CONSTRUCTION INDUSTRY COUNCIL
建造業議會

The Opportunities for Low-carbon Materials

Mr. Ivan FU
Chairperson,
Committee on Environment,
CIC

5 December 2023

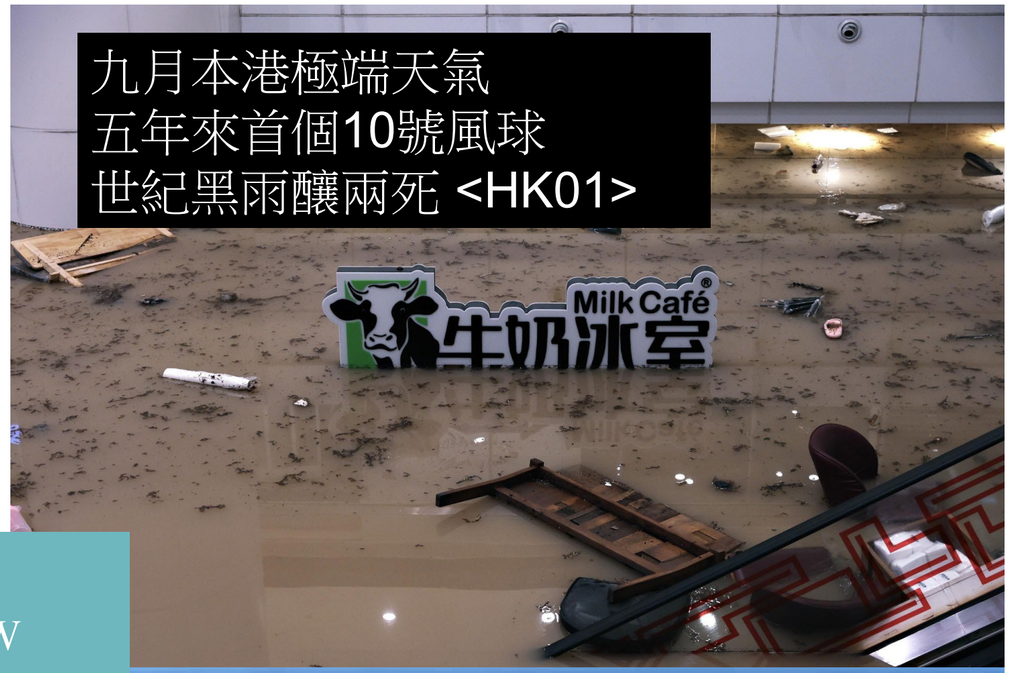
When Extremes Become Normal

Climate Change Fuels Extreme Heat

More Frequent Super Strong Typhoon

Record Breaking Rainfalls

Black 黑



NEW NORMAL

Earth to warm up to 2.9C even with current climate pledges: UN

Paris (AFP) – Countries' greenhouse gas-cutting pledges put Earth on track for warming far beyond key limits, potentially up to a catastrophic 2.9 degrees Celsius this century, the UN said Monday, warning "we are out of road".

Issued on: 20/11/2023 - 15:55 3 min

2023 is expected to be the hottest year in human history © Spyros BAKALIS / AFP/File

1.5 °C

CLIMATE

GOAL

Hong Kong's Roadmap To Carbon Neutrality

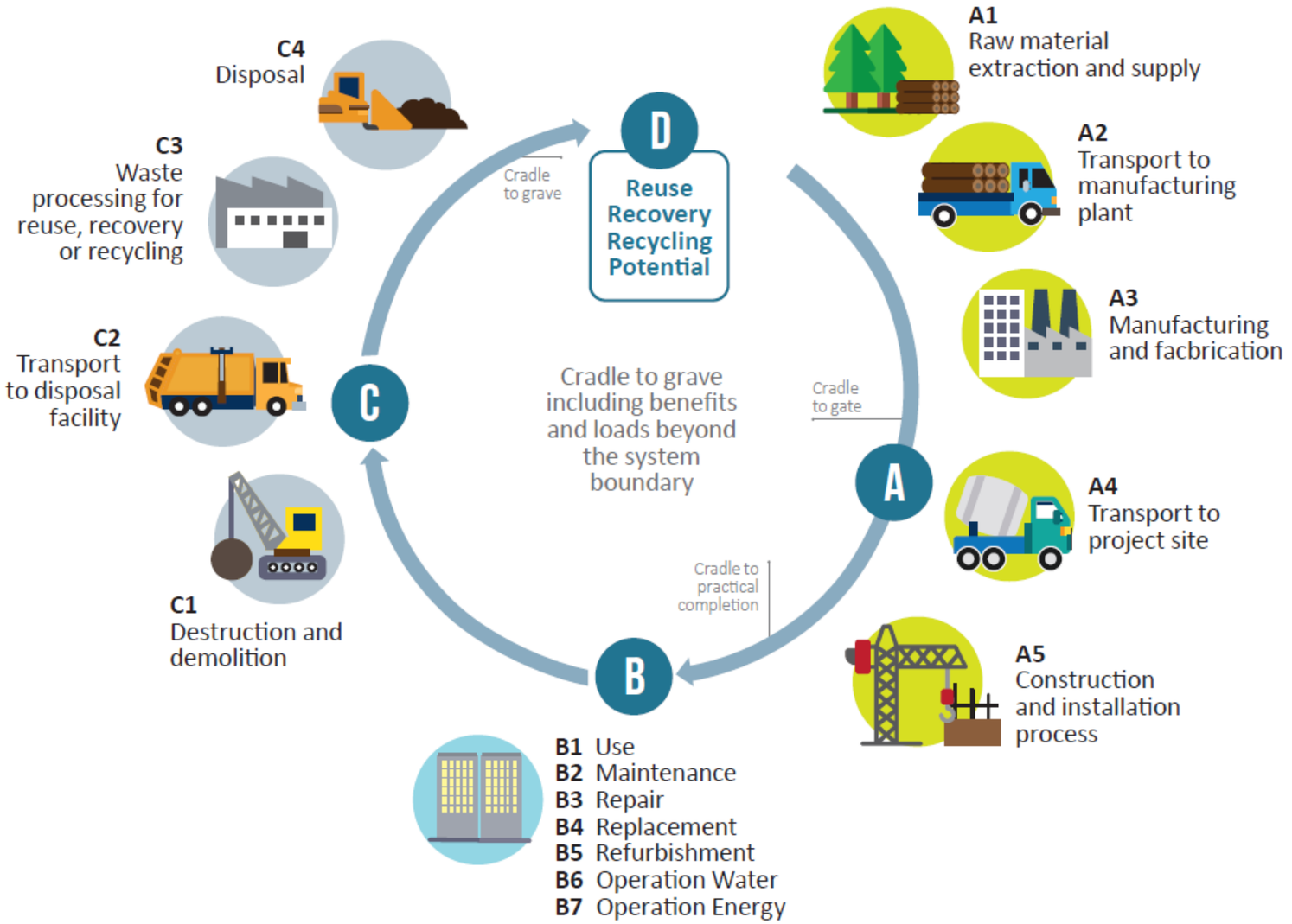
ENERGY SAVING & GREEN BUILDINGS

NET ZERO ELECTRICITY GENERATION

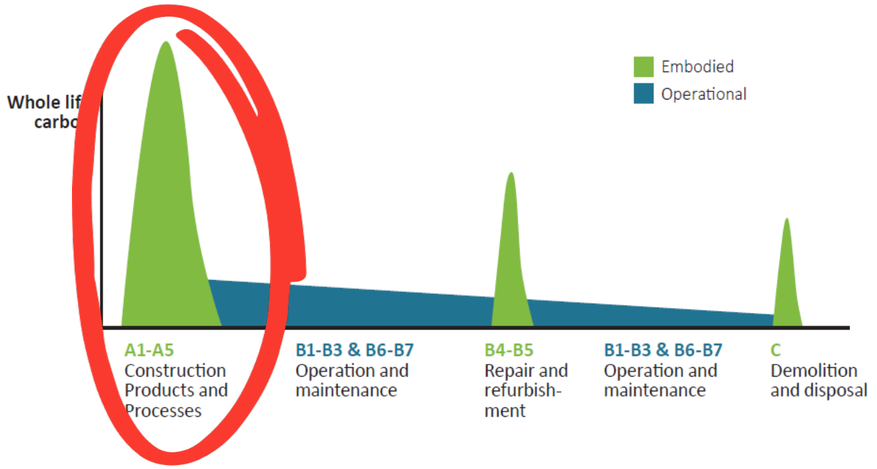
GREEN TRANSPORT

WASTE REDUCTION

source: LETI, 2020



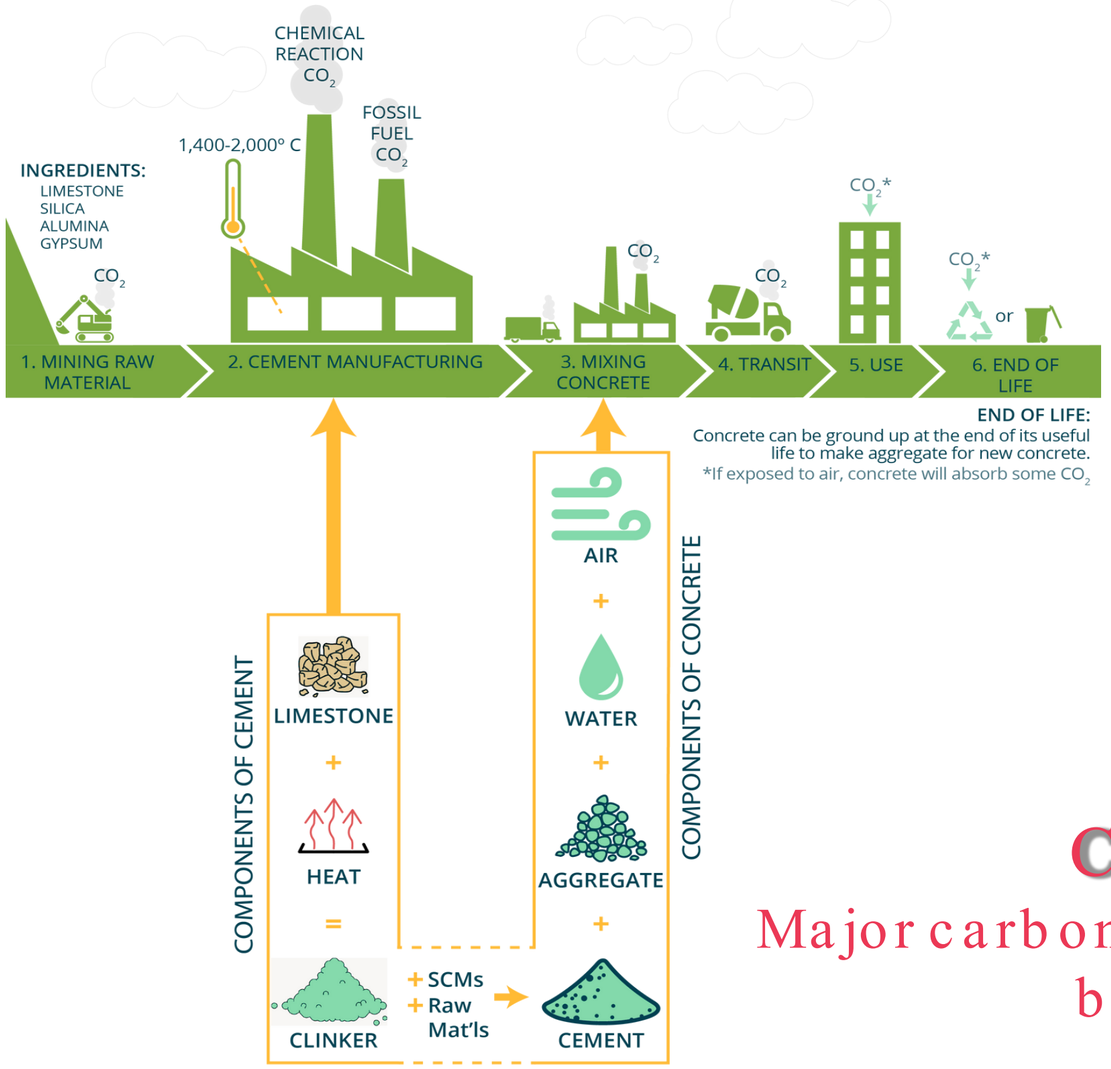
Embodied carbon makes up 30-40% of buildings' total lifecycle emissions



Embodied and Operational carbon emissions timeline

Upfront Carbon in Whole Building Lifecycle

Carbon in Concrete



Cement

Major carbon emission source in buildings

2022 中国建筑能耗与碳排放研究报告

2022 Research Report of China Building Energy Consumption and Carbon Emissions

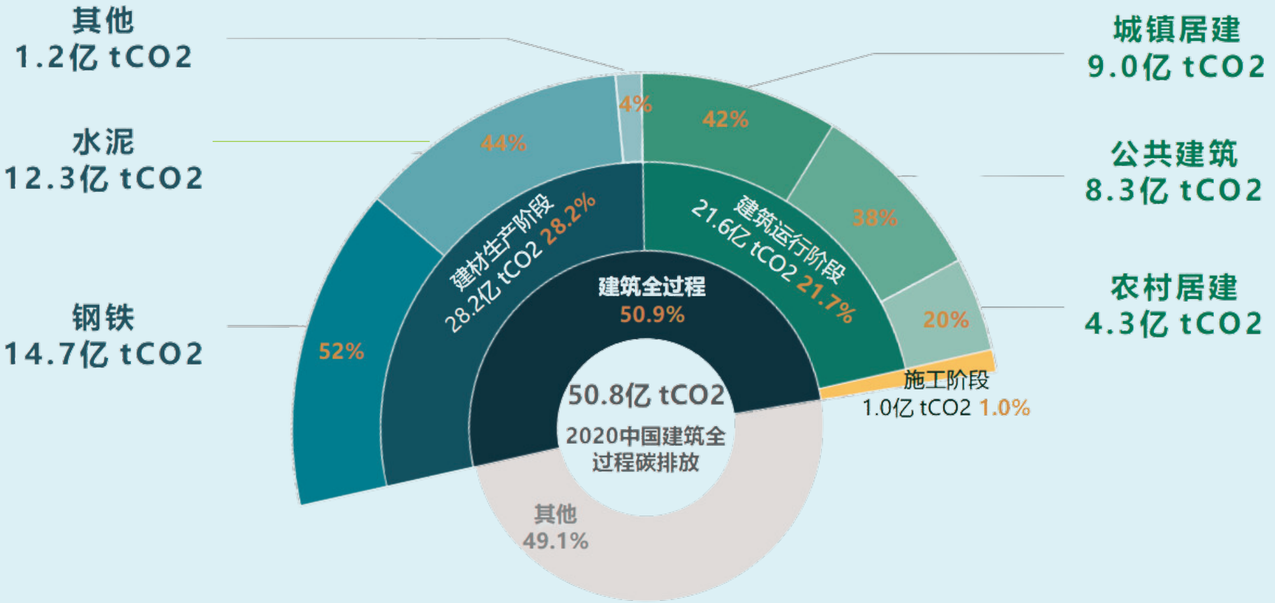
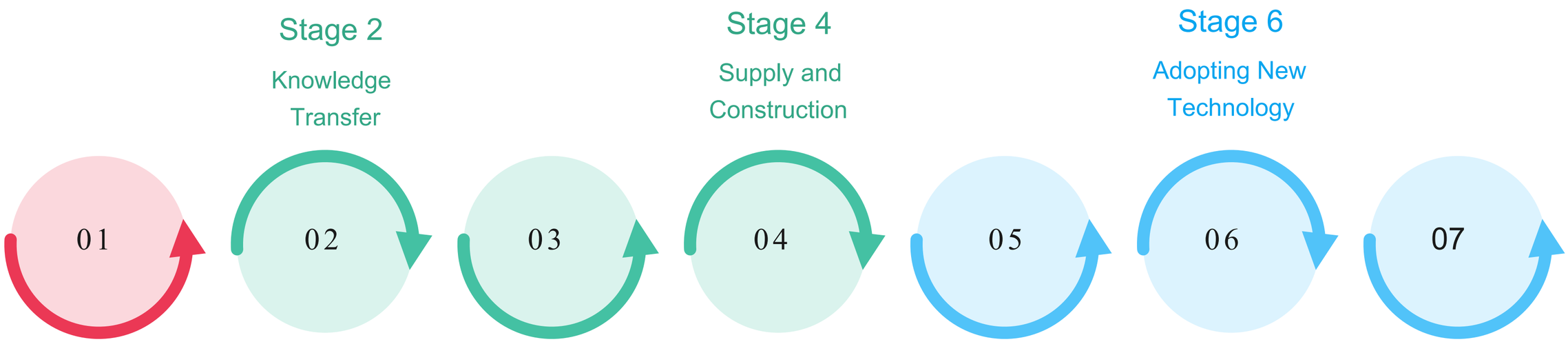


图 1 | 2020 年中国建筑全过程能耗与碳排放总量及占比情况

Low Carbon Concrete Routemap selected actions to 2030



BENCHMARK

BEST PRACTICE IN USING CONCRETE

BEST PRACTICE IN MAKING CONCRETE

UK Example: Low Carbon Concrete Routemap

	2022 Action Taken/in progress	2030 Directions
1. CONTINUOUS BENCHMARKING	**Public reporting of CO_2e for all concrete works against the Low Carbon Concrete Group benchmarking as standard practice**	CO_2e calculations based on kg CO_2e e/kg of materials as used, not general database values
2. KNOWLEDGE TRANSFER	**Formation of Concrete Decarbonisation Task Force and repository to showcase low-carbon technologies and initiatives**	Develop performance-related standards
3. DESIGN AND SPECIFICATION	**Increase utilisation factors and optimise elements through geometry, including forming voids and profiled sections**	Continuous improvements in efficiency, designing with re-used elements and for re-use
4. SUPPLY AND CONSTRUCTION	**Add a requirement for procurement to take account of CO_2e throughout the supply chain, with measuring mandatory**	Reclaim cementitious material and aggregates from demolition arisings for reprocessing and use in new concrete
5. OPTIMISING EXISTING TECHNOLOGY	Increase and optimise use of GGBS, fly ash and limestone as an SCM with adoption of additional multi-component cements into standards	AI/sensing enabled real-time adjustment to optimise mix design used at scale
6. ADOPTING NEW TECHNOLOGY	Identify clays in the UK with mineralogy suitable for calcining to use as cementitious materials (SCM or AACM)	AACMs based on calcined clay (including metakaolin)
7. CARBON SEQUESTRATION	Coordinated database of pilots required and identification of optimal locations for factories that will make use of captured CO_2	Synthetic SCMs/AACMs and aggregates that sequester CO_2e during manufacture

01

Benchmark for Low Carbon Concrete

Standards & Tools

CORPORATE GHG INVENTORY

CARBON FOOTPRINT
CO_2
UNI EN ISO 14064-1

PROJECT CARBON /ENERGY

PAS 2080
Carbon Management in Infrastructure Verification

ISO 50001
ENERGY MANAGEMENT

PRODUCT CARBON LABEL

CIC GREEN
PRODUCT CERTIFICATION

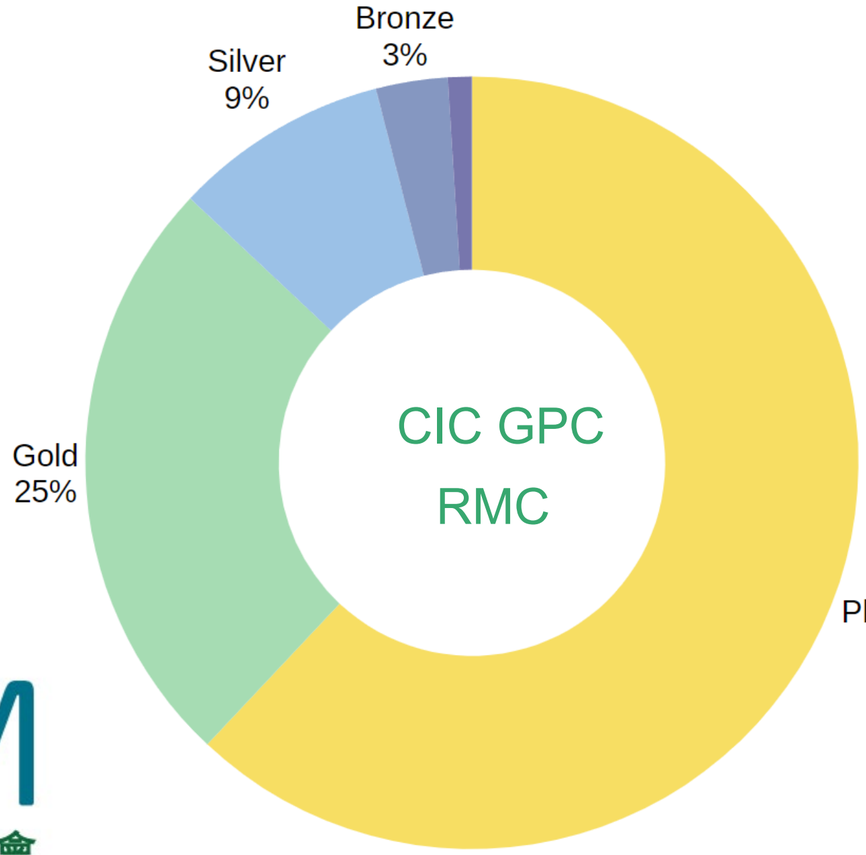
CIC Carbon Assessment Tool
建造業議會碳評估工具

THIRD-PARTY VERIFIED
EPD
ISO 14025 and EN 15804
Institut Bauen und Umwelt e.V.

ISO
ISO 14067

CIC Green Product Certification

612 Ready Mixed Concrete



CIC GREEN
PRODUCT CERTIFICATION

http://cicgpc.hkgbc.org.hk

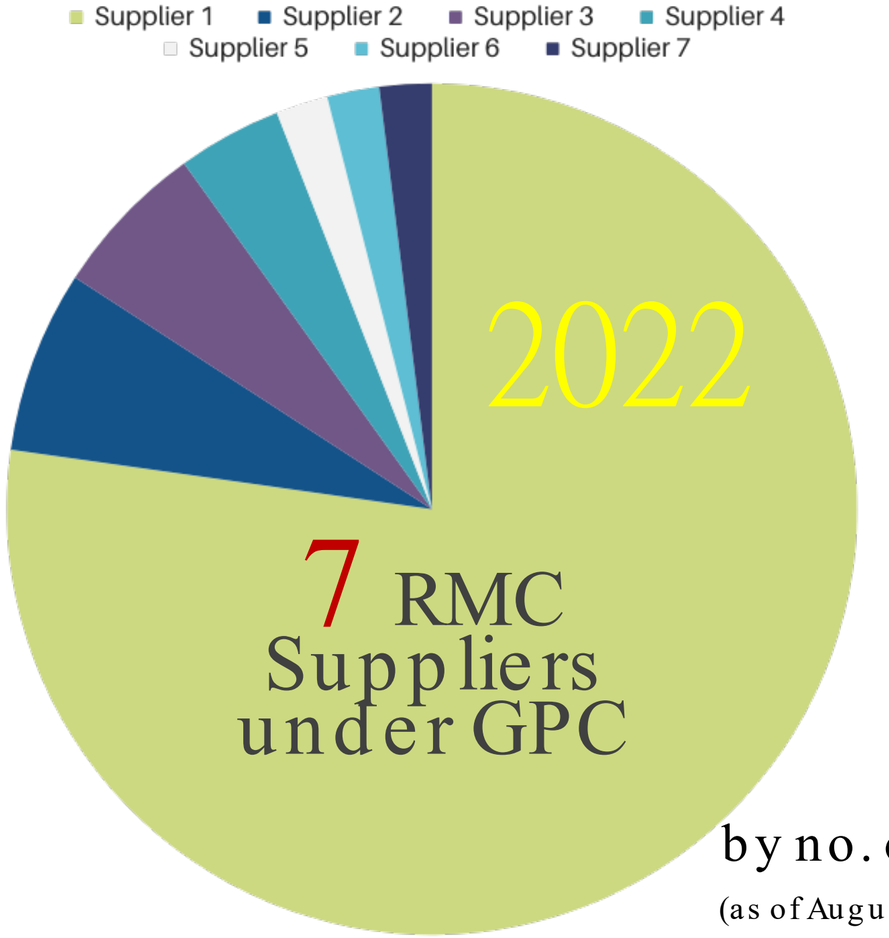
12 Suppliers

6 Credits under BEAM Plus New Building 2.0

BEAM 建築環保評估協會

(as of June 2023)

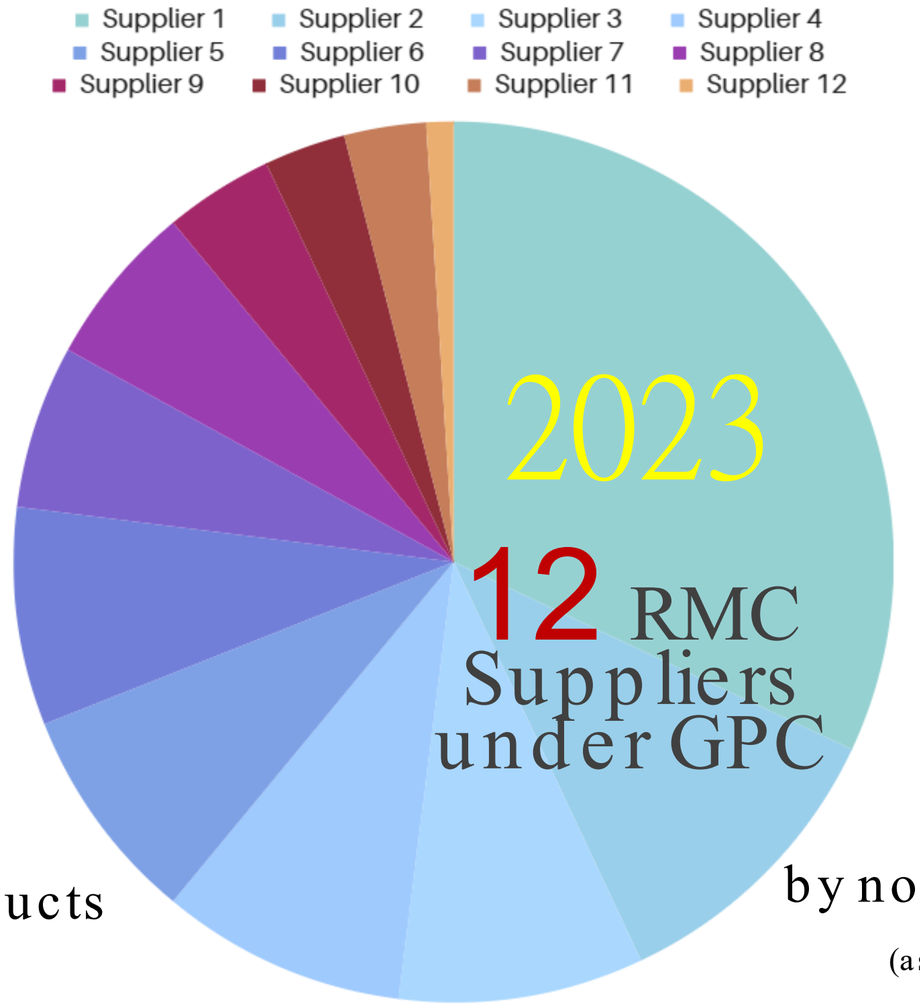
CIC Green Product Certification



by no. of products

(as of August 2022)

One supplier covers over 70% of the RMC

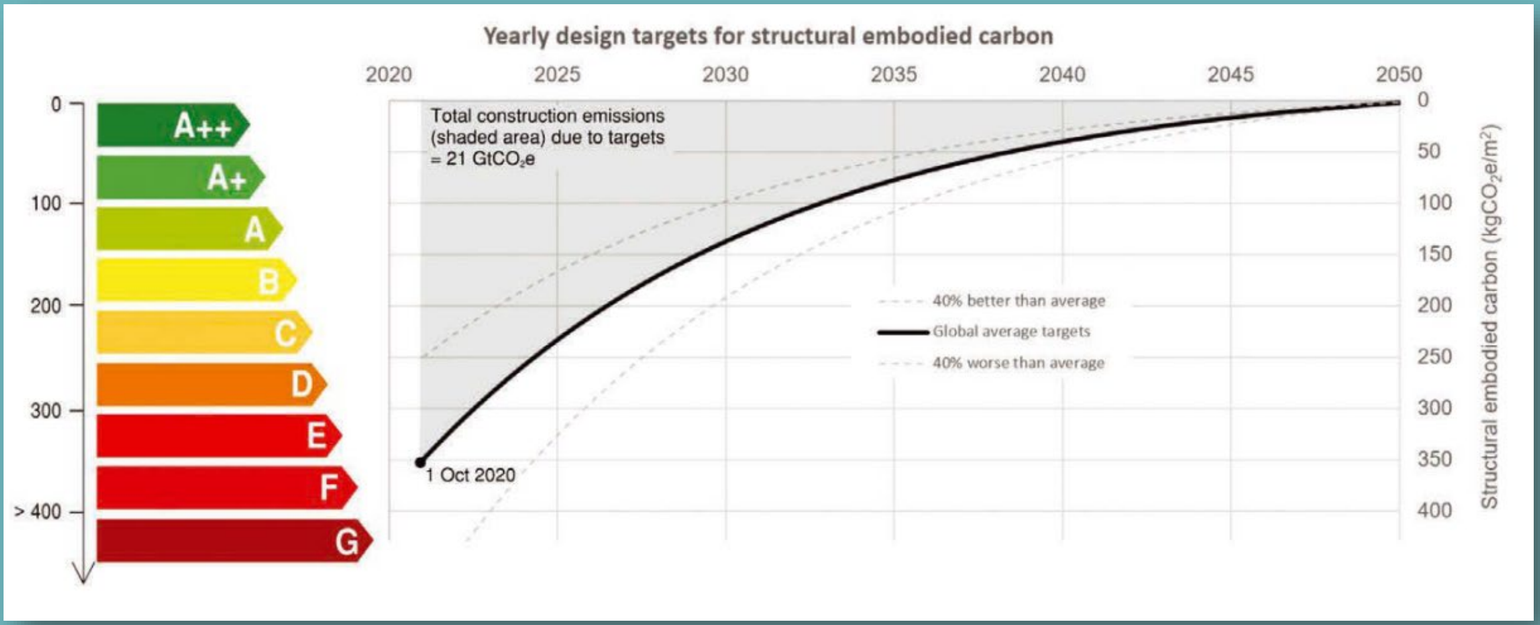


by no. of products

(as of June 2023)

Market share is relatively balanced

CIC GREEN
PRODUCT CERTIFICATION



IStructE suggests 10% reduction in concrete carbon per year towards 2050 zero emissions

Ref: Setting carbon targets: an introduction to the proposed SCORS rating scheme, IStructE

Table 1. Benchmark for Ready-mixed Concrete under the CIC Green Product Certification

Concrete Grade	C30	C35	C40	C45	C50	C60	C70	C80
E_{da}	296	323	350	373	396	443	490	490
Certification Level	($kgCO_2e/m^3$)							
Platinum	<252	<275	<298	<318	<337	<337	<417	<417
Gold	252-280	275-306	298-332	318-354	337-375	337-420	417-465	417-465
Silver	281-310	307-339	333-367	355-391	376-415	421-464	466-514	466-514
Bronze	311-340	340-372	368-403	392-429	416-455	465-509	515-563	515-563
Green	>340	>372	>403	>429	>455	>509	>564	>564

In Hong Kong, C45-C60 is commonly used.

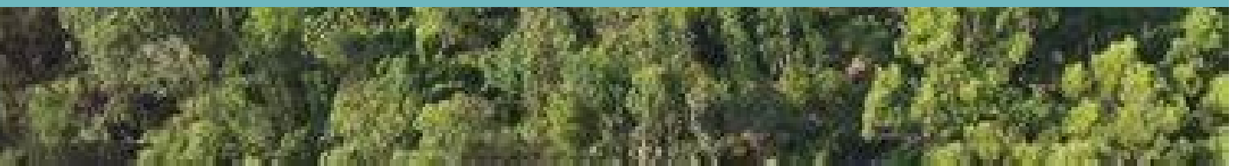
- **More stringent rating scheme?**
- **More ambitious targets?**

Ref: CICGPC_AG Ready-mixed Concrete_V1.4_07-2020

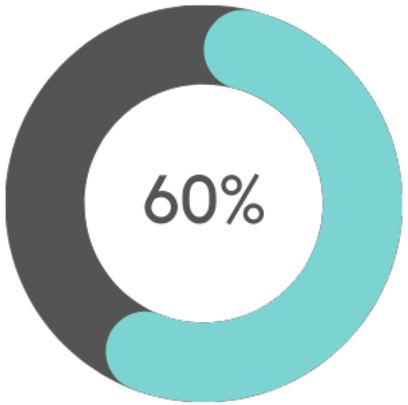
02-04

Best Practices in using Low Carbon Concrete

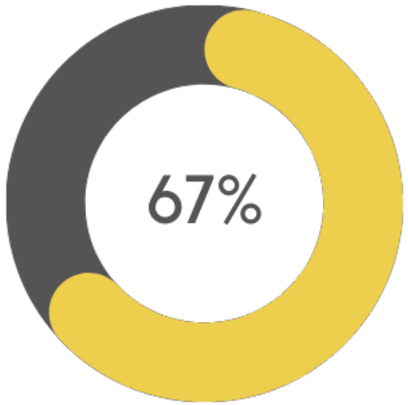
PUBLIC PROJECT SHOWCASE



O PARK 2



GGBS Replaces
60% Cement



Low Carbon Rebar

From Project Team

"Since special equipment is required to make concrete, the cost has increased. However, the strength of "green concrete" is better and the safety factor is 5% to 10% higher than that of ordinary concrete."

廚餘廠「O．PARK2」2024年啟用　承建商施工期三招減24%碳排放 (hk01.com)

Codes & Specifications

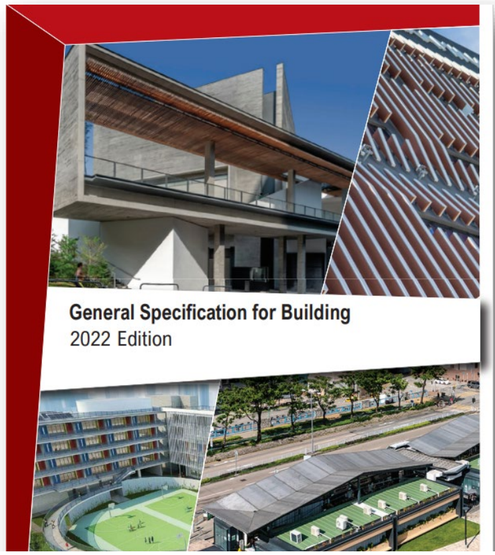
(3) Cement, PFA, GGBS, aggregates, water and admixtures for concrete shall comply with Clauses 16.06 to 16.10.

(4) SRPC shall only be used if stated in the Contract. PFA shall not be used with SRPC.

(5) PFA shall not be used in addition to PFAC.

(6) Either PFA or GGBS shall be used in concrete of all pile caps and substructure construction where the concrete member is thicker than 750 mm.

(7) GGBS shall not be used in conjunction with PFA or PFAC.

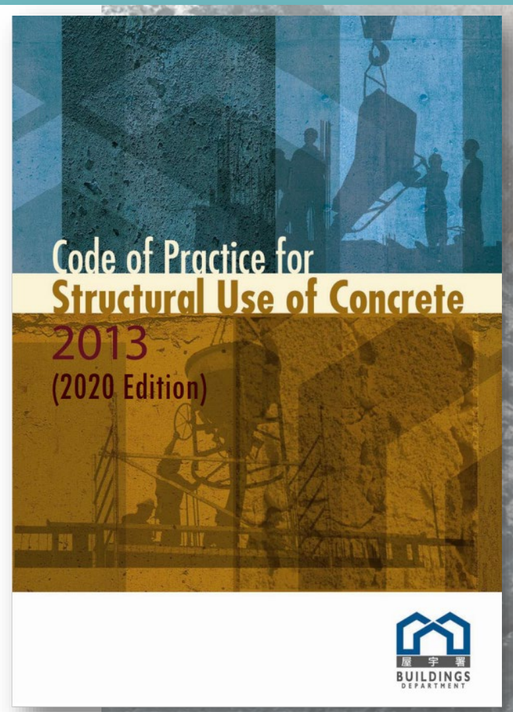


If CSF, PFA or GGBS is incorporated in the concrete as separate cementitious materials, the following requirements shall be complied with unless specified/ approved otherwise by the SO:

(a) The proportion of PFA replacement shall not exceed 35% of the total cementitious content.

(b) The proportion of CSF replacement shall not exceed 10% of the total cementitious content.

(c) The proportion of GGBS replacement shall not exceed 40% of the total cementitious content and the use shall be subject to the approval by the SO of the Contactor's proposal on concrete curing method and formwork striking times.



The usual range of pfa or ggbs content by mass of the total cementitious content should be:

(a) 25% to 35% for pfa

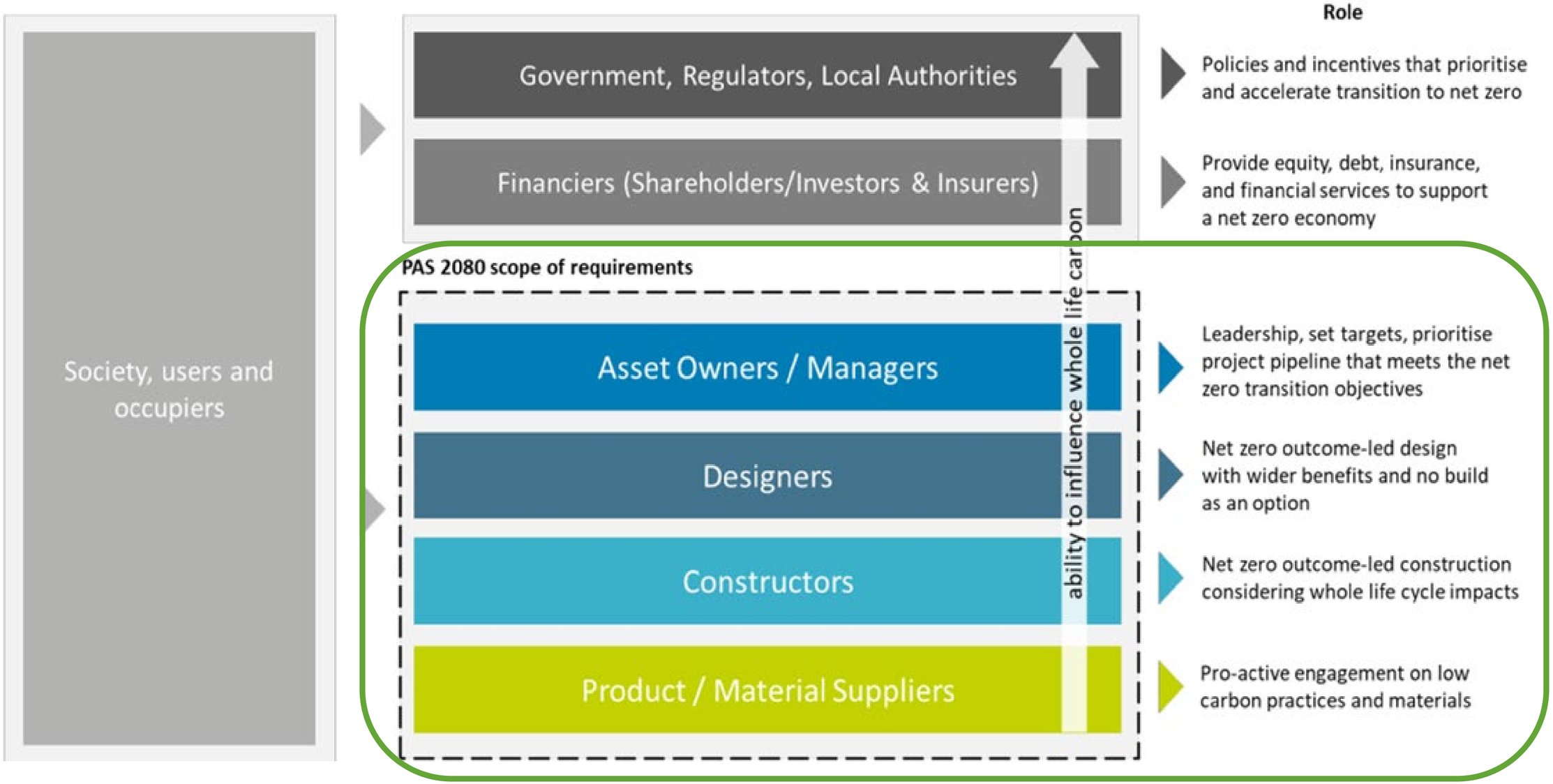
(b) 35% to 75% for ggbs.

To cope with more New Low Carbon Materials?

Prescriptive to Performance -Based Requirements?

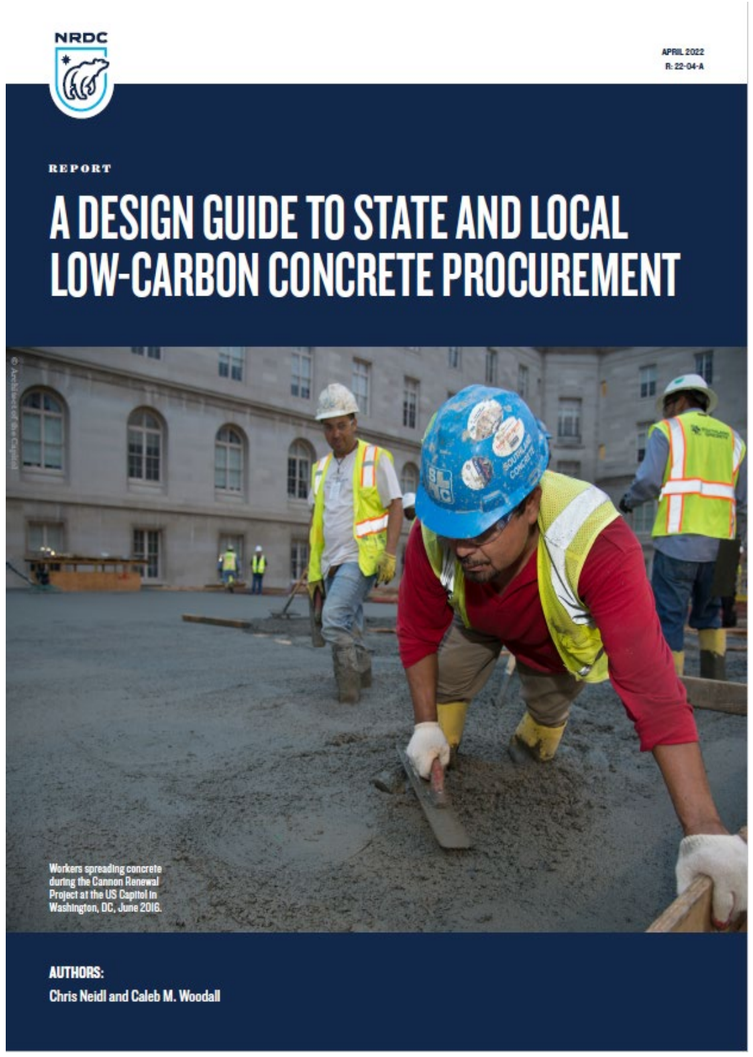
Engaging ALL Stakeholders

Value Chain Stakeholders



Source: PAS 2080:2022 Carbon management in buildings and infrastructure (under public consultation)

Public Procurement to stimulate market supply



Public Projects can Catalyse Concrete Decarbonisation

Establish public procurement rules in adopting low carbon materials

Require EPD/ GPC for public construction contracts

Incentivize Private Sector

BEAM Plus assessment is Hong Kong's leading initiative to offer independent assessments of building sustainability performance.

- **GFA Concession**
- **Tax deduction for environment-friendly facilities/ materials ?**
- **Financial Support?**

05-07

Technology in Reducing Concrete Carbon

Decarbonising Concrete Approaches

Concrete Mix Design

Minimise Cement Content

VS

Strength, Durability, Workability, Elasticity, etc.

Supplementary cementitious materials

PFA
GGBS
Silica Fume
Glass Fibre
…

Low carbon cement sourcing

China
Japan
…

Carbon Curing Technology

Utilise waste CO_2 captured from other industrial processes

PFA series concrete mixes (bored pile and pile cap), which can replace 25 -35% of cementitious material, are all certified to Platinum grade.

GGBS series concrete mixes, which can replace 35 -75% of cementitious materials

A Study on the Carbon Neutrality Pathways of China's Cement Industry

《中国水泥行业碳中和路径研究》2023.7

2060

1. Replace Limestone Extraction
2. Use low carbon clinker
3. Use cementitious materials e.g. GGBS

水泥行业全面实现碳中和技术路径部署情况

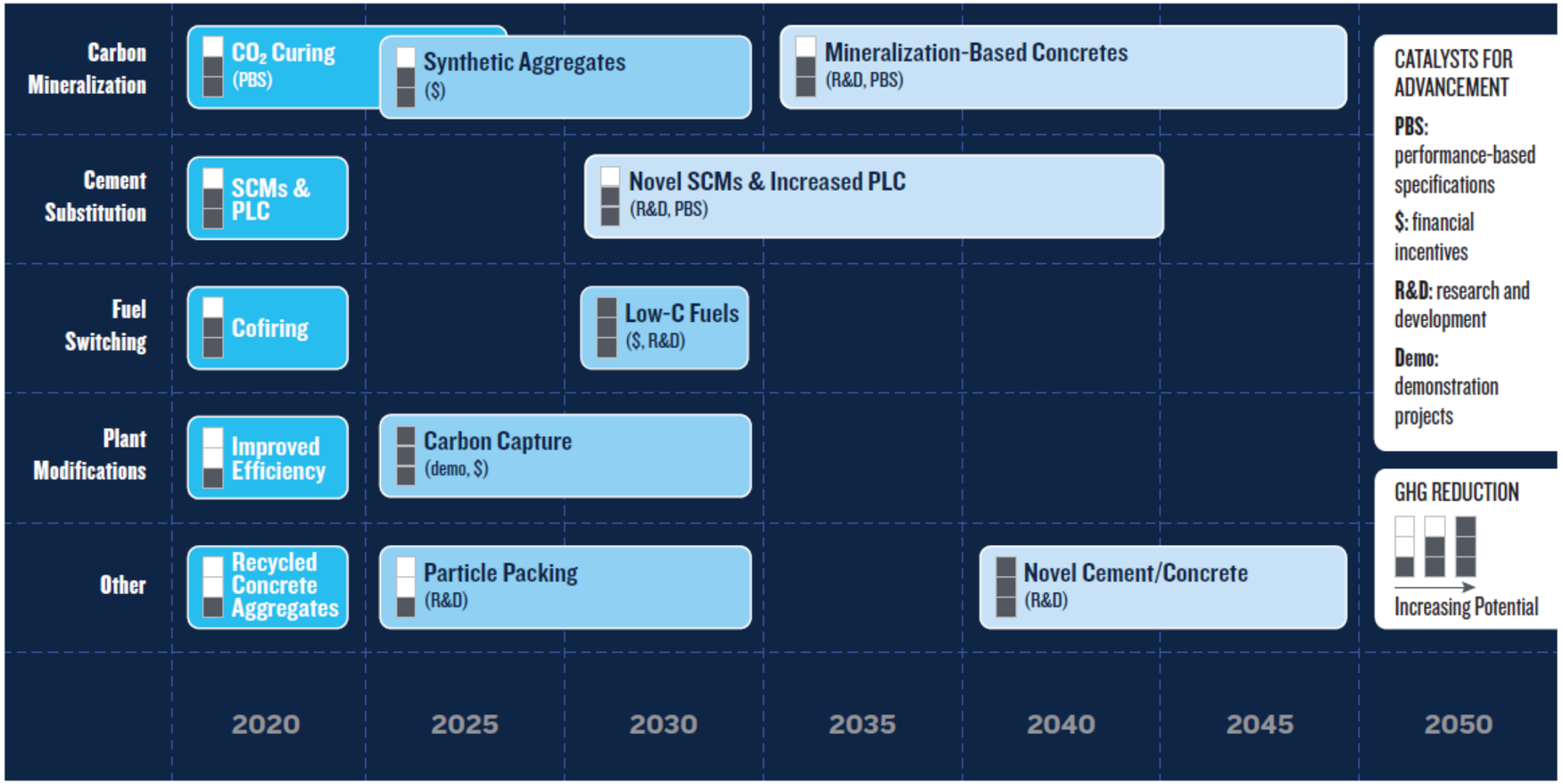
2060 13.26亿吨	83	27.6	10	30	40-60	90%	70%	70%	60%	90%	80%	100%	90%	90%	5-15	20-35	5-10	6-10	10-20	7-12	20000-25000万吨/年 150-430元/tCO_2
2050 10.28亿吨	81	23.5	8	25-30	25-40	80%	65%	60%	55%	80%	75%	100%	80%	80%	4-10	8-20	4-8	3-9	7-12	5-10	12000-14000万吨/年 170-480元/tCO_2
2040 7.03亿吨	77	18.1	6	15-20	15-20	70%	60%	50%	40%	65%	70%	95%	70%	70%	3-7	6-15	3-4	2-7	2-7	1-6	3500-4200万吨/年 190-530元/tCO_2
2030 4.03亿吨	72	11.9	3	5-8	3-10	50%	40%	30%	30%	50%	50%	60%	50%	60%	1-3	4-8	1-2	1-3	1-3	1-3	800-1100万吨/年 220-580元/tCO_2
2025 3.07亿吨	68	9.3	2	1-2	1-2	40%	30%	15%	15%	30%	35%	30%	40%	45%	0.2-0.5	1-2	0.1-0.2	0.1-1.5	0-0.5	0-0.5	300-600万吨/年 300-640元/tCO_2
	城镇化率(%)	人均GDP(万元/人)	原料替代(替代率%)	低碳水泥熟料(应用比例%)	低碳水泥复合材料(应用比例%)	生料磨节能技术	旋浮预热器改造	燃烧系统节能改造	分解炉节能改造	耐火材料整体提升	冷却机提升技术	数字化智能化	风机能效提升技术	水泥磨节能技术	TDF(替代率%)	RDF(替代率%)	SRF(替代率%)	生物质(替代率%)	绿氢(替代率%)	绿电(替代率%)	
						生料粉磨	熟料烧成							水泥粉磨	固废基燃料			绿色能源			
累计减碳量	需求量下降		低碳水泥			能效提升（技术渗透率）									能源替代						CCUS
	源头减排/过程再造					现有技术不断提升/新技术迭代															末端治理技术

图 29 水泥行业碳中和各技术路径及关键技术部署情况

China Building Materials Academy

中国建筑材料科学研究总院

Available Technologies to Produce Low Carbon Concrete

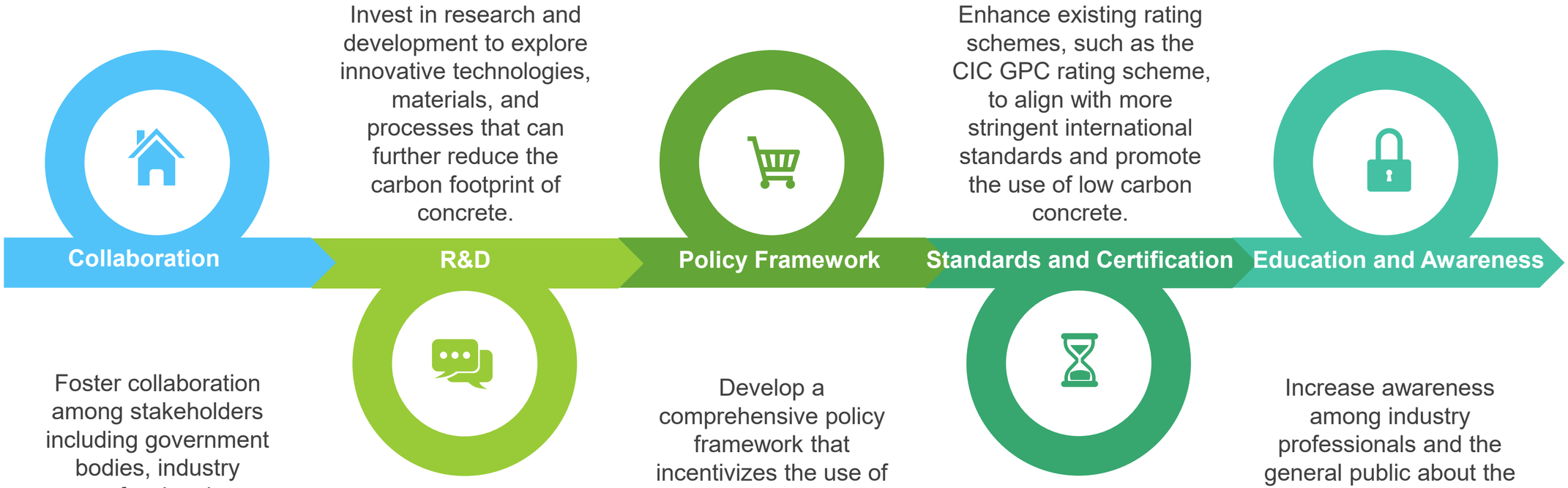


SCM: supplementary cementitious material.
PLC: Portland-limestone cement.
RCA: recycled concrete aggregates.

A DESIGN GUIDE TO STATE AND LOCAL LOW-CARBON CONCRETE PROCUREMENT

Conclusion: Low-carbon Concrete Strategies

改革尚未成功 同業仍需努力



THANK YOU !

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