ANNEX D

BUILT ENVIRONMENT DECARBONISATION TECHNOLOGY ROADMAP

1. Singapore is committed to reduce its greenhouse gas emissions to about 45 to 50 million tonnes (MtCO2e) by 2035, from the projected 60 MtCO2e target in 2030.

2. Technology plays a key role in the transition to encourage the switch to low-carbon alternatives and drive transformational change. To this end, the Building and Construction Authority (BCA) and the Singapore Green Building Council (SGBC), with support from A*STAR, have refreshed the 2018 Super Low Energy Building Technology Roadmap. Renamed the Built Environment Decarbonisation Technology Roadmap, it identifies close to 70 key technologies and strategies and adopts "whole-life carbon" approach, addressing both operational and embodied carbon emissions.

3. Since January 2025, BCA and SGBC have engaged about 100 built environment stakeholders, including building owners, consultants, Institute of Higher Learning (IHLs), material suppliers and technology solution providers to co-create the roadmap.

4. The technology roadmap serves two primary purposes; Firstly, it encourages stakeholders to leverage market-ready solutions to reduce whole-life carbon emissions in their building projects. Secondly, it provides the research community with a clear directive on emerging technology priorities, to support Singapore's Research, Innovation, and Enterprise (RIE) 2030 plan. More details of the solutions identified in the roadmap are listed in Table 1.

Table 1: Examples of solutions identified in the BE Decarbonisation Technology Roadmap

Themes	Strategies	Number of solutions	Examples
Operational Carbon Reduction	District Integration	3	• District Cooling System (DCS) • District-Level Control Algorithms for Dynamic Optimisation
	Passive	9	• Ventilated Facades • Advanced Facade/Envelope Solutions that are retrofittable for existing buildings (E.g. On-site retrofit glass that can be installed from building interior by affixing Low-emissivity glass over existing windows) • CO_2 Absorbing Coatings (Carbon Capture Coatings) with sequestration capabilities

	Active	23	• Alternative Cooling and Ventilation Technologies (E.g Magnetocaloric cooling chillers, thermoelectric cooling, hybrid radiative cooling) • Energy Recovery Systems • Dual Temperature Chiller Plant
	Smart Technologies and AI	8	• Occupant-Centric Air Conditioning and Mechanical Ventilation (ACMV) Optimisation • Smart Operations with Digital Twins
	Renewable Energy	5	• Facade-integrated Photovoltaics (BIPV) • Micro Wind Turbines • Vibration Energy Harvesting Materials
Embodied Carbon Reduction	Carbon Avoidance Design	*(Design Concept)*	• Adaptive Reuse • Kit-of-Parts
	Low-Carbon Materials	11	• Supplementary Cementitious Materials • CO_2 to aggregates • Geopolymer Concrete with CO_2 Sequestration
	Low-Carbon Construction	5	• Construction Site Microgrid and On-Site Renewable Energy Integration • Lean Construction Methods and Resource Circularity
	Circularity in Construction	2	• Advanced Construction & Demolition (C&D) Waste Processing • Material Passports
	Digital Carbon Tools	3	• AI Agentic solution for Whole Life Carbon Management

More details can be found in the public report: https://go.gov.sg/decarbroadmap

About BCA

The Building and Construction Authority (BCA) champions a safe, sustainable, and liveable built environment for Singapore. As a leader in the sector, BCA is dedicated to driving industry transformation and setting rigorous standards in building safety, quality, and environmental sustainability. By advancing innovation, digitalisation, and the development of a skilled workforce, BCA fosters a dynamic industry that is ready to meet the evolving needs of the nation and build a resilient and progressive built environment for all. For more information, visit www.bca.gov.sg

About SGBC

The Singapore Green Building Council (SGBC) enables sustainability across the building and construction value chain, championing capability development and innovative solutions that support industry transformation through our membership, certification, and outreach programmes. The repository of proven green building solutions helps to enable green procurement in the industry, profiling leading and innovative solutions that go towards building a greener, healthier built environment.

Together with a growing pool of industry-recognised Green Mark Accredited Professionals, SGBC addresses every touchpoint of the green building ecosystem.