and infrastructure, it becomes necessary to account for both operational and embodied carbon. And for that, we need clearer definitions and standards for what qualifies as a "green" material.

Low Embodied Carbon: Produced with minimal emissions (e.g., LC3 Cement).

Circularity: Recycled or recyclable (e.g., recycled plastic bricks.

Resource Efficiency: Use renewable resources (e.g., bamboo, hemp).

Figure 4: Environmental Characteristics of Green Building Materials

4.1. A Working Definition for Green Building Materials in India

There is currently no single, universally accepted definition of green building materials. Existing frameworks offer helpful direction:

- The **Indian Green Building Council (IGBC)** defines a green building as one that "uses less water, optimises energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants."
- The **World Green Building Council (WGBC)** takes a lifecycle view, defining green buildings as "highly resource efficient, with upfront carbon minimised to the greatest extent possible and all remaining embodied carbon reduced or, as a last resort, offset across the lifecycle."

However, these definitions focus more on building-level outcomes than material-level evaluation. To support the growing ecosystem of material innovators, certifiers, and adopters, this study proposes a working definition of green building materials for the Indian context:

A building material can be considered 'green' if it is developed through an end-to-end approach that prioritizes carbon-neutral, low-carbon, or carbon-positive* processes. This involves minimizing environmental and human impacts by optimizing the use of natural resources, incorporating alternative and low-emission inputs, and enabling resource efficiency and lifecycle sustainability through strategies like reuse or repurposing."

**Carbon-positive materials refer to those that sequester more carbon than they emit—for example, materials like hempcrete or biochar-infused blocks.*

This definition is intended as a practical tool for guiding **innovation, investment, and ecosystem alignment,** while enabling India to set its own benchmark for sustainable construction.

4.2. Types of Green Building Materials

To understand the application of green building materials across the construction value chain, it's important to categorise them not just by their composition but also by their role in reducing environmental impact, particularly embodied carbon emissions. These materials intervene at different stages of a building's lifecycle, contributing to sustainability through reduced emissions, improved circularity, and enhanced resource efficiency.

Green building materials can broadly be categorised into four key types, based on their function in the construction process and their potential environmental benefits:

Figure 5: Categories of Green Building Materials

Table 1: List of conventional materials and their potential alternatives in the building and construction sector

Conventional Materials	Green Building Materials	Key Benefits
Structural Materials		
Portland Cement	Fly Ash, LC3 Cement	Reduces CO2 emissions by 30–50% with industrial byproducts.
Clay/Fired Bricks	Compressed Earth Blocks, AAC Blocks	Uses less energy; made from natural or recycled materials.
Virgin Steel	Recycled Steel	Saves 75% energy vs. virgin steel; reduces mining.
Structural Timber	Cross-Laminated Timber (CLT)	Renewable wood-based; sequesters carbon.
Synthetic & Composite Materials		
PVC Pipes	Recycled HDPE Pipes	Repurposes plastic waste; corrosion resistant.
Synthetic Paints	Low-VOC/Natural Paints	Reduces indoor air pollution; eco-friendly ingredients.
Polyurethane Foam Insulation	Plant-Based Polyurethane	Derived from soy/castor oils; non-toxic.
Epoxy Adhesives	Bio-Based Adhesives	Uses renewable resins (e.g., soy).
Supporting & Speciality Materials		
Ceramic Tiles	Recycled Glass Tiles	Repurposes post-consumer glass waste.
Synthetic Paints	Magnesium Oxide (MgO) Board	Fire-resistant; avoids gypsum mining.
Bitumen Waterproofing	Bio-Based Membranes	Plant-derived (e.g., soy); renewable and non-toxic.
Asphalt Roofing	Green Roof Systems	Reduces urban heat; improves stormwater management.
Mechanical & Advanced Materials		
Copper Wiring	Recycled Aluminium Wiring	Saves material and energy through recycling; lightweight.
Galvanized Steel Pipes	Recycled HDPE Pipes	Durable; repurposes plastic waste.
Traditional Concrete	Geopolymer Concrete	Uses industrial waste (fly ash/slag); alkali-activated binders.
Fiberglass Insulation	Sheep Wool/Cellulose Insulation	Biodegradable; superior thermal performance.

5. Market Landscape And Adoption Barriers

This section provides a closer look at the current state of green building material adoption in India, highlighting growth potential, policy gaps, and systemic challenges.

5.1. Market Growth of Green Building Materials

To understand the commercial potential of green building materials in India, it's important to look beyond the conventional construction sector and focus on **emerging material categories** that are specifically designed to reduce environmental impact.

The market for green building materials, excluding high-volume sectors like cement and steel, is projected to grow significantly across all categories. These include structural, mechanical, speciality, and composite materials, as defined in earlier sections.

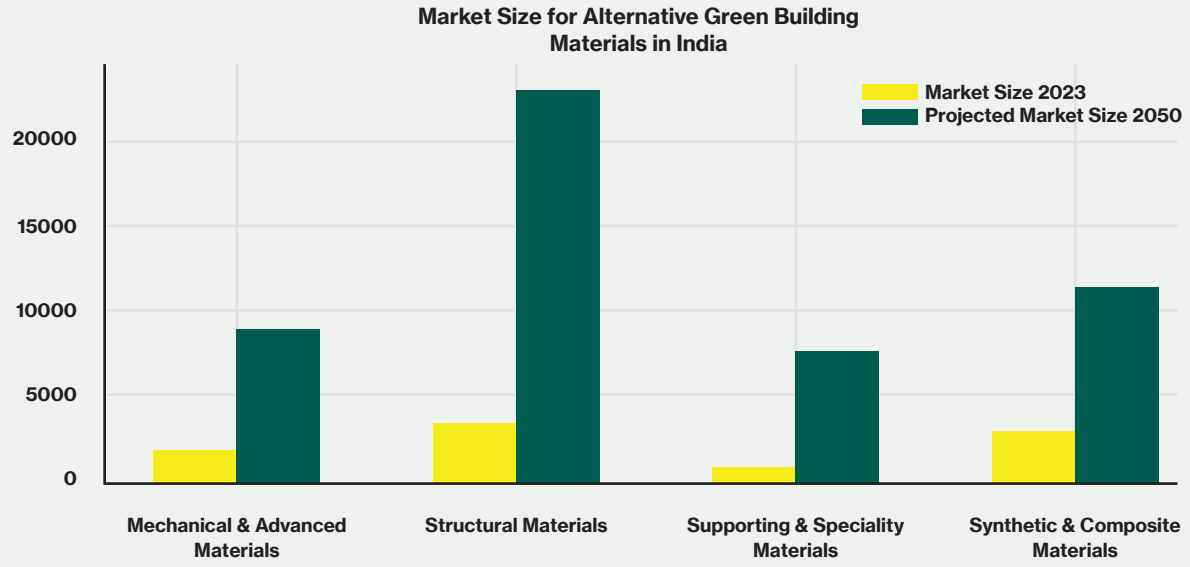


Figure 6: Market Size of Alternative Green Building Materials in India (2023 vs 2050 Projection)

This graph captures the estimated and projected market size (in INR crores) for four key categories of green building materials. It does not include traditional sectors like cement and steel, whose broader applications go beyond green buildings.

Sources: Data synthesized from multiple sources: Economic Times [1], EDGE Buildings [2], Asset [3], iMarc Group [4].

1. Green Buildings Market in India to Reach USD 39 Billion by 2025
2. India Green Building Market Maturity Snapshot 2020 (IFC)
3. India's Construction Sector Must Learn from Its Glorious Past
4. India Building Materials Market Report (by IMARC)

Structural materials are currently the largest segment due to their fundamental role in construction, but other categories, such as synthetic composites and mechanical materials, are also expected to see rapid expansion.

5.2 Policy and Standards Landscape for Green Building Materials

India's green building materials ecosystem is shaped by a web of national, state-level, and private policy instruments and standards, each addressing different parts of the value chain. While some initiatives directly promote material innovation, many focus more broadly on operational energy use or building-level performance.

At the national level, policy direction is primarily governed by the **Ministry of Housing and Urban Affairs (MoHUA),** with critical roles played by:

- **The Ministry of Environment, Forest and Climate Change (MoEFCC) :** Responsible for environmental clearances and impact assessments that indirectly influence material choices, especially for large-scale construction projects.
- **The Bureau of Energy Efficiency (BEE) under the Ministry of Power (MoP) :** Leads the formulation and implementation of energy efficiency codes, such as the Energy Conservation Building Code (ECBC), which sets performance benchmarks for buildings but currently gives limited attention to embodied carbon or material-level emissions.

> **"Embodied carbon from materials like cement and steel is rising fast – set to match operational emissions by mid-century. Scalable adoption of low-carbon alternatives like LC3 and recycled steel could cut India's cumulative embodied emissions by nearly 29% by 2070."**
> – *Mr. S.P. Garnaik, India Country Representative (GGGI) and ALCBT Project Advisor.*

Key Policy Drivers for Market Shift

1

Embodied Carbon Policy Leadership

BMTPC and PMAY uniquely address material-level innovation to reduce embodied carbon – unlike most building policies which focus only on operational energy use.

2

Market Creation Through Regulation

SEBI's ESG vendor reporting and IGBC subsidies are building demand-pull for certified green materials, essential for market transformation.

3

Geo-Climatic Customisation

The Smart Cities Mission enables regional adaptation – such as bamboo-based systems in the Northeast or rammed earth in arid zones.

Policy Breakdown: Regulatory Instruments by Function

Below is a mapping of key policies and instruments that influence green building material adoption in India, structured by type of policy function:

Policy/Instrument	Role
A. Material-Specific Mandates & Innovation Incentives	
Pradhan Mantri Awas Yojana (PMAY) [1]	Mandated the use of low-carbon materials (e.g., fly ash bricks, AAC blocks) in affordable housing, with an estimated 9 million tonnes of CO_2 savings by 2024.
Building Materials and Technology Promotion Council (BMTPC) [2]	Provides funding for R&D, testing, and commercialisation of green materials (e.g., LC3 cement, agri-waste panels) in collaboration with academia and startups.
B. Standards & Certification Drivers	
National Building Code (NBC) [3]	Requires inclusion of material sustainability in design considerations, including recycled or alternative inputs.
IGBC / LEED / GRIHA Certification Schemes	Unlock financial incentives (e.g., 25% capital subsidy) for projects that demonstrate the use of certified green materials such as low-VOC paints or recycled steel. While certification agencies do not directly offer financial benefits, recognized certifications can serve as eligibility criteria for accessing public subsidies, green financing schemes, or preferential procurement programs.
State-Level Tax Rebates (IGBC Portal) [4]	At least 14 states, including Andhra Pradesh, Tamil Nadu, and Telangana, offer 5–20% property tax rebates for buildings using certified recycled materials (e.g., C&D waste aggregates).
C. Financial & Market-Based Mechanisms	
SEBI ESG Vendor Reporting Guidelines [5]	Mandate ESG disclosures for real estate developers, including sustainability performance of vendors whose materials contribute >2% of project value.
RBI Green Bonds [6]	Pilot programs offer interest rate concessions for use of innovations such as geopolymer concrete or carbon-negative tiles.
D. Corporate Actions	
Renewables-first decarbonisation pathways	Ambuja Cement targets a **60 % green-power share by 2030** to cut scope-2 emissions. [7] UltraTech has adopted an internal carbon price of US $10 per ton CO_2 to steer low-carbon capex. [8] In Europe, **H2 Green Steel** plans to supply **2.5 Mt yr-1** of **hydrogen-based "green steel"** for construction markets by 2030, signalling the direction of global best practice [9].

1. Housing for All Scheme Reaches Major Milestone (Government of India, MoHUA - PIB Release ID 1952081)
2. Building Materials & Technology Promotion Council (BMTPC)
3. National Building Code of India (BIS - Bureau of Indian Standards)
4. Government Incentives for IGBC-Rated Green Buildings (Indian Green Building Council)
5. SEBI's Latest ESG Disclosure Reforms: Impact on Indian Businesses and Compliance Strategies (Ricago Blog)
6. Sustainability Financing: Unconventional Models for Contemporary Times
7. Ambuja Cements Integrated Report 2023
8. UltraTech Cement Limited (Science Based Targets initiative)
9. FT Article: India Inc's Race Towards Net Zero Targets

Testing and scaling low-carbon materials	■ L&T has field-tested a stabilising mix that **cuts lime content by 80%** and allows recycled aggregates in concrete [1]. ■ Lodha Group integrates recycled steel and green concrete, piloting **LC3 cement blends with IIT Delhi** to slash embodied carbon[2]. ■ Godrej & Boyce has recycled **> 30,000 ton of C&D** waste across projects, cutting material costs 20–30% [3]. ■ UltraTech collaborates with startups such as CarbonOrO, Coomtech and Fortera to trial CCUS and low-heat kilns[4].
Circular-economy commitments	■ Several Indian majors now co-process alternative fuels and wastes; for instance, Ambuja has set a **27% Thermal Substitution Rate target by 2030** [5]. ■ **Saint-Gobain has developed ORAÉ®, the world's first EPD-verified low-carbon glass substrate.** According to industry documentation, ORAÉ® has a carbon footprint of 6.64kg CO_2e/m^2, a 42% reduction compared to the baseline for clear glass, offering a substantial embodied-carbon saving in façades [6].
E. Circular Economy & Waste Management Policies	
C&D Waste Management Rules (2016)	Mandate the recycling of construction waste such as bricks and concrete. However, enforcement remains inconsistent [7].
Fly Ash Utilisation Policy	Encourages use of fly ash bricks in public infrastructure projects like housing and highways to reduce landfill pressure [8].

Table 2: Key policies and schemes for green buildings and materials in India

While policies like the **Energy Conservation Building Code (ECBC)** and **Eco Niwas Samhita (ENS)** have strengthened operational energy standards, they often overlook the material side of building performance. Green materials can contribute to both operational and embodied carbon reduction, but to do so, they must be **integrated into design choices early on.** Addressing material sustainability from the **design and procurement stage** is crucial for delivering not just policy compliance, but also lifecycle cost-efficiency and long-term carbon reduction.

India's green building materials policy ecosystem is evolving, with several promising instruments already in place. However, most remain **fragmented, under-enforced, or poorly aligned with on-ground market realities.** The opportunity now lies in bridging the gap between policy intent and implementation, through greater awareness, technical capacity-building, pilot procurement, and financial innovation.

1. Larsen & Toubro Integrated Report 2023-24
2. Lodha's Roadmap to Net Zero: Science-Based Targets for a Sustainable Future
3. Godrej Boyce Constructs a Fully Functional Office Within 40 Hours Using 3D Construction Printing Technology
4. Ultratech Targets Green Energy at 85 Percent of Its Total Energy Mix by 2030
5. Ambuja Becomes the World's First Cement Company to Join the Alliance for Industry Decarbonization
6. Saint-Gobain Glass Launches Its First Low-Carbon Glass on the Market
7. CPCB Rules under the rules section
8. Fly Ash Management and Utilization (CPCB)

5.3 Investment Trends In Green Buildings And Materials

Investments in green buildings are driven by regulations, compliance and brand credibility over the last two decades. These investments have grown with the advent of green bonds and real estate investment trusts (REITs). Most funds are aligned with the ESG priorities of corporates, with relatively limited direct investment in green building materials.

Table 3: Investment focus (examples) in green building and materials sector

Organize	Sector/Focus Area	Investment Commitments (USD Million)
Aavishkaar Capital	Circular economy, C&D waste recycling, bio-based materials	1000
Clean Energy Finance Corporation (CEFC)	Energy-efficient construction, renewable energy	200
Green Growth Equity Fund (GGEF)	Low-carbon building materials, sustainable real estate	740
IndusInd Bank & Yes Bank	Green bonds for sustainable real estate, waste recycling	1000
International Finance Corporation (IFC)	Sustainable materials, green building technologies	1000
JSW Ventures	Green hydrogen, carbon capture in steel and cement	1200
Mahindra Sustainability Fund	Green-certified buildings, LC3 cement, energy-efficient designs	60
Re Sustainability (Ramky Enviro)	C&D waste recycling, upcycling materials for construction	600
Tata Capital Innovations Fund	Low-carbon cement (LC3), green concrete, recycled steel	250

5.4 What's Holding Back Green Building Materials?

While the environmental case for green building materials is clear, their mainstream adoption in India remains limited. This is not just due to cost or supply issues, but because of several systemic barriers related to regulation, awareness, certification, and market readiness. These include:

- **Embodied Carbon not Prioritised in Green Building Norms:** Most green building regulations and certification schemes in India continue to focus on **operational efficiency. Embodied carbon,** is often overlooked in building design, procurement, and certification processes. As a result, climate action misses a major contributor to emissions in the built environment.

- **Limited Use of LCA and EPDs due to Awareness and Capacity Caps:** Tools like **Life Cycle Assessment (LCA) and Environmental Product Declarations (EPDs)** are widely used globally to evaluate and communicate the environmental footprint of materials.
  - **LCA** is a method that measures a material's total environmental impact from raw material extraction to disposal, like a report card for carbon emissions across its lifecycle.
  - **EPDs** are third-party verified documents that publish these results in a standard format, like a nutrition label that allows architects and developers to compare products based on credible data.

In India, these tools are rarely used. Startups often lack the resources and technical capacity to conduct LCAs or obtain EPDs. There are only a handful of accredited EPD verifiers in the country. While certification systems like GreenPro and GRIHA encourage LCA data, it contributes only a small share to scoring and is often overlooked in practice.

- **Weak Enforcement and Limited Infrastructure for C&D Waste Recycling and Circularity:** India generates between 150–500 million tonnes of construction and demolition (C&D) waste each year [1], yet less than 1% is currently recycled [2]. The construction sector continues to follow a largely linear model, extract, use, and discard, resulting in significant resource waste and carbon emissions. Policies encouraging recycling and reuse exist, but enforcement is weak and supporting infrastructure is insufficient, leaving most waste unmanaged.

A technician at Tvasta's facility prepares a mix for 3D printed construction

1. Government released comprehensive guidelines for effective disposal of C&D waste: Hardeep S Puri
2. India recycles only 1% of its construction and demolition waste - CSE

- **Innovation is Yet to Match Industry Scale:** Startups often face a fundamental challenge: their **manufacturing capacity cannot meet the volume requirements** of large real estate or infrastructure projects. This is typical of any emerging business, but in the construction sector, it becomes a bottleneck. To overcome this, startups need **patient capital from investors and early demand commitments from developers** to scale gradually and reliably.

- **The Green Premium: High Cost Limits Market Adoption:** Green materials often come with a **price premium** due to higher R&D costs, smaller production runs, and lack of economies of scale. In India's price-sensitive construction market, even a 10–15% premium becomes a major barrier. Without targeted incentives or lifecycle cost calculators, builders struggle to justify the upfront cost, even when long-term benefits exist.

- **Trust Deficit: New Materials Struggle to Prove Themselves:** The construction industry is inherently conservative. Builders and architects prefer using materials with a proven track record, tested over years, with known performance standards. New materials, however innovative, lack that opportunity. Without pilot projects or long-term studies, they are seen as risky. This creates a vicious cycle: new materials can't prove themselves without adoption, and they can't get adopted without proof.

- **Lack of R&D Infrastructure and Testing Facilities:** Startups developing green building materials often lack access to research and development funding, accredited testing facilities, and opportunities for live pilots in construction projects. As a result, many promising innovations remain stuck at the prototype stage and struggle to gain market validation or investor confidence.

- **No Universal Certification or Labelling for Green Materials:** Unlike conventional materials governed by Indian Standards (IS) codes, green materials often operate in a grey area. BMTPC's Performance Appraisal Certification Scheme (PACS) is a promising initiative but is still relatively new and lacks wide industry recognition. The absence of a unified, credible labelling system makes it difficult for buyers to evaluate the performance or credibility of new materials.

- **Fragmented and Insufficient Financial Incentives:** While some property tax rebates and certification-linked benefits exist, they primarily reward building-level performance (e.g., energy or water efficiency), not material choices. There are no dedicated subsidies, carbon credits, or procurement-linked incentives aimed specifically at low-carbon or recycled materials. As a result, green materials struggle to compete on cost with carbon-intensive incumbents.

6. Innovation Landscape of Green Building Materials

6.1 Why Innovation in Materials Matters

As India accelerates its infrastructure and housing development, building **materials are becoming the next frontier for climate innovation.** While architectural design and digital tools have matured, the construction sector is now entering a phase where **low-carbon, high-performance materials** will determine the sustainability of future buildings.

The shift from traditional materials like clay bricks and cement-heavy concrete to newer solutions, such as **geopolymer blocks, recycled composites, agri-fibre panels, and low-carbon glazing,** has created a platform for startups to reimagine construction from the ground up. These materials not only reduce **embodied carbon** but also offer benefits such as improved thermal performance, faster installation, and resource circularity.

6.2 What Startups Are Building

India's construction materials market has long been dominated by large, capital-intensive firms, particularly in cement, steel, and float glass. However, in recent years, startups and early-stage innovators have carved out meaningful space in segments that incumbents have underexplored: circular materials, bio-composites, modular systems, and carbon-negative technologies.

Category	Technologies/Feedstocks	Representative Startups
Decarbonised cement & concrete	Geopolymer binders, CO_2-cured concrete, AI-optimised mix design	RecycleX, CarbonStrong, SatiQ
Waste-to-value masonry & paving	Fly ash, plastic waste, C&D debris, agro-industrial residues	Zerund, Angirus, Paving+, Saltech, GreenBanana
Bio-based panels & insulation	Straw panels, wood fibre, coconut husk, compressed agri-waste	Strawcture, ModRoof, GreenJams
Advanced prefab & 3D printing	Modular wall systems, mortarless construction, 3D printed shells	Tvasta

Illustrative, not exhaustive. See Annex 1 for detailed startup case profiles

Plastic-Based Materials: Addressing a Complex Narrative

Some of the most visible innovations in green construction materials rely on post-consumer plastic waste, transforming it into bricks, pavers, and composite panels. Given India's growing plastic-waste crisis (estimated at 3.4 million tonnes/year), such materials offer a promising route for both decarbonisation and circularity.

However, plastic-based products also raise concerns about long-term leaching, microplastics, and thermal resistance. Startups like Saltech, Zerund, and Paving+ have sought to address these through third-party leachate testing, heavy-metal analysis, and adherence to BIS and GreenPro standards. Procurement agencies and developers should apply due diligence by requesting independent test certificates, especially in the absence of clear national protocols for construction-grade recycled plastic.

Rather than dismiss these innovations, the sector must engage critically, balancing the benefits of landfill diversion and low-carbon impact with evolving evidence on health and lifecycle safety, while also holding producers accountable for ensuring long-term performance and environmental responsibility.

6.3 Use-Case Based Comparison of Green vs Conventional Materials

Green building materials are not just climate-aligned, they're also increasingly competitive on **performance, durability, and ease of use.** The comparison tables below highlight how startups across India are delivering products that match or surpass conventional benchmarks in areas such as thermal insulation, strength, water resistance, and embodied carbon.

Walling (Bricks, Blocks, Panels)

Parameter	Conventional (Clay, Bricks)	Green Building Materials	Why GBMs Win
Thermal Performance	U-value ~1.8 W/m²K	Agrocrete®: ~0.9 W/m²K; Zerund: <0.252 W/mK	Better insulation, lower HVAC loads
Compressive Strength	3–4 MPa	Agrocrete®, Zerund: 3–15MPa	Comparable
Water Absorption	15–20%	Angirus: 0%; Zerund: <5%	Waterproof, mold-resistant
Carbon Footprint	~0.3–0.45 kg CO_2e/kg	Angirus: 0.196 kg CO_2e/unit; Zerund: -0.44 kg CO_2e/kg	Carbon-negative or low-carbon
Material Source	Virgin clay, cement	Recycled plastic, fly ash, agro-waste	Reduces landfill, preserves soil

Flooring & Paving (Tiles, Pavers)

Parameter	Conventional (Concrete Pavers, Tiles)	Green Building Materials	Why GBMs Win
Compressive Strength	25–30 MPa	Paving+: 50–60 MPa	Stronger and longer-lasting
Water Absorption	8–10%	Paving+: <1.5%; CarbonCraft: <3%	Better durability
Thermal Performance	Low	Saltech: Cooler surface via composite blend	Urban heat reduction
Carbon Footprint	~0.3–0.6 kg CO_2e/sq.ft	CarbonCraft: 0.087 kg CO_2e/sq.ft	Lower embodied emissions
Aesthetics	Generic Finish	CarbonCraft: Designer grade, customizable	Visual appeal for premium use

Precast & Structural components

Parameter	Conventional Concrete Blocks	Green Building Materials	Why GBMs Win
Compressive Strength	5–25 MPa	RecycleX: 5–40 MPa; GreenBanana: M60+	Comparable or better
Durability	10-15 Years	GreenBanana: 75+ years	More chemical and weather resistant
Thermal Insulation	Low	GreenBanana: <0.252 W/mK	Greater comfort and efficiency

Parameter	Conventional (Concrete Pavers / Tiles)	Green Building Materials	Why GBMs Win
Installation	Mortar-based	Mortarless, modular (GreenBanana)	Faster, easier construction
Durability	Cement-based: ~350 kg CO_2e/m^3	RecycleX: Carbon-negative via CO_2 curing	Better ESG Profile

Roofing Solutions

Parameter	Conventional (RCC, Metal Sheets)	GBM (ModRoof)	Why GBMs Win
Material	RCC, cement sheets	Waste wood composites	Lightweight and modular
Installation Time	Multi-day	1-day installation	Fast deployment
Thermal Performance	Low insulation	ModRoof: Cooler indoor conditions	Improved comfort
Carbon Footprint	High	~3600 tons CO_2 saved over 450,000 sq.ft	Sustainable impact
Aesthetics	Varies	Fully waterproof, 30+ years tested	Long-lasting durability

Glazing & Glass Façades

Parameter	Conventional Float Glass	Green Building Materials	Why GBMs Win
Carbon Footprint	~11.5 kg CO_2e/m^2 (4 mm)	ORAÉ®: 6.64 kg CO_2e/m^2 (4 mm) – 42% lower 【Saint-Gobain, 2023】	Verified low-carbon EPD
Recycled Content	~25–30%	~64% (including 55% external cullet)	High circularity
Aesthetic/ Performance	Standard	Same optical and thermal performance as conventional glass	No performance trade-off
Certifications	General compliance	EPD, Cradle to Cradle Bronze (Platinum for circularity), Solar Impulse Label	Credible and global standards
Applications	Façades, partitions, doors	Windows, curtain walls, skylights, partitions	Broad adaptability

Table 4: Comparison of green materials against various use-cases in the construction value chain

6.4 Use-Cases Across Construction Segments: Where Startups Are Scaling

Green Building Materials (GBMs) are no longer limited to early-stage pilots or demonstration sites. Across India, startups are actively deploying sustainable materials in real-world construction projects, from rural homes and office buildings to factories and civic infrastructure. These use cases signal a maturing market and growing developer confidence in material-level climate innovation.

Residential | **Zerund –** Affordable Housing with Fly-Ash Blocks

- **Where:** Assam, Meghalaya, Nagaland, and other North-Eastern states under the Pradhan Mantri Awas Yojana (PMAY) scheme
- **What they built:** Low-carbon bricks made from fly ash and plastic waste
- **Deployment:** Partnered with state PMAY programs to supply over 3.5 crore bricks across 1000+ homes, enabling faster construction and lower material emissions
- **Why it matters:** By integrating into government-led affordable housing, Zerund demonstrates that GBMs can meet quality and scalability requirements for mass housing needs

1. Zerund official website

Commercial | **Strawcture –** Agri-Fiber Panels for Interiors

- **Where:** Offices, educational institutions, and studios in Delhi NCR, Bengaluru, and Hyderabad
- **What they built:** Pre-fabricated panels made from compressed agri-residue, replacing gypsum and plywood boards
- **Deployment:** Used in Godrej and Tata Realty workspaces, T-Hub Hyderabad, and coworking spaces
- **Why it matters:** Strawcture's panels deliver thermal insulation and aesthetic value, while promoting circular economy by diverting crop stubble from being burnt

1. Strawcture official website

Industrial

RecycleX – Carbon-Cured Concrete Products

- **Where:** Infrastructure and factory projects in Ankleshwar, Gujarat
- **What they built:** Low-carbon concrete made from recycled plastic, C&D waste, and CO_2 curing
- **Deployment:** Supplied to developers and infrastructure firms for precast components, including India's first cement-free road at Army Public School, Bengaluru (350 m^2)
- **Why it matters:** RecycleX's carbon-negative manufacturing reduces dependence on virgin materials while turning plastic and demolition waste into durable construction components

1. Recyclex official website

Public Infrastructure

Tvasta – 3D-Printed Bus Shelters for Godrej

- **Where:** Mumbai, Maharashtra
- **What they built:** Modular 3D-printed concrete structures using robotic fabrication and low-waste design
- **Deployment:** Deployed as part of a pilot with Godrej to build smart bus stops that reduce cement use by 30–40%
- **Why it matters:** Tvasta's approach shows how next-gen GBMs and construction tech can reduce emissions and accelerate installation timelines for civic projects

1. Bus Shelters for Godrej by Tvasta

Public Infrastructure | **GreenJams –** Agrocrete® Wall with ITC

- **Where:** Kapurthala, Punjab
- **What they built:** A 1.5 km long perimeter wall using Agrocrete®, a carbon-negative block made from agri-waste and fly ash
- **Deployment:** Executed with ITC Limited to decarbonize their industrial campus construction
- **Why it matters:** This high-visibility use case validates the commercial readiness of carbon-negative materials and the role of corporate buyers in scaling their adoption

1. https://www.youtube.com/watch?v=5x3DzqqhLNQ

Public Infrastructure | **Paving+ –** Recycled Pavers Across Bengal

- **Where:** Madhyamgram, Dankuni, Hosiery Park, and other township projects in West Bengal
- **What they built:** Paver blocks made from unsegregated plastic and industrial waste
- **Deployment:** Over 10 lakh sq ft of installations with municipalities and civic bodies, recycling 185 tonnes of plastic waste
- **Why it matters:** Paving+ provides a high-performance product that simultaneously tackles plastic pollution and offers municipalities a climate-resilient alternative to concrete pavers

> **"The construction industry stands at a pivotal moment where corporate leadership must drive the transition to green building materials. As we face the challenge of reducing embodied emissions, it's not enough to simply develop innovative solutions – we must create pathways for their widespread adoption. My experience in the cement and steel sectors has shown me that meaningful change happens when industry players collaborate to scale innovations from pilot projects to market reality. At Build Ahead, we're committed to bridging this gap between innovation and implementation, ensuring that low-carbon materials become the standard rather than the exception in India's built environment.**
> *Mr. Manoj Rustagi, Chief Sustainability and Innovation Officer, JSW Cement and Chairperson, Build Ahead Coalition*

1. Projects – Paving+

7. Research Findings : Sectoral and Stakeholder Perspectives

To better understand the opportunities and bottlenecks in the green building materials (GBM) ecosystem, this study conducted extensive surveys, interviews, and roundtables with over 100 organisations across five Indian cities. The findings are presented through two complementary lenses: **(1) Stakeholder-specific insights,** capturing real-world challenges and incentives experienced by ecosystem actors, and **(2) Sector-level systemic analysis**, identifying broader challenges and levers for ecosystem-wide change.

7.1. Stakeholder Perspectives

Government & Policymakers

- **Barriers:** There is no national mandate for reducing embodied carbon in buildings. Only 14 states have incorporated sustainability into their building codes, and most public procurement guidelines still exclude green materials from official tender documents.
- **Drivers:** Central schemes like Smart Cities, PMAY, and SEBI's ESG rules indicate growing intent to embed sustainability. Some states have initiated pilots with green construction.
- **What this means:** Policymakers are open to innovation, but they need standardised tools and mandates to confidently adopt green materials in public works. Translating high-level policy into actionable procurement norms is critical.

> **"India's construction boom offers an unprecedented opportunity to build cities that are not only climate-resilient but also inclusive and equitable. At C40, we define clean construction as a decarbonised, resource-efficient, resilient, and socially just system – one that supports thriving communities, safeguards worker health, and creates green jobs. With urban areas projected to house nearly 600 million people by 2036 and residential energy demand expected to increase eightfold by 2050, how and what we build today matters immensely. Construction already accounts for over 23% of global CO_2 emissions and consumes more than a third of extracted resources. A shift to clean construction can help India meet its infrastructure needs while reducing environmental impact. Through the Clean Construction Accelerator, C40 mayors are leading this change by setting clear visions, transforming municipal procurement, rethinking materials, and prioritising reuse and retrofit. This is how we build not just better structures, but a better future.**
>
> *— Shruti Narayan, Managing Director - Regions and Regional Director - South and West Asia, C40 Cities*

Corporates & Material Producers

- **Barriers:** Shifting to green materials (like fly ash bricks or geopolymer concrete) requires major capital investment. Producers also face inconsistent supply of waste inputs and lack of clarity on long-term demand.
- **Drivers:** Net-zero goals and rising ESG scrutiny are motivating corporates to explore cleaner production options. Energy efficiency and raw material reuse offer additional cost benefits.
- **What this means:** Producers want to act but need clear market signals and lower upfront risk. Shared manufacturing hubs and pooled procurement could help unlock private investment in green production.

Developers, Architects & Contractors

- **Barriers:** Green materials are often seen as expensive (15–20% higher), unfamiliar, and hard to get approved by engineers or structural consultants. There is also a lack of project-level data on how these materials perform over time.
- **Drivers:** Green-certified buildings are fetching 10–15% higher resale or rental value in urban markets. ESG-focused investors are also rewarding sustainable construction practices.
- **What this means:** Developers are open to experimenting, but only when risk is low and returns are clear. Early adoption will depend on credible pilots, standard approvals, and real-world performance data.

Consumers & End Users

- **Barriers:** Most homebuyers are unaware of green materials or associate them with higher cost. Benefits like thermal comfort, durability, or lower electricity bills are not well communicated.
- **Drivers:** Subsidies and Rebates: Government schemes or green loans offering lower interest rates for using sustainable materials. Low Interest 'green' building Loans. [1]
- **What this means:** Messaging needs to shift from technical language ("low-carbon" or "eco-friendly") to tangible consumer benefits like health, comfort, and cost savings. Awareness efforts should focus on what green materials offer beyond the environment.

1. Financing Green Housing: A Key to India's Green Transition

Certification Bodies & Standards Agencies

- **Barriers:** The presence of multiple overlapping standards (e.g., IGBC, GRIHA, EDGE) creates confusion. Testing processes are long, expensive, and labs are often far from where materials are produced.
- **Drivers:** Global trends are pushing for lifecycle-based assessments. India is also developing digital certification platforms that can speed up the process.
- **What this means:** Startups and developers need a unified, streamlined, and affordable certification system.

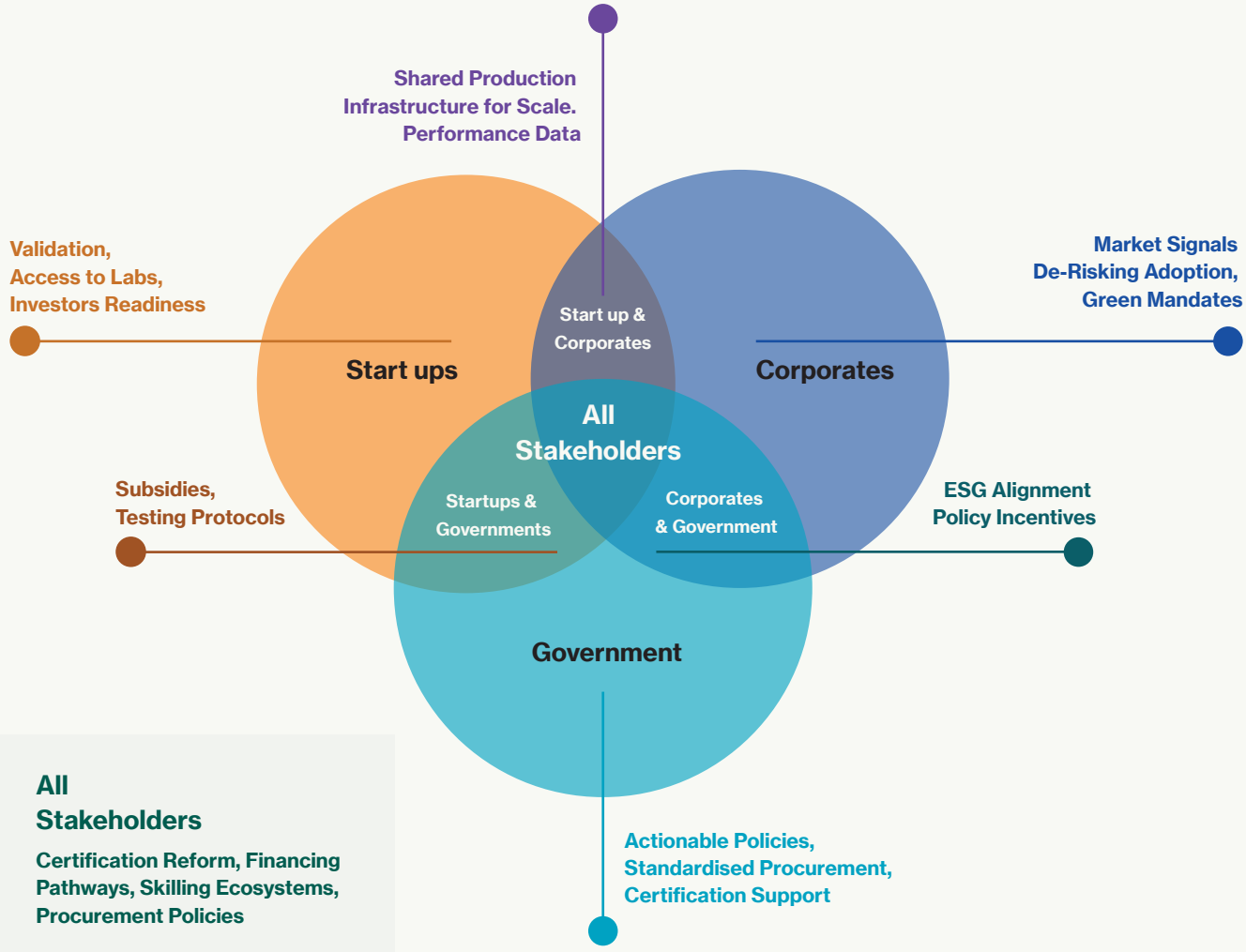


Figure 7: Overlapping Needs Across Stakeholder Groups

7.2 Sector-Wide Systemic Insights

While stakeholder-specific barriers reveal the 'micro' side of the story, this section outlines the broader system-wide challenges and proposed solutions to build an enabling ecosystem for GBM adoption.

Table 5: Key findings and insights from the market study

Focus Area	Key Insights and Gaps Identified
Certification and Standards	Startups reported delays of 4–6 months for material testing, often needing to send samples to labs located 300 km or more away. The existence of multiple parallel certification schemes increases complexity and cost. Testing protocols also remain geared toward conventional materials.
Financing and Incentives	The financing ecosystem remains weak for hardware-intensive and manufacturing-focused innovations. Most startups struggle to attract commercial investors due to long payback periods. Subsidies and incentives (such as tax breaks or GST waivers) for GBMs are either unavailable or inconsistently applied.
Policy and Regulatory Environment	Green materials are often missing from official procurement schedules or Schedules of Rates (SoRs), making it difficult for government bodies to procure them even when willing. Few states have formal mechanisms to integrate sustainability into construction codes.
Market Demand and Adoption	Developers and contractors often request performance proof over 18+ months before considering adoption. This delays market entry for newer innovations. Additionally, local procurement decisions are often price-driven, with limited flexibility for innovation.
Supply Chain and Logistics	Many materials rely on locally available waste streams (e.g., fly ash, demolition debris), but quality and volume are inconsistent. Some manufacturers are forced to source inputs from distant regions, increasing transport costs and carbon footprint.
Workforce Skills and Awareness	On-site workers, including masons and contractors, often lack the knowledge to correctly install or handle new materials. Training modules on GBMs are largely absent from mainstream skilling programs and construction curricula.
Collaboration and R&D Platforms	There are very few dedicated platforms where startups, corporates, researchers, and policymakers can come together to co-develop, pilot, or validate new materials. Most collaborations are project-specific and donor-driven rather than institutionalised.

Unlocking a Systems-Level Opportunity

The study reveals that the construction sector is on the brink of change, driven by growing intent but constrained by a fragmented and underprepared ecosystem. Certification delays, overlapping standards, and limited lab infrastructure continue to stall innovation. Financing remains elusive, especially for hardware-heavy startups with long payback cycles. Regulatory frameworks are outdated, with green materials missing from public procurement systems and Schedules of Rates. Meanwhile, developers lack confidence due to insufficient performance data, and on-site workers remain unfamiliar with new materials due to gaps in training.

Despite these challenges, the incentives across the ecosystem are beginning to align. Policymakers are seeking practical tools to translate sustainability mandates into actionable norms. Corporates are under pressure to meet ESG targets but need de-risked pathways to adopt low-carbon and resource-efficient production methods. Developers are increasingly open to sustainable materials that enhance asset value, and consumers are starting to respond to tangible benefits like comfort, and energy savings. Startups are ready to scale but require validation, market access, and collaborative platforms.

India now has a window to move from fragmented pilots to coordinated systems change, anchored in unified certification, accessible financing, integrated skilling, and green-aligned public procurement. If scaled strategically, green building materials can become more than a climate solution, they can redefine the construction economy as resilient, inclusive, and globally competitive.

8. Pathways to Scale Green Building Materials

Based on our study findings and stakeholder engagements, this section outlines an **integrated framework** for accelerating the adoption of Green Building Materials (GBMs) in India. Structured around four actionable pillars, the goal is to build a scalable, investor-ready, and impact-driven ecosystem.

8.1. Drive Market Demand

Anchoring demand is critical to accelerating the adoption of green building materials. Aligning public procurement policies, corporate ESG commitments, and the supply capacities of startups can unlock predictable market signals and reduce first-mover risk. Strategic demand creation builds trust, supports early adoption, and lays the foundation for scaling green materials across the construction ecosystem.

Key Intervention Areas:

A. Anchor Demand through Policy & Procurement

- **Mandated Procurement Commitments:** Urban development departments, housing boards, and Smart Cities missions can earmark 10–20% of public project budgets for verified green materials. The coalition will support governments through a dedicated policy and advisory unit that helps integrate GBMs into tendering processes, technical specifications, and Schedules of Rates (SoRs). This unit will also develop incentive structures and procurement guides aligned with national building codes.
- **Corporate Offtake Agreements:** ESG-driven corporates can commit to multi-year procurement of green materials through structured supplier agreements. These offtake commitments reduce demand volatility for startups and enable bankability.
- **Demonstration Projects:** Facilitate pilot projects in affordable housing, schools, and infrastructure, especially in Tier 2 and Tier 3 cities, that showcase GBM feasibility, performance, and cost-effectiveness. These serve as replicable templates for mainstream adoption.

B. Strengthen Supply Chain Infrastructure

- **Raw Material & Logistics Aggregation:** Enable partnerships between startups and raw material suppliers, such as fly ash plants, demolition contractors, and agro-residue aggregators, to ensure consistent quality and reduce landed costs.

> "The building materials industry is undergoing a quiet revolution – from low-carbon cement and bricks to bio-based insulation and smart water systems. Yet, the critical bottleneck isn't innovation itself; it's bridging the gap between groundbreaking solutions and real-world construction sites. The future demands more than a marketplace: it requires an ecosystem where sustainable innovation meets practical challenges. The imperative is clear: connect developers with vetted, certified green materials backed by data and trust, transforming sustainable options from niche alternatives to the default choice in every building project.
>
> *SaiPadma P, Founder; CEO, Hubeco.market*

8.2. Bridging the Valley of Death

Many green material startups face a funding gap after developing a prototype but before achieving commercial scale. This is often referred to as the "valley of death." A dedicated innovation fund, combining philanthropic, public, and private capital, can help bridge this gap by supporting high-potential solutions through their early growth phases.

Key Intervention Areas:

A. De-risk Early Deployment

- **Milestone-Based Grants & Concessional Loans:** Disburse funds linked to product development or commercialization milestones, such as successful pilot completion, customer acquisition, or certification achievement. This creates a performance-based funding approach with reduced investor risk.
- **Viability Gap Funding (VGF):** Where GBMs are slightly costlier than conventional alternatives, the fund can provide short-term subsidies to bridge this gap. This enables trial without shifting cost burdens to buyers during early market seeding.

B. Build Shared Infrastructure

- **Co-Investment in Manufacturing Hubs:** Partner with local industrial estates or institutions to develop shared-use manufacturing clusters that reduce capex burdens. Startups can access these on a rental or membership basis to produce at quality and scale without high upfront investment.

C. Strengthen Commercial Readiness

- **Go-to-Market & Investor Readiness Support:** Provide startups with targeted assistance on pricing, packaging, distributor tie-ups, and fundraising strategy. This is especially critical for technical founders who need support with commercialization.

D. Unlock Public Procurement Capital

- **Green Procurement Bonds:** Support public agencies in raising capital through green bonds earmarked for GBM adoption in infrastructure or housing projects. These instruments can mobilize scale capital for institutional offtake.

8.3. Center of Excellence (CoE)

A Centre of Excellence (CoE) is proposed as a key institutional anchor to fast-track GBM certification, reduce testing costs, strengthen quality standards, and build market trust. It will also serve as a knowledge hub and policy thought leader.

Key Intervention Areas:

A. Expand Testing Capacity and Reduce Costs

- **Regional Testing Labs with Academic Institutions:** Set up a distributed network of 5–6 low-cost testing labs in collaboration with IITs, CSIR, and NITs. Labs will specialize in categories such as C&D waste, agro-residues, or bio-based materials, based on regional innovation clusters.

B. Build Market Trust Through Standardisation

- **Performance Rating System:** Develop a national green material rating label (akin to BEE star ratings) that evaluates durability, carbon impact, and lifecycle performance. This rating will be interoperable with IGBC/GRIHA frameworks and easily understood by builders and consumers.
- **Simplified LCA & EPD Templates:** In collaboration with national certifiers, create standardized templates for Life Cycle Assessment (LCA) and Environmental Product Declarations (EPD). This reduces compliance costs and enables transparent communication of sustainability claims.

C. Strengthen Sectoral Capacity

- **Green Literacy & Training Hubs:** Set up regional training centres with NSDC and local polytechnics to build capacity among masons, engineers, architects, and procurement professionals. Curriculum will focus on material handling, installation, and specification interpretation.

> **"India has made a commitment to be net zero by 2070. Several builders and developers have commitments for net zero for time frames well before 2070. Low-carbon building materials can play a key role in meeting these commitments. There is an urgent need for government bodies, architects and design consultants as well and builders to lead collective actions that canaccelerate offtake, reduce costs, and shift the market toward sustainable construction at scale. The construction industry, long viewed as carbon-intensive, needs to show leadership in sustainability, driving innovation, growth, and climate resilience at scale.**
> *DR. BHASKAR NATARAJAN, Director, AEEE*

8.4. Market Platform for Access and Awareness

A national digital platform, complemented by regional outreach efforts, can play a central role in making green materials more visible, comparable, and accessible to stakeholders across the ecosystem. This marketplace would function as both a discovery tool and a capacity-building space.

Key Intervention Areas:

A. Product Discovery and Verification

- **Verified Green Material Catalogue:** The platform will feature a curated, searchable catalogue of green building materials with detailed product profiles. Each listing will include technical specifications, product images, third-party certifications, indicative pricing, and documented use cases. This structured database will enable users to identify suitable GBMs with clarity and confidence.
- **Real-Time Certification and Compliance Updates:** The marketplace will be directly linked with recognised testing and certification agencies, ensuring real-time updates on compliance status. Users will be able to track certification validity, approvals, and renewals, thus eliminating the need for manual background checks and strengthening material credibility.

B. Procurement Planning and Market Linkages

- **Procurement and Planning Tools:** To support evidence-based decision-making, the platform will include practical tools such as cost comparison calculators, carbon footprint estimators, lead time dashboards, and material compatibility filters. These features will help procurement officers and developers assess trade-offs and plan more effectively.
- **Buyer-Seller Networking Events:** The platform will also act as a channel for market activation by hosting regular demo days, virtual exhibitions, and roundtable discussions. These events will connect GBM startups with public buyers, housing finance institutions, and large developers. Co-hosted with ecosystem partners like IGBC, CREDAI, and urban ministries, these engagements will strengthen market linkages and accelerate adoption.

C. Awareness and On-Ground Implementation Support

- **Knowledge Hub for Capacity Building:** To address the significant awareness and training gap among field professionals, the platform will include a dedicated learning section. It will feature explainers, installation guides, FAQs, and instructional videos tailored to masons, site engineers, and contractors. These resources will be region-specific and designed to promote correct usage of GBMs in real-world construction contexts, particularly in Tier 2 and Tier 3 locations.

To advance the four key pathways: driving market demand, bridging the financing gap, strengthening infrastructure, and building awareness, it is essential to establish a cross-sector coalition. This coalition can align public procurement priorities, corporate ESG goals, and startup capabilities to create predictable market signals, reduce adoption risks, and build trust. By enabling coordination across stakeholders, it can provide the foundation needed to scale green building materials across India's construction ecosystem.

Let's Build Together

Villgro Innovations Foundation, Terwilliger Center for Innovation in Shelter, Saint-Gobain and Terrarium invite stakeholders across the construction, finance, policy, and innovation ecosystem to join a national working group dedicated to advancing the adoption of green building materials.

This collaborative platform will drive the implementation of the key pathways and solutions outlined in this study, addressing systemic barriers and unlocking scale for sustainable materials.

Villgro will take the lead in operationalising these initiatives in a phased manner, prioritising short-, medium-, and long-term actions based on sectoral urgency, ecosystem readiness, and stakeholder demand. By coordinating efforts across public procurement, innovation funding, testing infrastructure, and market awareness, this working group can serve as a catalyst for India's green construction transition.

Together, we can shape a future where India not only meets its housing and infrastructure needs – but does so sustainably, inclusively, and at scale.

1 CaseStudy

CarbonStrong:

CarbonStrong creates Supplementary Cementitious Materials (SCMs) by activating fly ash and steel slag, allowing for a 40-50% reduction in cement usage in concrete. This innovation addresses one of the highest-emitting materials in construction.

Website	https://carbonstrong.in/
Location	Bangalore, Karnataka
Founders	Harsh Jain [1], Vikramaditya Singh [2]

Problem Statement

India's construction sector struggles to reduce its reliance on high-emission cement due to the lack of scalable, high-performance alternatives. CarbonStrong addresses this gap by transforming flyash and steel slag into validated SCMs that cut concrete emissions by up to 40% and unlock circular use of industrial byproducts.

Innovation Summary

- **Product:** SCMs from processed fly ash, steel slag, others
- **Material(s):** Processed fly ash and steel slagwasteash
- **Technology:** Thermal, mechanical, chemical activation
- **USP:** Reduces cement use without compromising strengthdurability
- **Stage:** Pre-commercial; lab-validated; customer trials ongoing

1. https://www.linkedin.com/in/harsh-jain-climateaction/
2. https://www.linkedin.com/in/vikramaditya-singh-750262121/

Certifications and Validations

Aligned with BIS grades (M20–M40)

Carbon footprint validated through comparative studies

Environmental Performance

- **GHG Reduction:** 30-40% in concrete mix
- **Circularity:** Reuses fly ash, steel slag, other industrial **by products for high-value application**
- **Potential:** Could save 50M tons CO_2 annually if scaled nationally

Deployment & Use Cases

Pilots in concrete road, pavers, pavements and ready-mix concrete. MoUs with concrete producers for deployment and thermal power plants/ steel plants for access to raw materials

Traction

- Partners: Urban local bodies, RMC suppliers
- Funding: Early-stage grant
- Industry recognition as a decarbonization game-changer

2 CaseStudy

Tvasta:
3D Printing for Low-Carbon, Customizable Construction

Tvasta is pioneering 3D printing for construction, offering customizable, resource-efficient, and lower-carbon structures for housing, infrastructure, and industrial use. Its tech stack spans hardware, software, and materials, enabling flexible deployment and rapid prototyping.

Website	tvasta.construction [1]
Location	Chennai, India
Founded	2016
Founders	Adithya VS, Parivarthan Reddy

Problem Statement

Traditional construction methods are labor-intensive, wasteful, and carbon-heavy. There's a growing need for scalable housing solutions and greener alternatives, especially amid rapid urbanization and climate concerns.

Innovation Summary

- **Product:** On-site 3D-printed buildings, modular pods, and coral reef units
- **Material(s):** Cement-free mix with fly ash, GGBS, and local aggregates
- **Technology:** Vertically integrated additive manufacturing
- **USP:** 30% less binder, hollow walls, rapid builds, design flexibility
- **Stage:** Revenue-generating, with pan-India and international deployments

1. Tvasta Construction official website

Certifications and Validations

- **Patents filed**
- **BMTPC certification received**
- **Recognized by MoHUA and DSIR**

Environmental Performance

- **Carbon footprint:** Reduced via binder replacement and optimized design
- **Material savings:** 30% less material use due to hollow wall structures
- **Water use:** Lower due to in-situ mix design and no curing required
- **Circularity:** Uses industrial waste streams like fly ash and GGBS

Deployment & Use Cases

Used for G+1 villas (Godrej), site offices (RVNL), coral reefs (Emrat, Koral Kinetics), and public infrastructure (Greater Chennai Corp). Suitable for facades, landscape elements, low-rise housing, and disaster-relief structures.

Business Model

Hybrid model with printer sales, project-based services, and AMC/training support. Exports to the U.S. and UAE via distributors.

Challenges

Need for regulatory standards on 3D printing; high upfront printer cost for small contractors

Traction

- ₹48 Cr+ revenue over 3 years; ₹39 Cr raised; partners include L&T, Godrej, SEPC, and ISRO; recognized by MoHUA, CIDC, and DSIR

Tvasta is looking for partners to expand pilot sites, mainstream green building certifications, and co-develop 3D printing standards in India and abroad.

3 CaseStudy

RecycleX:
Carbon-Negative Cement Alternatives from Industrial Waste

RecycleX is tackling the environmental toll of cement and industrial waste by manufacturing high-performance, carbon-negative construction blocks, bricks, and pavers. Using innovative alkaline activation and CO_2 curing, the company transforms hazardous industrial side streams into safe, structurally strong, and affordable building materials.

Website	www.recyclex.in [1]	Founded	2020
Location	Bharuch, Gujarat	Founders	Vedant Gandhi (M.Engg), Abhishek Chhazed (B.Engg)

Problem Statement

Cement alone contributes over 8% of global CO_2 emissions – more than the aviation industry. Simultaneously, India generates over 1.1 billion tons of industrial waste annually (fly ash, slag, mine tailings), 60% of which ends up in landfills or tailing ponds. This poses both an environmental hazard and a resource waste.

RecycleX addresses this by creating sustainable building products using these side streams, reducing the environmental impact of both waste disposal and cement production.

1. Recyclex official website

Innovation Summary

- **Product:** Carbon-negative bricks, blocks, and pavers
- **Material(s):** Fly ash, slags, sludge, mine tailings ash
- **Technology:** Alkaline activators + <1-day CO_2 curing
- **USP:**
  - Strength range: 5–40 MPa
  - Fire-resistant, recyclable, and better insulation
  - Meets India Building Code standards
  - Cheaper than concrete blocks
- **Stage:** Scaling with active sales, clients, and pilots

Certifications and Validations

Ongoing commercial deployments

Validated features: fire resistance, recyclability, high compressive strength

Product Pricing
- Rs. 4 per BrickRs.
- 30/sq. ft (Pavers)
- Rs. 40 per block

Environmental Performance

- **Waste diverted:** 12,000 tonnes of fly ash, slags, and sludge reused
- **Jobs created:** Employment for 60+ migrant workers
- **CO_2 saved:** 1,800 tonnes
- **Carbon footprint:** Carbon-negative products through sequestration and CO_2 curing

Deployment & Use Cases

Reference projects include:

- Residential buildings (Vedant Gandhi, Vibgyor Infra)

- CSR school complex (Technip Energies)
- Industrial construction (Ace Chemie, Capital Construction)
- Infrastructure like village roads and petrol pumps
- Other Clients Industrial Construction (Aditya Birla Hindalco, Neogen Ionix, Garda Chemicals, Heubach)
- Infra Projects (Bullet Train- NHSCRL, Mumbai – Delhi Express Way, Indian Army)

These diverse deployments across sectors show the material's adaptability and durability.

Business Model

RecycleX operates a **dual-revenue model:**

1. Project-based consulting:

- R&D, site-specific feasibility
- Sidestream logistics and sourcing
- ESG impact assessment

2. Recurring revenue streams:

- Licensing
- Alkaline chemical sales
- Technical support

This model allows modular expansion in partnership with local precast companies and industries.

Challenges

- Requires further **certification and benchmarking** to mainstream in government projects
- **Supply chain logistics** for waste material sourcing is complex and location-specific
- Needs **capital and R&D support** to expand product lines into culverts, crash barriers, and prefab panels

Traction and Recognition

- Financial growth:
  - ₹11M revenue in 2022
  - Projected ₹71M+ in 2023
- Net income rising from ₹0.6M (2022) to ₹12M+ (2023)
- Recognized and supported by industry leaders including AIC GUSEC, BRIGADE REAP, and Global Proptech Network

RecycleX is seeking:

Real estate and infra firms to adopt RecycleX materials in bulk projects

Partners for waste valorization and local deployment

Investors and ecosystem enablers to help scale manufacturing, certification, and licensing across India

4 CaseStudy

SatiQ Concrete Manufacturer Pvt. Ltd.

SatiQ is redefining concrete by replacing 30–70% of cement with standardized alternative binders made from locally sourced industrial waste. By combining cement chemistry, microstructure engineering, and AI/ML-based data optimization, SatiQ reduces both cost and carbon emissions of concrete while enhancing performance. Their waste-agnostic approach enables scalable, location-adaptive concrete solutions for both structural and non-structural applications.

Website	www.scmconcrete.com	Founded	June 13th 2024
Location	Chennai, Tamil Nadu	Founders	Dr. Shantanu Bhattacherjee, Dr. Smrati Jain

Technology & Innovation

- **Product:**
  - Tiles, façades, veneers, interior elements, concrete facades
  - Lightweight and ultra-high-performance concrete panels
  - IoT-enabled sensors for real-time quality control

- **Material Innovation :**
  - **Rapid strength durable concrete** – Reduces construction cycle by 2–4 days, enhances structure life by 15–30 years
  - **Rheology-modified concrete** – Tailored for 3D printing and advanced machinery **Impact-resistant concrete** – Engineered for high shock loads
  - **Low-carbon high-performance concrete** – Up to 150 MPa strength; thinner sections, longer lifespan
  - **Severe exposure-grade concrete** – For chloride/sulfate-prone environments like sewage pipelines

- **Technology:**
  - Microstructure engineering and advanced cement chemistry
  - AI/ML models for mix design optimization and material characterization
  - IoT-based real-time quality tracking during production

- **USP:**
  - **Cement and cost reduction through** binder optimization
  - **Waste-agnostic sourcing** using chemistry-based algorithms
  - **Performance gains** in speed, strength, and service life
  - **Smart manufacturing** via data and sensor integration
  - **Eco-friendly footprint** with competitive pricing

- **Stage:**
  - **Cement and cost reduction through** binder optimization

Certifications and Validation

- **In Progress**
  - BMTPC PACS, LEED alignment, NABL labs
- **Intellectual Property**
  - Patents under filing
- **Environmental Benchmarks:**
  - **Structural concrete:** 160–230 kg CO_2 eq/m^3 (vs. 290–350 conventional)
  - **Non-structural concrete:** 50–150 kg CO_2 eq/m^3 (vs. 220–300 conventional)
  - **Net-zero formulations:** 20–50 kg CO_2 eq/m^3

- **Durability and Strength:**
  - RCPT: 200–2000 coulombs
  - Carbonation: < cover depth in 70 days
  - Strength range: 15–150 MPa
  - Satisfies BIS and IS 456 standards for water absorption, acid resistance

Deployment & Impact

- **Pilot Deployments:**
  - **Vidisha Villa** – G+1 structure with 30% cement replacement
  - **PGP Glass, Surat** – Mould workshop with low-carbon concrete
  - **SLABS, Pune** – PCC slab with rapid 7-day strength gain
  - **Chennai Precast Unit** – Cement cut from 330 to 200 kg/m³ in M25 mix
  - **SRO Collaboration** – 3D printed refractory tiles with VSSC
- **Ongoing Projects:**
  - **Affordable housing** near Chennai using M-sand wastePGP Glass, Surat
  - **Sobha Construction, UAE** – Lightweight panels (650–700 kg/m³) for thermal efficiency
- **Production Capacity:**
  - **Third-party manufacturing:**
    - 1 ton/day binder production
    - 25–100 m³ concrete/day
- **Geographic Reach:**

  Tamil Nadu, Gujarat, Maharashtra, Madhya Pradesh, Karnataka, Kerala
- **SDG Alignment:**

  SDG 9 (Industry), SDG 11 (Sustainable Cities), SDG 12 (Responsible Consumption), SDG 13 (Climate Action)

Market Traction & Recognition

- **Clients/Partners:**

  ISRO, Tata Power, PGP Glass, Ultratech, Sobha Construction, Tvasta, Habitat for Humanity, IITM Incubation Cell, PDEU IIC
- **Funding**

  Grants from TDCA-HDFC Parivartan, NIDHI Prayas; family and friends

- **Recognition:**
  - **Startup Maharathi Award (2025)** – Winner
  - **Solar Decathlon India (2025)** – Top 10, Climate Smart Innovation
  - **TDCA-HDFC Parivartan (2025)** – Winner
  - **Boeing Build (2024)** – Regional Winner
  - **M-Sand Innovation Challenge (2024)** – Winner (Habitat for Humanity + KSUM)

- **Business Model & Expansion:**
  - **Short-term (6–18 months):**
    - Pilot validation and certification (BMTPC, LEED)
    - Early revenue from bespoke products and consulting
    - Micro manufacturing plant + mobile testing labs
    - Outsourced production via partner batching plants
  - **Short-term (6–18 months):**
    - Binder sales to concrete producers
    - Luxury segment and non-structural market focus
    - Expand user base and stabilize recurring revenue
  - **Long-term (2–5 years):**
    - Geographic expansion across South and West India
    - Establish large-scale binder production units
    - Create material supply clusters and smart distribution hubs

- **Supply Chain Strategy**
  - Raw material mapping and geo-tagged characterization
  - Transporter partnerships for decentralized waste logistics
  - Modular, location-based processing units
  - Demand-led supply chain clusters based on concrete usage patterns

SatiQ is actively looking for:

Public and private developers to pilot sustainable concrete products
Government agencies to enable procurement through certifications
Investors and ecosystem enablers to support scale-up of binder technology and AI-driven production systems

Let's make sustainable concrete the new norm.
Let's build India, sustainably.

5 CaseStudy

Angirus: Revolutionizing Brickmaking with Plastic-Bound Wricks

Angirus replaces fired clay bricks with Wricks – a waterless, cement-free brick made from plastic and C&D waste.

Website	angirusind.com [1]
Location	Udaipur, Rajasthan
Founded	2021
Founders	Kunjpreet Arora, Lokesh Puri Goswami

Problem Statement

Conventional brickmaking heavily depletes topsoil and emits significant CO_2. Meanwhile, construction and low-value plastic waste continue to overwhelm India's landfills. Angirus bridges both problems through an integrated, circular material innovation.

Innovation Summary

- **Product(s):** Wricks
- **Material(s):** Low-value plastic, C&D waste
- **Technology:** Patented process using plastic as binder, no water or cement
- **USP:** 75% lower carbon footprint, waterproof, load-bearing, cost-saving
- **Stage:** Growth stage with commercial deployments

Certifications and Validations

- **LCA completed**
- **BIS and GreenPro certifications underway**
- **Granted Indian patent**

Environmental Performance

- **Carbon footprint:** 0.196 kg CO_2e/unit
- **Water use:** Zero in manufacturing
- **Waste diverted:** 200,000+ kg of waste
- **GHG emissions reduced:** 1,000 TCO_2e

Deployment & Use Cases

Used in 6+ cities including Srinagar, Chennai, and Jaipur for residential, commercial, and public infrastructure projects. Particularly valuable for low-rise structures and waterproofing applications.

Business Model

- B2B distribution with decentralized manufacturing units
- Working with C&D aggregators and local waste processors

Challenges

- Needs regulatory recognition for faster mainstreaming
- Raising awareness among contractors and masons

Traction

- Forbes 30 Under 30 Asia
- Clinton Foundation, World Economic Forum, Netflix India
- Seed funding from impact investors

Angirus is seeking partners for decentralized scale-up, certification support, and developer collaborations.

6 CaseStudy

Zerund:
Northeast India's Flagbearer of Lightweight GBM

Zerund is pioneering the use of plastic and fly ash-based bricks in India's Northeast. Their high-performance bricks are light, durable, and thermally efficient.

Website	zerund.com [1]
Location	Guwahati, Assam
Founded	2018
Founders	David Gogoi, Mousum Talukdar, Rupam Choudhury

Problem Statement

There's limited access to sustainable construction materials in Northeast India, despite high volumes of industrial and plastic waste. Zerund tackles this with an affordable, scalable alternative to conventional bricks.

Innovation Summary

- **Product:** Lightweight multilayer bricks
- **Material(s):** Fly ash, pond ash, plastic
- **Technology:** Patent-pending multilayer process
- **USP:** Crack-resistant, insulating, lightweight
- **Stage:** Early commercial

1. Zerund official website

Certifications and Validations

In-house testing lab

GreenPro, GRIHA, and LCA underway

Environmental Performance

- **Carbon footprint:** -0.44 kg CO_2e/kg
- **Lifespan:** 75+ years
- **Thermal Conductivity:** <0.252 W/mK

Deployment & Use Cases

Approved under Assam PWD's schedule of rates; now expanding to Maharashtra. Used in institutional walls and non-load-bearing partitions.

Business Model

- Franchise model for national expansion
- Focus on B2G contracts through policy advocacy

Challenges

- Regulatory push needed to compete in public procurement
- Capacity-building to meet demand

Traction

- INR 15 lakh from ShelterTech
- INR 15 crore Series A – a landmark deal in GBM space

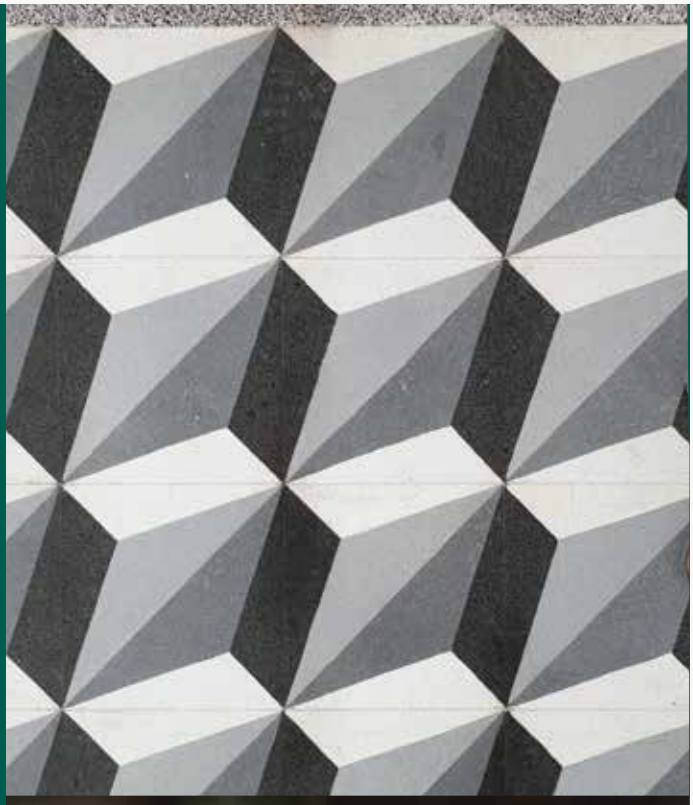
Zerund is open to partnerships with developers, state governments, and EPC contractors.

7 CaseStudy

CarbonCraft: Capturing Carbon in Aesthetic Tiles

CarbonCraft integrates climate-conscious design and material science to make carbon-negative wall tiles, claddings, and decorative building surfaces.

Website	carboncraftdesign.com [1]
Location	Bangalore, Karnataka
Founded	2016
Founders	Tejas Sidnal



Problem Statement

Air pollution and industrial waste are rising, while aesthetic, sustainable options for interior/exterior surfaces remain limited. CarbonCraft merges utility with beauty using carbon capture innovation.

Innovation Summary

- **Product:** CarbonCraft Tiles
- **Material(s):** Industrial byproducts
- **Technology:** Proprietary 3-stage process
- **USP:** Carbon-negative, customizable, scalable
- **Stage:** Early commercial

1. Carbon Craft design official website

Certifications and Validations

GreenPro and EPD certified

Compliant with strength benchmarks for claddings

Environmental Performance

- **Carbon footprint:** 0.087 kg CO_2e/sqft
- **15,000+ sq ft installed; 49 TCO_2e captured**

Deployment & Use Cases

Adopted by Adidas, Subko, Royal Enfield, and multiple real estate firms for cladding and décor applications.

Business Model

- Distribution-led scale-up in six cities
- Dealer model with volume targets

Challenges

- Need for increased production efficiency
- Expanding decentralized production

Traction

- ₹25L equity + ₹2.6Cr in grants
- Featured in key innovation showcases

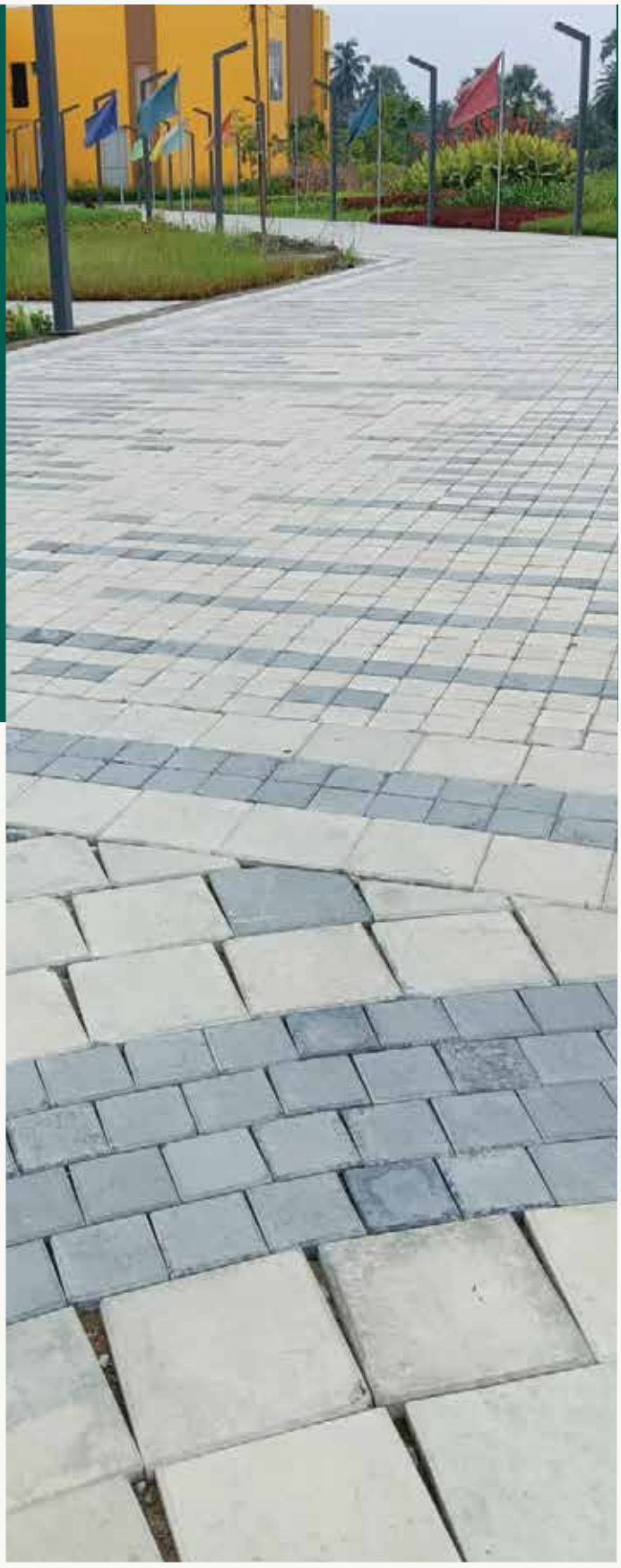
CarbonCraft is seeking partners for distribution, institutional procurement, and capital to expand output.

8 CaseStudy

PAVING+:
Making Roads from Plastic Waste

Paving+ produces heavy-duty pavers for urban and industrial use from high-content plastic waste and silica ash, using a zero-water, zero-discharge process.

Website	paving-plus.com [1]
Location	Kolkata, West Bengal
Founded	2018
Founders	Ranjan, Ziaur



Problem Statement

Plastic waste disposal in urban areas is a massive problem. Paving+ tackles it by using 80% waste content to create durable and climate-resilient pavers.

Innovation Summary

- **Product:** P-80 paver blocks
- **Material(s):** 80% plastic, 20% industrial ash
- **Technology:** Patented heating process
- **USP:** Carbon-negative, high compressive and flexural strength
- **Stage:** Market Ready

Certifications and Validations

GreenPro certified

BIS and microplastic leachate tests ongoing

Environmental Performance

- **Carbon footprint:** 960 kg CO_2/ton
- **Water absorption:** <1.5%
- **Strength: 50–60 MPa (compressive), 6–8 MPa (flexural)**

Deployment & Use Cases

Used in walkways, landscaping, and compound walls by Infosys, Polycab, and Build-A-Home. Recycled over 75,500 kg plastic to date.

Business Model

- JV-based scaling (Bangalore plant in pipeline)
- B2B and institutional partnerships

Challenges

- Scaling operations and navigating regulatory clearances
- Managing quality at scale

Traction

- ₹16L seed raised, ₹7Cr term sheet under negotiation

Paving+ is open to collaborating with infra players, CSRs, and investors for JV partnerships and regulatory advocacy.

9 CaseStudy

Green Banana: Prefab Solutions from Industrial Discard

Green Banana develops modular enclosures, blocks, and pavers using zero-discharge manufacturing and plastic waste streams. They focus on harsh, high-performance use cases.

Website	green-banana.in [1]
Location	Anand, Gujarat
Founded	2022
Founders	Nihar Agarwal, Mudit Kothari, Shridhar Rao

Problem Statement

The need for long-lasting, high-durability infrastructure in challenging terrains (chemical plants, high-altitude areas) is rising. Most conventional materials have high carbon costs. Green Banana provides a robust green alternative.

Innovation Summary

- **Product:** Modular blocks, pavers, prefab enclosures
- **Material(s):** Plastic and industrial waste ash
- **Technology:** Mortarless, patented design
- **USP:** Carbon-negative, corrosion-proof, 75+ years durability
- **Stage:** Market Ready

1. Green Banana official website

Certifications and Validations

GreenPro, LCA, ISO 9001

Process/design patents filed

Environmental Performance

- **Carbon footprint:** -0.08 kg CO_2e/kg
- **Thermal Conductivity:** <0.252 W/mK
- **Production capacity:** 520 MT/month

Deployment & Use Cases

B2B clients include JK Cement, RR Kabel, and Smart City projects. Used in industrial zones, roads, and outdoor landscaping.

Business Model

- CSR and B2B-led sales
- High-volume institutional buyers

Challenges

- Policy and regulatory inclusion
- Scaling R&D and manufacturing infrastructure

Traction

- Seed funded
- Strong traction via CSR channels and infra developers

Green Banana is looking to partner with government projects, EPCs, and industrial buyers for large-scale deployment.

10 CaseStudy

ModRoof

ModRoof designs and manufactures modular roofing systems using sustainable materials such as recycled wood chips and bio-waste. Tailored for both low- and high-income segments, ModRoof offers a cleaner, faster, and more durable alternative to conventional cement roofing. Their roofing system is modular, lightweight, and easy to install, with the potential for mass customization, better thermal comfort, and circular economy alignment.

Website	modroof.in	Founded	2014
Location	Ahmedabad, Gujarat	Founders	Hasit Ganatra

Technology & Innovation

- **Product:**
  - Modular roofing system
  - Applications include sloped and flat roofs, skylights, garden roofs, solar-enabled roofs, and even railings
- **Material:**
  - Panels made from recycled wood chips
  - R&D underway for roofing materials made from waste cardboard and biopolymers

- **Technology:**
  - Unique integration of modular materials and rapid installation methods
  - Modular design library allows customized configurations for diverse user needs
  - Structural and insulation properties comparable to concrete roofing, with added flexibility
- **USP:**
  - Combines **sustainability, speed, and design flexibility**
  - Delivers the **look and strength of concrete**, without the weight or emissions
  - Installation completed in a fraction of traditional construction time
  - Long lifecycle (30+ years), with 90% reusability or recyclability
  - One of the **most-tested roofing systems in India**, evaluated on 700+ parameters
- **Stage:**
  - Early growth phase post-COVID with profitability and active expansion underway

Certifications and Validation

- **IP:** None currently filed
- **Green Certifications:** None yet
- **Compliance:** In-house testing protocols for acid/fire resistance, strength, and life
- Life cycle and maintenance guidelines included in manuals
- Not recommended for high-acid environments like chemical factories

Environmental Performance

- **Carbon & Water Savings:**
  - **3600+ tonnes CO_2 saved**
  - **2400 kiloliters water saved**
  - Cleaner construction conditions for workers and neighbors
- **Durability & Strength:**
  - Tested for life of **30+ years**
  - Compressive and structural performance comparable to RCC roofs
  - Dust-free and low-maintenance installation process
- **End-of-Life Circularity:**
  - 90% of materials **recyclable or reusable**
  - 25–30% resale value at end-of-life
  - RCC roofs recycle less than 3% of components

Deployment & Impact

- **Installations:**
  - Over **900 families** have received ModRoof installations
  - **450,000 sq. ft.** installed so far
- **Impact Highlights:**
  - Families in low-income communities report **30% increase in economic activity**
  - Improved indoor air quality and **better learning environments for children**
  - Safer, more hygienic, and cooler homes compared to metal or cement sheet roofs
  - Supported commercial clients in hospitals, schools, and farmhouses
- **Production Capacity:**
  - **120,000 to 240,000 sq. ft./month**
  - Teams present across 4 locations, with pan-India installation capability
- **Geographic Reach:**

  Nationwide presence, with deeper operations in metro and Tier-1 cities
- **SDG Alignment:**

  SDG 9 (Innovation), SDG 11 (Sustainable Cities), SDG 12 (Responsible Consumption), SDG 13 (Climate Action)

Market Traction & Recognition

- **Clients/Partners**
  - Architects, developers, and contractors
  - Microfinance institutions
  - Non-profit organizations
  - Separate product-market strategies for low-income and premium segments
- **Funding:**
  - Previously raised funds pre-COVID
  - **Currently seeking strategic investors** – preferably from construction or allied sectors (domestic or international)

- **Business Model & Expansion:**
  - Dual Market Strategy:
    - Low-income housing – Strong product-market fit in informal and semi-urban settings
    - Premium &; commercial segments – Including homes, farmhouses, hotels, and institutions

- **Expansion Plans:**
  - Growing sales and installation teams across major Indian cities
  - Setting up zonal warehouses to support regional demand
  - Strategic decentralization of supply chain:
    - Locally source non-core materials
    - Centralize manufacturing for critical components

- **Supply Chain Strategy:**
  - Modular procurement framework for regional agility
  - Clear distinction between centralized and localized components
  - Inventory optimization through demand-linked warehousing
  - Cleaner, more efficient logistics than traditional cement-based systems

ModRoof is seeking:

Strategic investors with interest in green construction or housing innovation
Implementation partners (real estate, government, CSR arms) for scaling impact
Channel partners for warehousing and regional sales

Let's build better homes.
Let's make sustainable roofing a mainstream reality.

Annexure 1 : Key Start-ups in Green Building Materials

There are various material innovations in the Global and Indian ecosystem that help in reducing and(or) replacing carbon intensive conventional materials for buildings and constructions. Some of the examples are provided below.

Company / Organisation Name	Technology Type	Technology Description
GreenJams	Carbon Negative blocks	GreenJams is an award-winning clean construction technology startup known for Agrocrete, world's first carbon-negative verified building material made of crop residues & industrial by-products. Agrocrete reduces the construction cost by up to 50% and increases the thermal Insulation by up to 350%.
Zerund	Carbon Negative blocks	Zerund is a manufacturer of lightweight waste plastic bricks to the construction industry.
CarbonCraft	Carbon Negative Tiles	CarbonCraft has developed Carbon Tile - a first of its kind to be made using upcycled carbon and using craft as a medium.
Paving+	Pavers using recycled plastic	A cleantech startup engaged in creating sustainable high-end construction material from unsegregated plastic waste.
GreenBanana	Pavers + Blocks	Pavers and interlocking blocks from plastic and burnt silica waste
Angirus	Pavers + Blocks	Manufacturing of sustainable damp proof bricks - 'WRICKs'. Made from 100% recycled materials - plastic waste, and inert waste from industries such as construction and mining.
Recycle X	Recycle X Carbon Negative Blocks	RecycleX produces eco-friendly bricks and pavers using Eco-Concrete to decarbonize construction.
Saltech	Carbon Negative Pavers	Saltech Design Labs offers waste management, construction and infrastructure, affordable housing, and renewable energy.
GOBAiR	Low-carbon Concrete mix	Cow-dung based building material that can be mixed with concrete to make a light building material product, which acts as thermal insulator

Company / Organisation Name	Technology Type	Technology Description
IISC	LC3	LC3 cement developed by IISc as an alternative to limestone-based cement
NovaCret	Cement Free Concrete	Cement-free concrete that reduces carbon emissions by 60% and conserves 80% of water resources by eliminating the need for curing. NovaCret concrete is also 10% more cost-effective compared to traditional concrete and achieves target strength in just 3 days.
C-Disc Technologies	Foundation	Pre-engineered nail foundation system that requires no excavation
Carbelim	Bio-Facade	Algae-integrated building facade that absorbs pollutants to improve air quality (AQI).
Biomart	Plastic Bricks	Construction bricks made from recycled plastic waste, reducing landfill burden.
Shelt Innovation	Self-Healing Mortar	Mortar embedded with bacteria ("Bioseal") that autonomously repairs cracks in concrete structures.
XeroCarbon	Carbon-Negative Clinker	Cement clinker alternative that absorbs more CO_2 than it emits during production.
Vashishtha Research	Composite Trusses	Lightweight structural trusses using advanced composites for enhanced durability and load-bearing.
SBH Electrocloud	Thermochromic Paint	Smart paint that changes color with temperature to regulate building heat absorption passively.
Strawcture Eco	Agro-waste-Based Structural Panels	High-performance panels made from compressed crop residues like wheat and rice straw. Offers thermal insulation, acoustic dampening, and a lower embodied carbon footprint compared to gypsum or cement boards. Designed for partition walls, ceiling systems, and modular interiors.
Satiq Concrete Manu-	AI-Enhanced Low-Carbon Concrete	Develops performance-enhanced concrete mixes with up to 50% cement replacement using alternative binders. Features AI-based real-time quality monitoring and rapid strength gain, suitable for precast and prefab construction without the need for heat or steam curing.
Tvasta Manufacturing	3D Printed Concrete Structures	Utilizes robotic 3D printing to construct homes with custom concrete mixes that reduce material waste and improve build speed. Tvasta's mix design incorporates locally available materials and aims for lower carbon content compared to traditional RCC structures.

Company / Organisation Name	Technology Type	Technology Description
CarbonStrong	Carbon-Sequestering Cement Alternative	Develops proprietary cementitious materials that integrate industrial byproducts (like fly ash, slag) and mineral carbonation to lock carbon within concrete. Designed to replace or supplement OPC in structural and non-structural applications.
Saint-Gobain - Low Carbon glass	Low-Carbon Façade and Glazing Solutions	Manufactured using decarbonized processes including electric furnaces and recycled glass (cullet), this new range offers up to 40% reduction in embodied carbon. Used in architectural glazing, this glass maintains energy efficiency (solar control, thermal insulation) while reducing the environmental footprint.

Note: It is also important to note the start-ups like Urjanovac, CabonClean, UGreen and other deeptech solutions in the carbon capture space, are relevant for the value chain of the green building materials as the CO2 captured can act as an input material for start-ups like Carbon Strong.

An exhaustive list of start-ups and companies in India and globally working in the green building materials space are as follows:

Company / Organisation Name	Technology Description
CemVision	CemVision is an industrial climate tech startup that is reinventing cement for the modern world. By utilizing recycled materials, innovative manufacturing processes, and renewable energy sources, we are creating an economical, environmentally friendly, and technically superior product that meets the needs of today's global market.
CarbonCure Technologies	CarbonCure Technologies creates, develops, and licenses solutions that consume waste CO2 to make better concrete. CarbonCure Technologies, a Nova Scotia-based company that has developed technology for concrete producers to inject captured CO2 into fresh concrete, picked up $80 million in a growth round led by Swiss impact investor Blue Earth Capital.
Carbon Built	Enables concrete manufacturing to drive greenhouse gas reductions through the utilization of CO2 and other industrial wastes.
Neocrete	Neocrete can reduce carbon in concrete by 30-50%, with no loss in strength at any age, and is on track to produce carbon neutral concrete by 2027.
Alchemy	Building a predictive quality control AI which will enable production of low-carbon green concrete at scale.

Company / Organisation Name	Technology Description
Terra CO2 Technologies	Terra CO2 Technologies specializes in the production of low-carbon alternatives for cement replacement. The company converts inexpensive, abundant, and local feedstocks from existing aggregate mines to high-performing and cost-competitive cementitious materials. Its climate-friendly, cost-competitive supplementary cementitious materials and zero-carbon cement undergo extensive third-party testing under harsh conditions to independently verify performance.
Ecolocked	Develops novel recipes for concrete and other building materials: CO2-optimized, lighter, more insulating, and with many other features that can be customized to different applications.
Neustark	Neustark removes CO2 from the atmosphere, permanently stores it in recycled concrete and cuts new emissions by reducing the use of cement.
Blue Planet	Blue Planet technology combines waste carbon dioxide with calcium sourced from waste, to manufacture synthetic limestone aggregate.
Solidia Technologies	Solidia Technologies combines low carbon processes, CO2 mineralization, and operational excellence to deliver superior concrete performance, strengthen supply chain resiliency, and reduce concrete's carbon intensity.
CAALA	Developed by the German company CAALA (Computer Aided Architectural Life-Cycle Assessment), the PLCA® parametric building life-cycle assessment software provides property developers, architects and local authorities with assistance in designing carbon-neutral buildings and decarbonizing existing buildings. It considers energy balances, ecological analyses and life-cycle costs in real time, right from the decision-making phase.
Carbicrete	Carbicrete's process for the production of precast concrete replaces cement in concrete with industrial by-products and cures it with carbon dioxide, avoiding the GHG emissions associated with cement production, while permanently sequestering CO2 within the resulting concrete products.
JUUNOO	Belgian startup JUUNOO is revolutionizing wall construction to reduce installation time and allow materials to be reused. The company produces easy-to-install, reusable office walls that can be used to make partition walls, meeting boxes, phone booths, and glass doors. At the end of its life, the wall doesn't have to be demolished but instead can be dismantled and reused. It can be installed seven times faster than a traditional wall and can be positioned and repositioned over and over again.
African Bamboo	Through their pioneering materials made of natural fibers, the Dutch-Ethiopian company African Bamboo aims to create sustainable alternatives to conventional building materials, such as plastic, aluminium, steel, glass and concrete. This exclusive, smart, and low-carbon technology is more than welcome in an industry accounting for 50% of materials and raw materials production, and 40% of energy consumption and carbon emissions.
Carbon Limit	Carbon Limit is a climate technology company that transforms concrete into a carbon capture and storage solution for global CO2 pollution. Carbon Limit's Capture crete has the ability to actively capture CO2 pollution directly from the air and store it permanently. With this technology, the construction industry can improve performance and generate valuable carbon credits.

Company / Organisation Name	Technology Description
H2 Green Steel (H2GS)	H2 Green Steel (H2GS) is on a mission to revolutionise the steel industry by accelerating its decarbonisation through the use of green hydrogen.
Materially	Materially is an Italian startup that facilitates sustainable material development. The startup partners with materials producers and users to develop personalized products. Their range of products includes plastic replacements, recycled plastics, grown materials, bio-based materials, and leather alternatives. Besides, Materially provides end-to-end services in product development from benchmarking to communication and positioning strategies. Hence, the startup serves as a one-stop solution for manufacturers to design and manufacture sustainable materials.
Vestack	French startup Vestack develops modular bio-based buildings. The startup combines digital twins, bio-based materials, and modular manufacturing to provide low-cost homes with improved thermal and acoustic performance. Moreover, this enables high-speed construction projects that finish within one or two weeks. Thus, Vestack allows real estate companies and landowners to improve the sustainability of their building projects.
Widuz	Widuz is a Singapore-based startup that offers Bamboo Veneer Lumber (BVL), high-performance composite lumber made from bamboo fibers. Apart from being sustainable, BVL has a high strength-to-weight ratio compared to conventional construction materials. Therefore, it finds applications in structural beams and external wall cladding while also being used in manufacturing furniture and skateboards. Widuz, thus, enables construction, sports, and furniture companies to shift to a sustainable choice without losing material quality.
TileGreen	Innovates technologies to make concrete-alternative, premium, and carbon-negative building materials from plastic waste.
Basilisk	Basilisk has a number of unique products that enable self-healing concrete. The technology is based on micro-organisms that produce limestone, as a result crack formation in concrete structures can be autonomously repaired.
Envirocrete	Develops environmentally friendly construction materials, including a green, lightweight aggregate and concrete mix, and offers an innovative, prefabricated building process.
Eco Material Technologies	Provider of low-carbon cement construction materials. The platform converts fly ash and pozzolans into near-zero carbon building materials that are environmentally and performance-wise superior to Portland cement.
Seratech	Seratech develops sustainable concrete materials utilizing waste carbon and magnesium silicate rock. The company's process produces net zero silica to replace Portland cement in concrete. This eliminates the need for carbon pipelines, shipping, or geological storage, making carbon capture and storage efficient and low-cost. The process consumes its own carbon emissions and requires less energy than other low-carbon cement processes. Further, the use of olivine, an abundant mineral, enhances the sustainability of the process.

Company / Organisation Name	Technology Description
Eco Material Technologies	Provider of low-carbon cement construction materials. The platform converts fly ash and pozzolans into near-zero carbon building materials that are environmentally and performance-wise superior to Portland cement.
Terratico	Terratico converts plastic waste into a concrete building material. It combines the lightness of plastic with the strength of concrete. This technology ensures that plastic waste is repurposed effectively, contributing to environmental sustainability. It is available in various colours and surface finishes. The company's approach benefits construction businesses and urban planners seeking eco-friendly yet aesthetic building options. Additionally, architects and builders benefit from its fully recyclable nature.
Brimstone	Manufacturer of cement through the carbon-negative process. The company manufactures low-carbon cement by removing CO2 from the air to produce cement that is identical to common Portland cement. The company is offering solutions to solve climate problems.
CarbonRe	AI-powered platform providing cutting-edge decarbonization solutions for industrial processes in cement, steel, and glass production sectors. They are developing an AI-powered platform to enable the decarbonization of these energy-intensive industries.
Hoffmann Green Cement Technologies	Hoffmann Green Cement Technologies is a manufacturer of low carbon cement. The company offers 3 types of low carbon cement such as H-UKR, H-EVA, and H-P2A. H-UKR - leverages alkali-activated slag technology, H-EVA is created by combining flash clay and gypsum/desulfogypsum, and H-P2A is created by leveraging geopolymer cement.
bioMASOM	bioMASON is a biological cement-based masonry building material using microorganisms. It employs bacteria to grow durable cement in ambient temperatures between loose grains of aggregate, producing building materials without emitting greenhouse gases, and without the depletion of non-renewable resources. Its products include proprietary manufacturing processes and materials used by users for incorporation in existing facilities or on-site manufacturing. They claim that their products can be used in any existing building infrastructure and are comparable to other contemporary products.
Sublime Systems	Electrified manufacturing process makes low-carbon cement
Prometheus Materials	Prometheus Materials develops bio-cement with zero carbon emissions to reduce the global CO2 emissions.
ecoLocked	ecoLocked is turning buildings into carbon sinks! We convert captured carbon into functional, carbon-negative construction materials.
Minus Materials	Minus Materials uses microalgae to produce CO2-storing biominerals for the cement and concrete industry.
AICrete	AICrete is the only recipe-as-a-service platform optimizing local materials for cleaner and more cost-efficient concrete.

Company / Organisation Name	Technology Description
Carbonaide	Carbonaide provides technology to utilize and store carbon dioxide in the precast concrete industry.
MAA'VA™	MAA'VA™ is developing next generation of green building materials that can functionally replace concrete.
Concrete4Change	Developing novel technology for carbon sequestration into concrete
Upcycles	Upcycles waste concrete into sustainable building materials.
Nanogence	Nanogence is pioneering carbon-avoidance technology through material science research. It develops eco-friendly smart catalyst technology for the construction and building industry by selectively enhancing the formation of interlocking crystals responsible for binding, thus improving the strength and durability of cementitious material (characteristic in cement). This saves up to 40 percent of carbon emissions without changing the current manufacturing process.
Biozeroc	Biozeroc uses biotech, nanotech and chemical science to grow the carbon negative construction materials of the future. BioConcrete is a patent-pending solution that removes the need for cement in concrete manufacturing and enables high strength and flexibility.
Mimicrete	Proprietary self-healing concrete
DMAT	DMAT develops highly advanced concrete formulas that increase durability and reduce carbon emissions.

> **"The pathways to scale innovations in green building materials lie at the intersection of policy, user adoption or practicality and capacity/ expertise in institutions to leverage these solutions. I am glad that this report touches on all these aspects**
> *Sumedha Malaviya, Head – Building Decarbonization - Energy Program, WRI*

Scaling green building materials is a win for India's economy, climate goals, and workforce. By embedding sustainability in the construction boom, India can cut emissions, boost domestic manufacturing, and lead globally in material innovation.

We invite **policymakers, corporates, developers, and investors** to join us and bring this vision to life. Together, let's shift the narrative from innovation at the margins to innovation at the mainstream.

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