
CARBON CAPTURE AND STORAGE TECHNOLOGY: A REGULATORY PATHWAY TO SUSTAINABLE DEVELOPMENT IN THE REAL ESTATE SECTOR

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ABSTRACT

Carbon Capture and Storage (CCS) technology which is renowned for its capabilities to mitigate industrial carbon emissions, particularly in the construction sector, has become a need for real estate development. The increasing climate change challenges has evolved as a global issue, the real estate industry is at a very crucial point where sustainability and regulatory frameworks must intersect to supplement in environmentally responsible development. The Real Estate (Regulation and Development) Act, 2016, imparts a basis function in conjoining environmental compliance as an inseparable limb of real estate development. This research paper broadly analyses how Carbon Capture and Storage technologies interconnects with the regulatory mechanisms of the R E Act, demonstrating how the Act facilitates the adoption of green building practices by enforcing environmental clearances and aligning with pollution control norms. The paper further explores CCS's impact on reducing the carbon footprint of building materials—especially cement and concrete—highlighting technological advances that make carbon-negative construction achievable. This paper studies how CCS interconnects with RERA's provisions and environmental enforcement mechanisms, placing out a detailed framework for integrating carbon-neutral construction practices into India's real estate regulatory matrix. The paper appraises progressing technologies and challenges faced by stakeholders, drawing conclusions vital to scaling green real estate development. Finally, this paper highlights that the association between CCS and RERA is contributory in transitioning India's real estate sector toward a low-carbon and environmentally resilient future.

I. INTRODUCTION

The construction of structures is the cause for approximately 40% of global greenhouse gas emissions, making the real estate sector a critical frontline in climate change mitigation efforts. Carbon Capture and Storage (CCS) technology, which captures Carbon dioxide from industrial and power plant emissions and stores it in geological formations offers significant potential for decarbonising the built environment. India's Carbon dioxide (CO₂) storage potential is estimated at 395–614 gigatonnes (Gt), indicating strong long-term feasibility for CCS deployment.¹ Climate change mitigation has become as a main global concern, pushing engineering modernisation and environmental regulation to the forefront of urban development. The real estate sector, notably in emerging economies like India, contributes significantly to carbon dioxide emissions through construction activities and material production. Among evolving solutions to decarbonize the manufacturing sector, Carbon Capture and Storage (CCS) and Carbon Capture, Utilization, and Storage (CCUS) technologies propose promising pathways to moderate or neutralize carbon releases associated with real estate sector. Concurrently, The RE Act, 2016 in India emerged as a significant rule of law for regulating the reality sector by promoting transparency, ensuring timely delivery of possession, and protecting interests of consumers. Notably, the Act provide directives for environmental compliance, positioning itself not only as a regulatory framework for transactions and construction standards but also as a mode for fostering sustainable development. The RE Act, suggests a landmark guiding intervention in India's real estate sector, mandating project registration, ensuring transparency in project execution, and safeguarding homebuyer interests. Though RE Act was not originally conceived as an environmental statute, but its framework of promoter accountability, mandatory disclosures, and regulatory oversight presents a unique opportunity to integrate sustainable development obligations—including CCS adoption—into real estate governance.²

II. OVERVIEW OF CARBON CAPTURE AND STORAGE TECHNOLOGY IN REAL ESTATE

Carbon Capture and Storage (CCS) is an environmental technology meant to neutralize carbon dioxide from entering the atmosphere. It acts like a screen for industrial and residential

¹ Carbon capture, utilisation, and storage (CCUS) A white paper by Yaksana S V, Thirumalai N C, Suresh N S, Center for Study of Science, Technology and Policy (CSTEP), March 2026.

² The role of real estate in Viksit Bharat @2047 by NAREDCO Feb 2026.

emissions. In place of releasing CO₂ directly into the air from power plants, factories, or largescale construction sites, the technology seizes the gas at its source. Once seized, the gas is compressed into a liquid-like state and transported via pipelines or ships to a secure storage site. There, it is injected deep underground into geological formations, such as depleted oil and gas fields, saline aquifers, or basalt rock layers, where it is permanently trapped. Carbon

Capture and Storage operates through three primary stages: (i) capture of CO₂ from industrial and power plant emissions; (ii) utilisation in applications such as enhanced oil recovery or chemical production; and (iii) permanent storage in geological formations. Integrating CCUS (Carbon Capture, Utilisation, and Storage) into an industry can theoretically abate 100% of its total emissions.³ In the real estate sector, CCS offers an encouraging trail to decarbonize the built environment. Buildings account for roughly 40% of global emissions due to energy use and construction materials. By implementing CCS at on-site energy generation for large complexes, developers can significantly reduce a project's carbon footprint. This technology is especially significant for industrial real estate and high-rise commercial/residential towers where emissions are extreme. While the technology holds immense potential to help our country achieve its Net Zero 2070 target, pervasive adoption currently faces economic and technical hurdles, including high costs and the need for specialized infrastructure. However, as regulatory frameworks advance, the technology could become a standard component of sustainable building practices, transforming real estate from a major emitter into a leader in climate mitigation.

III. RELEVANCE OF CCS IN REAL ESTATE SECTOR

The real estate sector is accountable for nearly 40% of global greenhouse gas (GHG) emissions, creating it one of the largest suppliers to climate change.⁴ Carbon Capture and Storage (CCS) technology offers a transformative approach to mitigate these emissions at construction sites by integrating capture mechanisms directly into construction processes and building infrastructure.⁵ Considering the sources of these emissions is critical for evolving effective decarbonisation strategies. The real estate sector's contribution to GHG emissions stems primarily from: (i) Embodied Carbon in Construction Materials; (ii) Operational Emissions

³ <https://rera.telangana.gov.in/54673hgsjkfdhgsfg-TG-RERA-lfkdbnklh5409u569> last visited on 26/05/2026.

⁴ <https://www.unepfi.org/themes/climate-change/40-of-emissions-come-from-real-estate-heres-how-these-sector-can-decarbonize/>

⁵ Policy Framework for Sustainable Real Estate Markets, Ece/Hbp/202, United Nations Economic Commission for Europe

from Building Systems; and (iii) Indirect Emissions from Energy Consumption.

EMBODIED CARBON IN CONSTRUCTION MATERIALS

Embodied carbon refers to all GHG emissions associated with the mining, manufacturing, carrying, fixing, upkeep, and end-of-life disposal of structure materials. Materials such as concrete, steel, and aluminium account for at least 6% of global emissions, with construction accounting for an estimated 7–11% of global CO₂ emissions. Concrete production alone is responsible for approximately 8% of global CO₂ emissions due to the chemical process of cement manufacturing. The embodied carbon component is particularly significant in warehouses and industrial buildings, where it can represent over 50% of the total carbon footprint. Traditional approaches have focused primarily on reducing operational carbon, but embodied carbon is projected to surge from 25% to nearly 49% of total building emissions by mid-century as operational emissions decline through grid decarbonisation.⁶ CCS technology can address embodied carbon through several pathways. Carbonated building materials offer a revolutionary approach by storing CO₂ directly within concrete, cement, and other durable construction products. Many cement and concrete facilities can integrate carbonation into existing processes or curing stages with minimal infrastructure changes. Additionally, CCS can be integrated into industrial-scale construction activities, such as cement manufacturing plants supplying building materials, capturing emissions at the source before they enter the atmosphere.⁷

OPERATIONAL EMISSIONS FROM BUILDING SYSTEMS

CCS technology can mitigate operational emissions through integration with on-site energy generation systems. Buildings equipped with combined heat and power (CHP) systems, district heating infrastructure, or on-site industrial boilers can install carbon capture equipment to trap CO₂ emissions before they are released into the atmosphere. District heating systems serving multiple buildings can centralise carbon capture facilities, achieving economies of scale that make CCS economically viable for residential and commercial developments. Direct air capture materials are also being evaluated for feasibility in integration with existing building

⁶ Building Materials and the Climate: Constructing a New Future by United Nations Environment Programme [operational-carbon-emissions-in-buildings.html](https://globalabc.org/buildingmaterialsandclimate/chapte-2-life-cycle-thinking/2-1-embodied-versus-operational-carbon-emissions-in-buildings.html)

[https://globalabc.org/buildingmaterialsandclimate/chapte-2-life-cycle-thinking/2-1-embodied-versus-](https://globalabc.org/buildingmaterialsandclimate/chapte-2-life-cycle-thinking/2-1-embodied-versus-operational-carbon-emissions-in-buildings.html)

⁷ Eyad Abdelsalam Elsayed Hamed, A Comprehensive Review of Carbon Capture, Storage, and Reduction Strategies Within the Built Environment, 2025 Dec 16

infrastructure, offering potential for buildings to actively remove CO₂ from the atmosphere while operating.⁸

INDIRECT EMISSIONS FROM ENERGY CONSUMPTION

Indirect operational emissions from residential buildings account for approximately 11% of total building and construction emissions, representing the carbon footprint of electricity and fuel purchased for building operations. These emissions are generated off-site at power plants but are attributable to building energy consumption patterns. As the electricity grid transitions toward renewable sources, indirect emissions will decline, but fossil fuel-based power generation will continue contributing to building-related emissions for decades.⁹ For real estate developments with significant energy demands, integrating CCS with on-site renewable energy generation and backup power systems can provide a comprehensive decarbonisation strategy. Industrial/Residential real estate and large commercial complexes can be benefitted from CCS-integrated power generation systems that capture emissions from backup generators, emergency power systems, or combined heat and power facilities.

IV. STRATEGIC INTEGRATION PATHWAYS

The introduction of CCS into real estate development requires harmonized planning across multiple avenues. In the housing and industrial sector, large-scale residential complexes, warehouses, manufacturing facilities, and logistics centres can incorporate CCS through district energy systems serving multiple buildings and with on-site energy generation and industrial processes respectively. Commercial real estate developments, especially high-rise office towers and mixed-use developments, offer opportunities for CCS assimilation through building-integrated energy systems and centralised mechanical infrastructure. While RERA underlines project transparency and timely delivery, explicit environmental obligations remain limited. The Act does not currently mandate green building certifications, carbon emission disclosures, or integration of low-carbon technologies such as CCS. This regulatory gap represents a missed opportunity to align RERA with India's broader environmental objectives. CCS technology can be merged with green building strategies, energy-efficient projects, and usage of biogenic, reclaimed, or recycled materials, assisting faster and more holistic

⁸ Ibid.

⁹ Building Materials and the Climate: Constructing a New Future by United Nations Environment Programme <https://globalabc.org/buildingmaterialsandclimate/chapte-2-life-cycle-thinking/2-1-embodied-versusoperational-carbon-emissions-in-buildings.html>

defossilisation of the construction sector. As regulatory frameworks evolve, particularly under instruments such as India's R E Act, CCS integration could become a standard component of sustainable building certification and regulatory compliance, transforming real estate from a major emitter into a leader in climate mitigation.

V. CHALLENGES AND LIMITATIONS

The introduction of carbon capture and storage technology in the real estate sector faces several practical, financial, technical, and regulatory challenges. Although real estate and construction are major contributors to carbon emissions, the technology is not as straightforward in this sector as it is in heavy industries such as cement and power generation. Buildings construction account for a major share of global carbon emissions, with UNEP reporting that the sector contributes around 37% of global emissions and depends heavily on materials such as cement and steel, which are themselves emission-intensive. The technology works better where carbon dioxide can be captured from large point sources, such as cement plants or industrial facilities. Even at the global level, CCUS deployment has progressed more slowly than expected, despite recent growth in projects and policy support. Finally, CCS is limited unless combined with broader decarbonisation strategies such as reducing material use, reusing existing buildings, improving energy efficiency, adopting renewable energy, using low-carbon materials, and designing for circularity. For real estate, CCS is more like a specialised tool in the carbon toolbox, not the whole toolbox. Its greatest potential lies in reducing the embodied carbon of cement, concrete, and steel used in buildings, but its deployment remains constrained by cost, infrastructure, policy gaps, technical suitability, and market acceptance.

VI. CONCLUSION

In India's emerging real estate sector, the Real Estate Act, 2016 enshrines a strong frame not only for organisational regulation but also for environmental governance. CCS technologies offer desperate solutions to decarbonize construction and align development with sustainability goals. Calculated combination of CCS technology into RERA's framework offers a pathway to decarbonise India's real estate sector while enhancing regulatory coherence with national climate commitments. In India's real estate, the technology is often indirect therefore developers may use low-carbon material for construction purpose, produced through CCS, rather than seizing emissions from the building itself. Capturing, compressing, transporting, and storing carbon dioxide requires expensive equipment, pipelines, monitoring systems, and

long-term storage infrastructure. For property developers, these costs for storing, transporting and capturing can increase budgets for development and lessen the profit margins, especially in markets where buyers or tenants are unwilling to pay a premium for low-carbon buildings. Achieving this potential requires deliberate legislative amendments, inter-agency coordination, and sustained stakeholder engagement. This coordinated approach is essential for improving India's climate commitments while safeguarding the interests of buyers and investors, ultimately charting a sustainable trajectory for urban growth. By inserting environmental compliance requirements, such as low-carbon building materials or carbon footprint reporting, RERA can act as a policy lever for decarbonising real estate projects. The synergy between RERA and CCS is most effective when regulatory mechanisms mandate or incentivise low-carbon materials, encourage transparency in carbon accounting, and enable third-party verification of environmental performance. For example, RERA could require project disclosures to include carbon intensity of materials, energy-efficient design measures, and the use of CCS-enabled construction material. In conclusion, RERA provides the regulatory platform and CCS provides the technological pathway. Together, they offer a calculated framework for transforming India's real estate sector into a low-carbon, sustainable, and future-ready industry.

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