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Global Best-practices in Cement & Concrete Emissions Reduction Policies Report





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Acronyms

CAPEX Capital expenditures

CCS Carbon Capture and Storage

CCUS Carbon Capture, Utilisation, and Storage

CDM Clean Development Mechanism

CO₂e Carbon Dioxide Equivalent

ETS Emissions trading systems

EU European Union

GHG Greenhouse Gas

GPP Green public procurement

IED Industrial Emissions Directive

LEED Leadership in Energy and Environmental Design

MRV Monitoring, Reporting, and Verification

Roland Berger identified key learnings across the policy framework based on international practices to provide a comprehensive guideline for policymakers

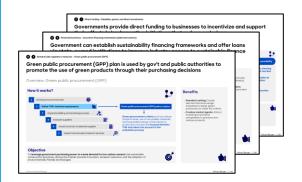
Overview of the Global Best Practices Report

Objective of the Global Best Practices Report

To provide a comprehensive reference for policymakers, regulators, and stakeholders in designing effective decarbonization strategies for the cement and concrete sectors, drawing on case studies of international best practices and regulatory frameworks from key producing countries

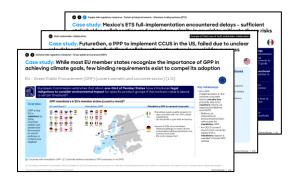
Global best practices in cement and concrete emissions reduction policies

An overview of policy mechanisms, successful case studies, and key success factors across each component of the policy framework—including vision, core policies, and enabling measures—derived from an analysis of international practices in selected countries



Mechanisms: How it works

Describes the policy instruments and regulatory approaches used to drive decarbonization in the cement and concrete sectors



Successful case studies

Presents selected examples from leading countries, highlighting the policy design, implementation process, and outcomes achieved



Key learnings/ success factors

Synthesizes insights from global best practices to identify critical success factors and key risks of policy effectiveness

Source: Roland Berger



Duration: 3 years 2024-2026

Funding: CAD 8,000,000 by Environment and

Climate Change Canada, Government

of Canada

Co-chair: Department of Industrial Works (DIW),

Ministry of Industry

Department of Climate Change and

Environment (DCCE),

Ministry of Natural Resources and

Environment

Net Zero policy frameworks and strategies

The project will support the government in strengthening the policy framework for decarbonizing Thailand's cement and concrete sectors. This includes aligning regulations with global best practices and advancing a net-zero emissions strategy through targeted policies, an action plan, and an investment scheme.

Expected outcome

Policy and institutional ecosystem enhanced with a stronger commitment and greater investment towards decarbonization of cement and concrete sectors

Project Objective:

To accelerate **deep decarbonization** in Thailand's cement and concrete sectors by reducing carbon dioxide emissions and supporting the country's Net Zero Targets by 2030. The emissions will be mitigated through **enabling policies**, **low-carbon materials**, and innovative technologies.



2

Innovation Acceleration Programme

The project will drive innovation across the cement and concrete supply chain, empowering Thai entrepreneurs to reduce carbon emissions. It will foster public-private collaboration in industrial decarbonization, engaging academia and establishing partnerships with international technology suppliers.

Expected outcome

Decarbonizing technologies by local entrepreneurs are guided by the programme and linked with key industry stakeholders and ready for market validation Investment and
Commercialization
of innovative
decarbonization
technologies

The project will review existing technologies and practices relevant to the industry, piloting short-term, mid-term, and long-term technologies to support carbon dioxide emission reduction.

Expected outcome

The pilot models will serve as an exemplary model for subsequent decarbonization projects, fostering inspiration and motivation for other sectors to replicate.



The project will develop standards and practices focusing on eco-friendly green procurement policies, supporting carbon dioxide emission reduction, and implementing the MRV (Measurement, Reporting, and Verification) Framework.

Expected outcome

An enabling environment that encourages industries to adopt low-carbon technologies and produce sustainable products, supported by green public procurement targets designed to drive emissions reduction.



5

Cooperation and Experience Sharing

The project will conduct capacity-building and skills training activities for government agencies and industry stakeholders in areas such as low-carbon technologies, resource-efficient and cleaner production practices, and the application of circular economy principles in cement and concrete manufacturing. Project activities aims to ensure that at least 40% of the participants benefiting from the training and skill development are women.

Expected outcom

Collaborating with key stakeholders to share knowledge and drive market creation for low-carbon cement and concrete, fostering industry adoption and sustainable growth.

1. Key emission reduction levers, challenges, and the need for policies

Six key emissions reduction levers are possible for cement/ concrete; while these will need to play a collective role for the sector, carbon capture will be key

Net zero emissions reduction levers

CO hanafita by 20E02)3)

	CO ₂ benefits by 2050 ^{2/3)}		
Emissions reduction lever	GCCA	TCMA	Description
1. Savings in clinker production	410 (11%)	4 (12%)	Optimizing processes, increasing the use of alternative fuels, and utilizing waste-derived materials during clinker production
2. Decarbonization of electricity	190 (5%)	2 (5%)	Transitioning to renewable or low-carbon electricity sources for cement and concrete operations
↑ ★ ↑ 3. Clinker substitution¹)	350 (9%)	3 (10%)	Lowering the clinker factor and enhancing the use of supplementary cementitious materials (SCMs ⁴⁾) and alternative binders
4. Efficiency in concrete production	430 (11%)	2 (5%)	Improving energy efficiency and reducing waste during the concrete production process
5. Carbon Capture in cement plants	1,370 (36%)	14 (45%)	Deploying CCUS technologies to capture CO ₂ emissions from cement production and exploring its utilization or storage
6. Efficiency in design and construction	840 (22%)	5 (16%)	Promoting efficient design practices, material optimization, and innovative construction methods to reduce overall material use and emissions
7. CO ₂ sink recarbonation	240 (6%)	2 (8%)	Utilizing the natural ability of concrete to reabsorb CO ₂ over its lifetime through carbonation (less relevant than the other 6 key levers)

¹⁾ Savings in cement and binders; 2) Indicative – Contribution level of each lever to net zero may differ slightly from one country to another based on circumstances; 3) GCCA BAU emissions in 2020: 2,500 m tons of CO₂ & TCMA BAU emissions in 2020: 32.2 m tons of CO₃; 4) For example, fly ash, slag, and calcined clays

Source: GCCA, CEMBUREAU, TCMA, Roland Berger

Policies are crucial for addressing challenges and capitalizing on available opportunities across these levers to achieve tangible reductions in emissions

Net zero emissions reduction levers – role of policy (1/2)

Emissions reduction lever



1. Savings in clinker production



2. Decarbonization of electricity



3. Clinker substitution¹⁾



4. Efficiency in concrete production



5. Carbon Capture in cement plants



6. Efficiency in design and construction



7. CO₂ sink recarbonation

 Limited alternative raw materials;
need scalable production for
clinkers .

Co-processing enables recycling and energy recovery

Rising energy demand and slow renewable deployment

Scaling renewables and improving grid connections offer solutions

Approvals for new low-carbon cements under codes/standards

• Dual systems for standards ensure quality and safety

• Adoption of new practices is slow but reduces emissions and material

Role of policy

Supply-side regulatory measures

Demand-side regulatory measures

Supply-side regulatory measures	Simplify access to alternative raw materials and incentivize technology adoption
Demand-side regulatory measures	Establish solution-neutral product certifications and standards that include clinker reduction as a criterion
Direct funding	Compared DOD for a second in large and originate about a rice and a second subjection

Direct funding

Support R&D for new clinker-reducing technologies and process optimization

Financial Incentives

Provide grants for upgrading clinker production facilities

- **Supply-side regulatory measures** Ensure affordable access to decarbonized energy
- **Demand-side regulatory measures**Promote use of low-carbon electricity through efficiency requirements **Direct funding**Invest in infrastructure for renewable energy integration at plants

Financial Incentives Offer tax incentives or subsidies for energy transition investments

Support use of alternative clinker materials through regulatory frameworks

Establish solution-neutral product certifications and standards that include clinker substitution as a criterion

Direct funding Fund innovation and scaling of alternative materials

Financial IncentivesOffer solution-neutral green premiums as incentives for sustainable initiatives, including clinker substitution

Supply-side regulatory measures

Simplify access to energy-efficient machinery and optimized mix technologies

Demand-side regulatory measures

Establish solution-neutral product certifications and standards that include energy efficiency as a criterion

Direct funding Support adoption of efficient concrete production via government programs.

Financial Incentives Provide grants for companies adopting energy-efficient technologies

Policies must target specific levers that drive emissions reduction in the cement and concrete industry



Source: GCCA, CEMBUREAU, Roland Berger

¹⁾ Savings in cement and binders

Policies are crucial for addressing challenges and capitalizing on available opportunities across these levers to achieve tangible reductions in emissions

Net zero emissions reduction levers – role of policy (2/2)

Emissions reduction lever











5. Carbon Capture in cement plants



6. Efficiency in design and construction



7. CO₂ sink recarbonation

Challenges & Opportunities

- High costs, incomplete infrastructure, and regulatory uncertainty
- High CO₂ reduction potential

· Efficient design reduces material

• Carbonation is slow but can create

Enhanced carbonation via design

long-term carbon sinks

and end-of-life strategies

use and lifecycle emissions

Role of policy

Demand-side regulatory measures

Supply-side regulatory measures

Direct funding

Financial Incentives

Supply-side regulatory measures **Demand-side regulatory measures**

Supply-side regulatory measures

Demand-side regulatory measures

Direct funding

Direct funding

Financial Incentives

Financial Incentives

Streamline permitting for carbon capture technologies

- Set targets for carbon capture and support low-carbon cement demand
- Commit to purchasing near-zero emission cement for signature public projects

Fund carbon capture and storage (CCS) demonstration projects

Offer support or tax breaks for implementing CCS technologies

Promote eco-design in construction material standards

Set emission reduction targets for construction projects in GPP and building codes

Invest in research to develop design guides and more efficient ways of using cement/ concrete in project design

Provide incentives for using low-carbon, energy-efficient designs

Support technologies enabling CO₂ mineralization in construction

Ensure low emission concrete certifications include accounting rules for recarbonation

Invest in CO₂ mineralization technologies for cement

Provide incentives for incorporating recarbonation in production

Policies must target specific levers that drive emissions reduction in the cement and concrete industry



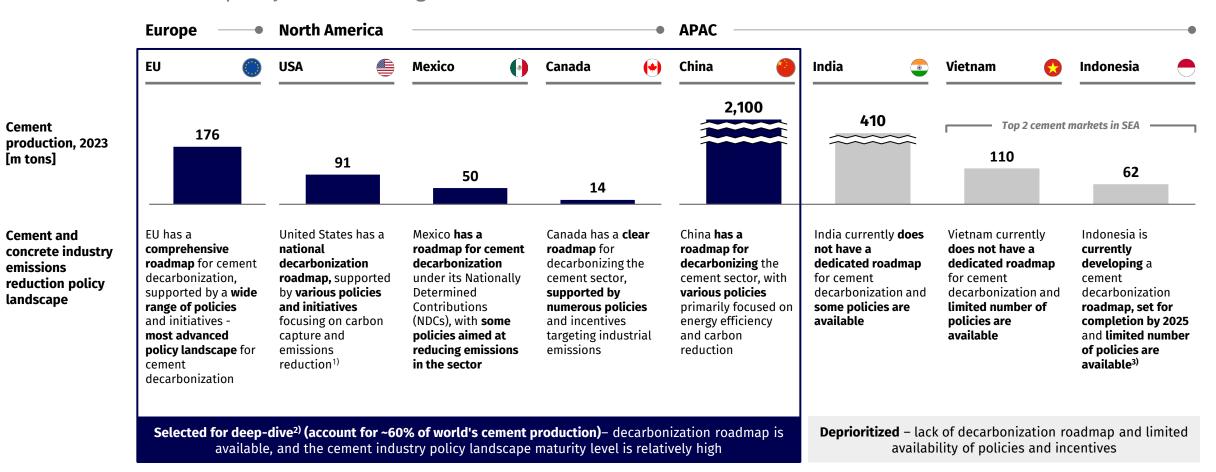
Source: GCCA, CEMBUREAU, Roland Berger 10

¹⁾ Savings in cement and binders

2. Roadmaps and policies from selected countries

EU, USA, Canada, Mexico, and China lead global cement emissions reduction efforts and were selected for benchmarking to determine global best practices

Selected countries for policy benchmarking for cement/ concrete emissions reduction



¹⁾ US policies may change depending on the strategic direction of the current administration; 2) Other major cement producers such as Turkey, India, Indonesia, Vietnam, and South Korea do not have dedicated roadmaps specifically for the cement industry; 3) Preliminary information from local online media sources and UNIDO

These countries have unveiled dedicated roadmaps to decarbonize the cement and concrete industry as part of their broader climate action commitments

Selected examples of cement & concrete industry decarbonization roadmaps



From Ambition to Deployment, the road travelled, pathways and levers to scale

Year issued: 2023 Issuer: Cembureau¹⁾





GCCA Concrete Future – Roadmap to Net Zero

Year issued: 2021

Issuer: Global Cement and Concrete Association





Canada's cement and concrete industry action plan to net zero

Year issued: 2023

Issuer: Cement Association of Canada





Roadmap to Carbon Neutrality

Year issued: 2021 **Issuer: Portland Cement** Association







Roadmap to Net-Zero Carbon Concrete by 2050

Decarbonization Roadmap for

Year issued: 2022

Issuer: ISED2)





Hoja de Ruta México Industria del Cemento

Year issued: 2023 Issuer: CANACEM³⁾, FICEM⁴⁾









Year issued: 2023

China's Cement

Toward Net Zero:





¹⁾ European Cement Association; 2) US policies may change depending on the strategic direction of the current administration; 3) Innovation, Science and Economic Development Canada; 4) German Cement Industry Association; 5) Inter-American Cement Federation

Case study: GCCA roadmap outlines key policy actions to make low-carbon cement investible, create market demand, and provide critical infrastructure

Overview of GCCA roadmap's policy recommendations



Making low-carbon cement investible



Creating market demand for low carbon products



Providing the infrastructure for circular & net zero mfg.

- Strategic public funding policies, both for innovation & deployment of low carbon technologies
- Policies that prioritize co-processing
- Carbon pricing: Emissions Trading Scheme (ETS), carbon tax, border adjustment mechanisms for fair competition
- Policies that incorporate CO₂ performance as an added criterion for public procurement, building standards, and construction codes
- Policies that promote assessment of CO₂ performance of buildings and infrastructure based on whole-life performance¹⁾
- Policies that provide demanding standards for energy performance of buildings

- Policies to ensure reliable access to abundant and competitively priced renewable energy (incl. H2 networks)
- Public-private partnerships (PPPs) to speed-up CCUS developments, including shared investment in CO₂ transport and storage networks
- Regulations to allow the construction of carbon storage facilities, determine liability for stored CO₂, and ensure long-term access to carbon stores
- Fiscal support for R&D in new uses in industries where the captured carbon can be utilized

Source: GCCA, Roland Berger

¹⁾ Whole-life assessments allow for circularity benefits (e.g., reuse of concrete elements) and phenomena that occur beyond the factory gate (e.g., natural recarbonation) of concrete to be included

1

Case study: EU roadmap suggests further development of its carbon pricing standards and promotes innovative funding for clean technologies development

Overview of EU roadmap's policy recommendations



Overview

- Net zero aspiration: EU aims to achieve net zero by 2050
- Emissions: Total CO₂
 emission from cement
 production reached
 68.2 m tons in 2023
- Roadmap: CEMBUREAU launched a decarbonization roadmap in 2023

Codes and standards



- Mandate compositionbased standards¹⁾ with the introduction of a performance-based system²⁾
- Set agile standardization processes to recognize new cement types and lowcarbon construction products

Carbon pricing



- Suggest aligning Carbon Border Adjustment Mechanism with EU ETS to ensure fair competition
- Emphasize the need of monitoring systems to prevent CBAM fraud and evasion
- Call for export solution to prevent carbon leakage and adheres to WTO³⁾ regulations
- Integrate carbon removal certificates⁴⁾ in EU ETS

Procurement policies



- Adopt a whole life carbon strategy to reduce CO₂ emissions in both operational and embodied carbon
- Review public procurement standards to create lead markets for low CO₂ products

Funding programs & fiscal support



Other

policies

- Recommend transforming the ETS Innovation Fund into Cleantech Deployment Fund for energy-intensive sectors
- Suggest allocating at lease 75% of future payments (EUR 80-100 bn by 2034) by the cement sector into EU ETS to finance large-scale transformation projects
- Pool national and European financial resources to support decarbonization projects

- Implement a sandbox/simplified permitting regime for renewable deployment on industrial
- Supports power price stability and protect industrial customers
- Emphasize fair access to CO₂ transport and storage infrastructure
- Support long-term access to zero-rated sustainable biowaste

¹⁾ Proportion of specific raw materials in cement; 2) Performance characteristics, such as carbon emissions, durability, energy efficiency, or environmental impact; 3) World Trade Organization; 4) Offset credits earned by pursuing activities that remove carbon from the atmosphere (e.g., afforestation)

Case study: US roadmap encourages exploring federal market-based carbon pricing mechanisms and suggests incentives to adopt low-carbon technologies

Overview of US roadmap's policy recommendations¹⁾



Overview

- Net zero aspiration: US aims to achieve carbon neutrality throughout the value chain by 2050
- Emissions: Total CO₂ emission from cement production reached 40 m tons in 2023
- Roadmap: Portland **Cement Association** launched a decarbonization roadmap in 2024

Codes and standards



- · Enforce mandatory and minimum requirements for performance-based standards²⁾ for building materials
- · Outline development of improved testing and quality control procedures

Carbon pricing



- Explore national marketbased carbon price
- Cap-and-trade system is preferable as it directly targets abatement
- Recommend Carbon Border **Adjustment Mechanism:** support domestic industries to prevent carbon leakage and maintain a level playing field

Procurement policies



- Incentivize energy efficient buildings
- Consider the full product, material, and life cycle in procurement standards and policies
- Suggest to eliminate minimum clinker **requirements** in government procurement projects
- Consider performance**based procurement** to promote PLCs3) and other blended cements

Funding programs & fiscal support



· Recommend financial

incentives to promote

emissions fleets (LEFs)

transportation, and

Other

policies

• Consider tax incentives and financing for **plant** efficiency upgrades

conversion to industrial low

 Propose revenue generated from carbon pricing for funding research and investment in manufacturing, material innovation, and CCUS

- Call for **investments** in clean fuel, energy,
- Study Public education programs e.g. EPA's National Recycling Strategy to increase community acceptance

industrial infrastructure

 Address barriers e.g. EPA's **New Source Review** regulations and the Non-Hazardous Secondary Materials (NHSM) rule

¹⁾ US policies may change depending on the strategic direction of the current administration; 2) Performance characteristics, such as carbon emissions, durability, energy efficiency, or environmental impact; 3) Portland-Limestone Cement

Case study: Mexico roadmap promotes performance-based standards, continuous development of its national ETS, and CCUS technology transfer

Overview of Mexico roadmap's policy recommendations



Overview

- Net zero aspiration: Mexico aims to achieve net zero emissions by 2050
- Emissions: Total CO₂ emission from cement production reached 19 m tons in 2023
- Roadmap: CANACEM launched a decarbonization roadmap in 2023

Codes and standards

Carbon pricing

Procurement policies

Funding programs & fiscal support

Other policies



 Establish mandatory and minimum requirements for performance-based standards¹⁾ for building materials



- Develop Mexico's ETS towards effective and stable international carbon pricing mechanisms
- Expand the use of carbon pricing to incentivize investment in clean energy sources



- material, and building life **cycle** in procurement standards
- Eliminate minimum-clinker **requirements** in government procurement



 Develop incentives for **CCUS adoption** and access to financial resources and technology transfer



- Promote co-processing of waste through collaborative work with authorities
- Suggest leakage **protections** for domestic manufacturers

¹⁾ Performance characteristics, such as carbon emissions, durability, energy efficiency, or environmental impact



Case study: Canada roadmap emphasizes low-carbon standards, funding for CCUS, and carbon pricing mechanisms like CBAM to prevent carbon leakages

Overview of Canada roadmap's policy recommendations (issued by Cement Association of Canada)



Overview

- Net zero aspiration: Canada aims to achieve net zero emissions by 2050
- Emissions: Total CO₂
 emission from cement
 production reached 6.8
 m tons in 2023
- Roadmap: Cement
 Association of Canada launched a decarbonization roadmap in 2022

Codes and standards



- Mandate mandatory and minimum requirements for climate-smart codes and performance-based standards¹⁾ for low-carbon products
- Implement a greening government strategy by requiring the disclosure of embodied carbon in structural materials in construction projects
- Ensure carbon emissions reporting by making sure all sectors develop lifecycle inventory datasets and environmental product declarations in a consistent manner

Carbon pricing



- Explore carbon border adjustment mechanisms (CBAM) to address carbon leakage, similar to the EU's model
- Consideration of carbon contract to address first full-scale commercial deployment of decarbonization

Procurement policies



- Suggest lower carbon materials to be considered as a criterion in procurement; Buy Clean Strategy to support & prioritize low carbon products in infrastructure projects
- Carve out projects specifically for showcasing new low-carbon products and processes

Funding programs & fiscal support





Other

policies

- Expedite decarbonization efforts via the USD 8 bn Strategic Innovation Fund-Net Zero Accelerator
- Leverage the Canada Infrastructure Bank (CIB) to invest in private sector-led projects in low-carbon technology
- Emphasize dedicated funding/ support for CCUS
- Natural Resources
 Canada's Office of Energy
 Research and
 Development
- Specific investment tax credit for CCUS projects if CO₂ stored is permanent

- Consider zero-emission heavy-duty vehicles for cement/ concrete transportation
- Suggest developing Clean Growth Hub and Sustainable Development Technology Canada (SDTC), as the focal point to further & coordinate efforts on clean technology

¹⁾ Performance characteristics, such as carbon emissions, durability, energy efficiency, or environmental impact



Case study: Canada also has a 2nd roadmap issued by the government (ISED¹⁾) that promotes emissions reduction policies across similar focus areas

Overview of Canada roadmap's policy recommendations (issued by ISED¹⁾)



Overview

- Net zero aspiration:

 Canada aims to achieve
 net zero emissions by

 2050
- Emissions: Total CO₂
 emission from cement
 production reached 6.8
 m tons in 2023
- Roadmap: ISED launched a decarbonization roadmap in 2022

Codes and standards

Carbon pricing

Procurement policies

Funding programs & fiscal support

Other policies



- Emphasize the adoption of climate-smart codes and performance-based standards²⁾ by regulatory authorities to mandate lowcarbon approaches in infrastructure projects
- Suggest voluntary standards can be used in public procurement and funding criteria



- Explore Carbon Border
 Adjustment (CBAM) as a
 policy tool to complement
 domestic carbon pricing
- Propose carbon contracts that factor future carbon prices into agreements between governments and low-carbon project investors



- Call for a new Buy Clean³⁾
 Strategy to prioritize the
 use of made-in-Canada
 low-carbon products in
 infrastructure projects
- Encourage engagement with provinces to develop sub-federal Buy Clean policies
- Emphasize the need to develop life-cycle inventory datasets and Environmental Product Declaration⁴⁾ for carbon emission reporting



- Highlight the importance of fiscal assistance to attract near-term capital investment in major decarbonization projects
- Propose specific investment tax credit for CCUS projects
- Explore the establishment of a Canada Growth Fund to attract substantial private sector investment
- Suggest to allow the Canada Infrastructure Bank (CIB) to invest in private sector-led infrastructure projects



- Encourage the use of zeroemission heavy-duty vehicles to transport cement and concrete products
- Suggest collaboration with the US, and other trading partners on the coordinated assessment of key technologies e.g., CCUS

¹⁾ Innovation, Science, and Economic Development Canada; 2) Performance characteristics, such as carbon emissions, durability, energy efficiency, or environmental impact; 3) Procurement policy encourages the use of low-carbon materials; 4) Standardized document that provides transparent information about the environmental impacts of a product throughout its lifecycle



Case study: China roadmap promotes inclusion of cement industry in ETS, green procurement, and investment in innovative technologies like hydrogen and CCUS

Overview of China roadmap's policy recommendations



Overview

- Net zero aspiration:
 China aims to achieve
 net zero emissions by
 2060
- Emissions: Total CO₂
 emission from cement
 production reached 718
 m tons in 2023
- Roadmap: RMI and China Cement Association launched a decarbonization roadmap in 2022

Codes and standards



 Enforce mandatory and minimum requirements for building carbon emission calculations Carbon pricing



- Include cement industry in the national carbon trading market¹⁾
- Emphasize proper pricing mechanism to ensure a cost advantage for low-carbon cement

Procurement policies



- Promote green procurement policies for low-carbon building materials
- Recommend implementation of green procurement policies, starting with government projects and leading real estate companies

Funding programs & fiscal support



- Recommend **Tax credits** for low-carbon technologies
- Suggest Green finance to support green transition
- Fund the deployment of innovative and costeffective emissions technologies

Other policies

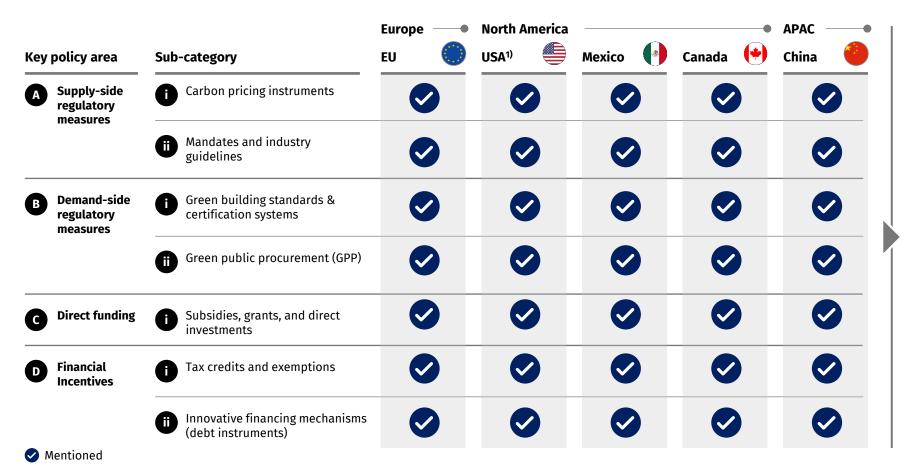


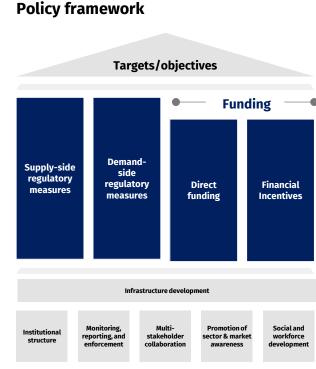
- Propose low carbon industrial parks
- Emphasize solid-waste collection and pretreatment systems
- Refine cement certification system
- Suggest infrastructure for major innovative technologies e.g., hydrogen, biomass, CCUS

¹⁾ Inclusion of the Cement, Iron and Steel, and Aluminum Industries in effect in 2025

These roadmaps emphasize the need for policies across 4 key areas, forming the "policy pillars" of the emissions reduction framework for cement/concrete

Policy recommendation – focus areas mentioned in selected decarbonization roadmaps





These key policy areas constitute the 4 policy pillars of the framework

Source: Roland Berger

¹⁾ US policies may change depending on the strategic direction of the current administration

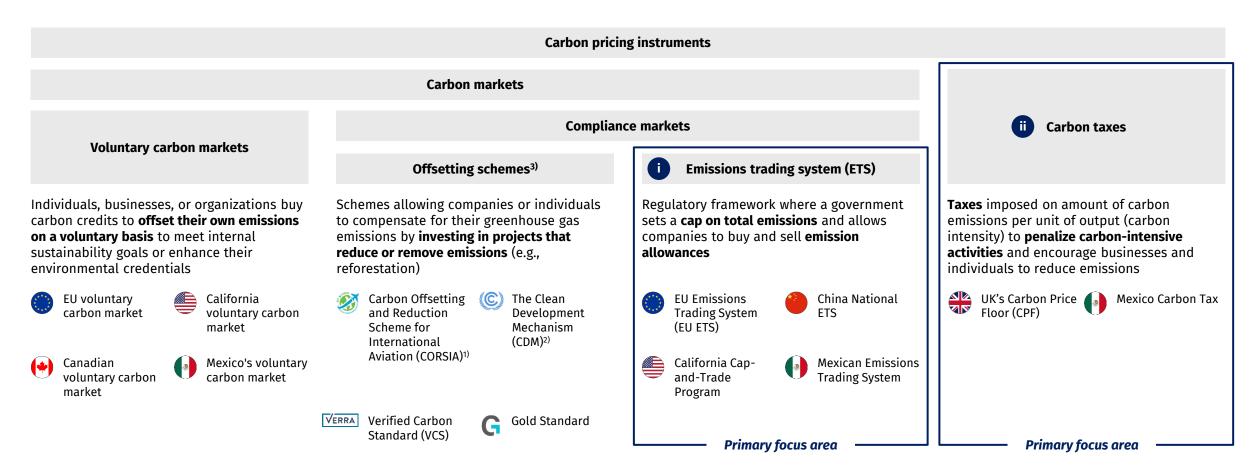
2.1 Supply-side regulatory measures- Carbon pricing instruments





There are 4 main types of carbon pricing instruments available: voluntary carbon markets, offsetting schemes, emissions trading system (ETS), and carbon taxes

Types of carbon pricing instruments



¹⁾ Global carbon offset scheme designed to offset international aviation CO₃ emissions; 2) United Nations-run carbon offset scheme allowing countries to fund greenhouse gas emissions-reducing projects in other countries and claim the saved emissions; 3) Not a tradable platform like voluntary markets and ETS, but generates carbon credits—certificates representing a reduction of one metric ton of CO₂ emissions—which can be traded in carbon markets

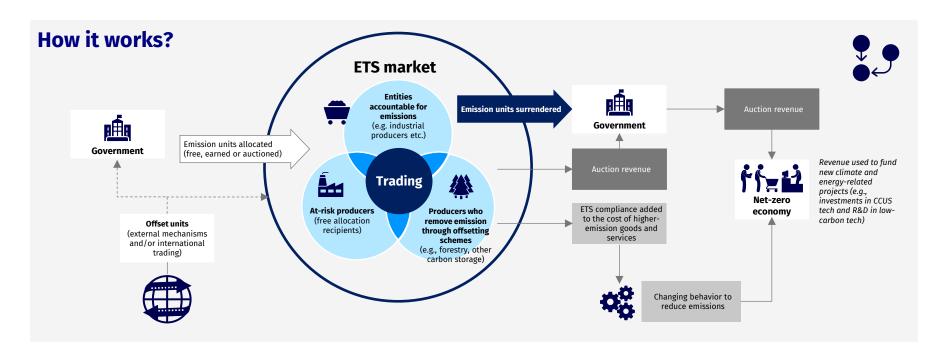
2.1.1 Emissions trading systems (ETS)





An Emissions Trading System (ETS) caps total emissions and enables trading of carbon allowances, creating a market incentive to reduce emissions

Overview: Carbon pricing instruments – Emissions trading systems (ETS)



Benefits

- **Drives innovation:** Encourages investment in low-carbon tech
- Generates revenue: Auctioning carbon allowances generates funds to further support green initiatives
- Guarantee reductions: Cap ensures that overall emissions reduction goals are met

Objective

To cap and reduce emissions, a **market-driven carbon price** is set by establishing an **emissions limit for a sector (e.g., cement)**, with individual companies within that sector receiving **specific allowances** depending on their total emission, incentivizing emissions reductions while generating revenue to fund new sustainability initiatives

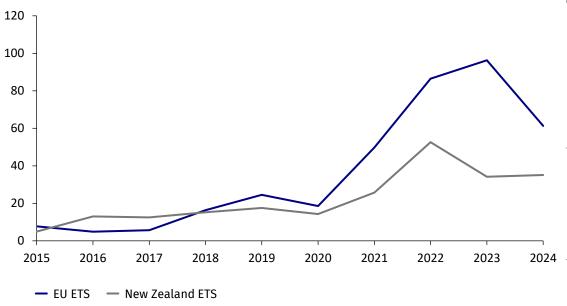




Source: Climate Explained, Roland Berger

In an ETS, carbon prices fluctuate depending on multiple factors such as economic events, policy changes, and political uncertainties

Price evolution of emissions trading systems (ETS) in USD/tCO₂e





Factors affecting ETS price volatility:

- Supply and demand dynamics
- Economic events e.g., COVID-19, EU energy crisis
- Change in ETS policies (e.g., reduced allowances)
- Political uncertainties

Factors driving prices fluctuations

emissions

under Fit for 55



New Zealand



26

- 2020
- COVID-19 pandemic reduced industrial activity led to lower demand for allowances and carbon prices
- COVID-19 pandemic reduced industrial activity led to lower demand for allowances and carbon prices

- 2021
- Fit for 55: tightened the cap on emissions. which increased allowance scarcity and prices
 - Energy crisis drove prices higher from increased reliance on coal and gas raised
- Prices rose as the minimum auction reserve price increased

- 2022
- Continued energy crisis and Russia-Ukraine
- war, disrupted energy markets Temporary prices drops from market

corrections after speculative spike

Auction price floors increased again

Market anticipation produced upward

pressure from policy debates on tightening

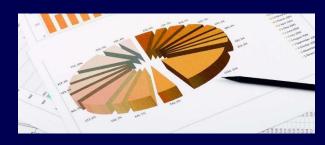
- 2023
- Short-term dips from economic slowdown
 - Prices rose from stricter allowance caps
- Prices dips from political uncertainty

Source: World Bank, Roland Berger





Which sectors should be covered in the ETS?



Properly determining which sectors are included allows for targeted emission reductions, prevents loopholes or unintended consequences, and ensures that high-emission sectors contribute to substantial emissions reductions

How to design the mechanisms and features of the ETS?



Clarifying the key specifics of the ETS ensures smooth operation by defining how carbon allowances are allocated, traded, and monitored, while maintaining transparency and accountability in emission reductions

Who should lead the development and implementation of the ETS?

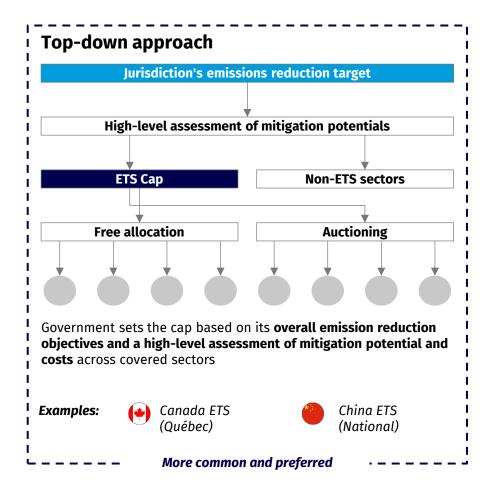


Identifying the right leadership for the ETS ensures effective design, implementation, oversight, and fostering collaboration

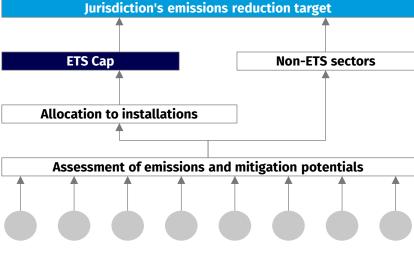


In determining sector coverage, there are 2 approaches: top-down approach is more common and preferred for its alignment with national climate goals

How to determine which sectors to cover?



Bottom-up approach



Government bases the cap on a more granular assessment of emissions, mitigation potential, and costs for each sector, subsector, or participant, and determines an appropriate emission reduction potential for each

Examples:



Early phase of EU ETS (later changed to topdown)



Early phase of ETS California (later changed to top-down)

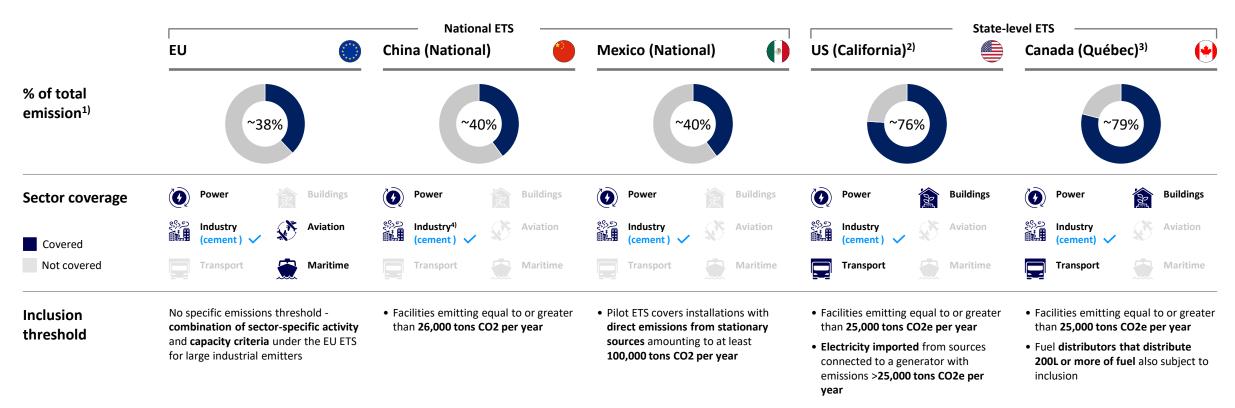
Key takeaways

- Top-down cap-setting approach is more common in carbon pricing mechanisms, esp. in large-scale systems (e.g., EU ETS and California's cap-and-trade program)
- Bottom-up approach is less common due to higher complexity but has been observed in some regional or smaller-scale systems
- Top-down cap setting is preferred because it allows for a more coordinated and unified approach, ensuring that the cap aligns with national climate goals



National ETS typically covers ~40% of a country's total GHG emissions and inclusion thresholds are typically set at ~25,000 tons of CO2 emissions per year

Coverage of ETS in benchmarked countries





Emission Trading Systems (ETS) universally prioritize the power and industrial sectors (including cement and concrete), with further sector coverage determined by each jurisdiction's emissions profile and national priorities

¹⁾ Based on latest available data of each country; 2) US currently does not have a national ETS – Besides California, Regional Greenhouse Gas Initiative (RGGI) is another ETS that applies to 11 member states; 3) Canada has both a national ETS and state-level ETS – National ETS applies to states without its own carbon pricing policy; 4) Inclusion of the Cement, Iron and Steel, and Aluminum Industries in effect in 2025





In setting up an effective ETS, there are three dimensions to consider:

Which sectors should be covered in the ETS?



Properly determining which sectors are included allows for targeted emission reductions, prevents loopholes or unintended consequences, and ensures that high-emission sectors contribute to substantial emissions reductions

How to design the mechanisms and features of the ETS?



Clarifying the key specifics of the ETS ensures smooth operation by defining how carbon allowances are allocated, traded, and monitored, while maintaining transparency and accountability in emission reductions

Who should lead the development and implementation of the ETS?



Identifying the right leadership for the ETS ensures effective design, implementation, oversight, and fostering collaboration





While setting up an ETS, 5 key factors must be thoroughly considered to address the specifics of the mechanisms

Key considerations for ETS implementation

Key considerations

1. How to set cap?

Available options based on market observations

Absolute cap – fixed limit on total emissions, which decreases over time regardless of changes in economic activity

Intensity-based cap – cap set relative to the carbon intensity of an underlying metric (per GDP, capita, output)



2. How to allocate allowances? (multiple selections possible)

Auctioning – companies participate in public auction of carbon allowances to ensure fair allocation

Free allocation¹⁾ – allowances are allocated to companies without charge, which helps to prevent carbon leakage²⁾



3. How to ensure market stability and liquidity?

(multiple selections possible)

Price floor & ceiling – minimum and maximum price limit on carbon allowances to help control price volatility

Reserve pool of allowances – set of carbon allowances set aside that can be released into the market

Price stabilization fund – reserved funds set aside that can be used to buy or sell allowances to help control price volatility



4. How to ensure transparency and integrity?

(multiple selections possible)

Public reporting & 3rd-party verification – mandatory disclosure of emissions data and validation from a 3rd party auditor Independent regulatory oversight – dedicated body that monitors and enforces the rules and performance of an ETS

Registry systems – Use of central online platform to track issuance, transfer, and ownership of carbon allowances or credits



5. Is cross-border trading available?

Domestic trading only – trading of carbon allowances or credits limited to domestic market only

Regional trading – trading of carbon allowances or credits involving multiple countries within a region

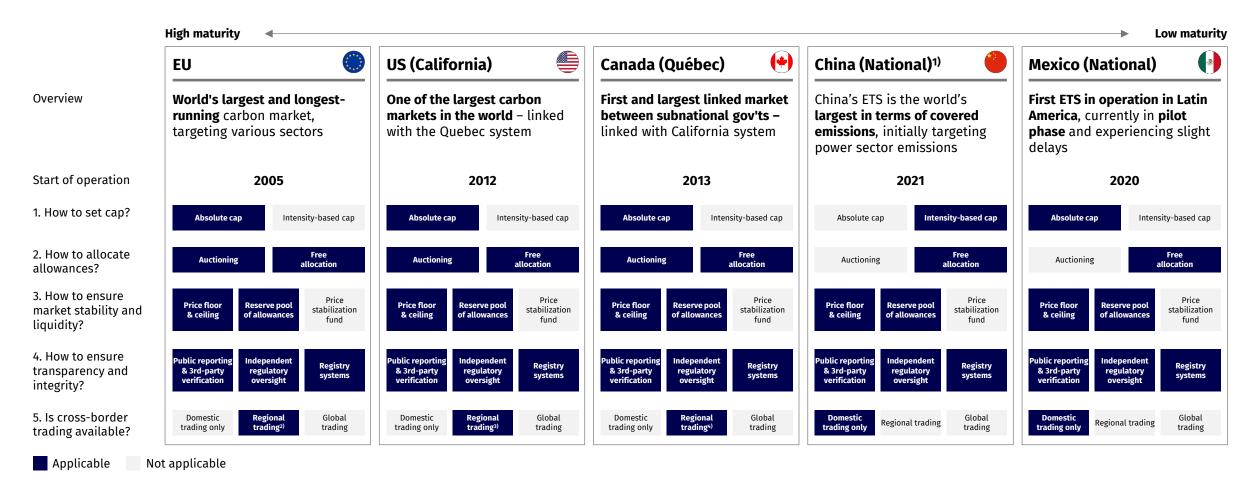
Global trading – trading of carbon allowances or credits involving multiple countries at the global-level

¹⁾ Either based on international benchmarks or historical performance; 2) Businesses subject to stringent environmental regulations move their operations to countries with weaker or no regulations



Across these 5 key factors, there are multiple pathways available as can be seen from multiple country/ region examples

Selected examples of ETS in benchmarked countries (with coverage of cement industry)



¹⁾ Inclusion of the Cement, Iron and Steel, and Aluminum Industries in effect in 2025; 2) Regional trading in EU covers all EU-member states; 3) Linkage with Quebec cap-and-trade program; 4) Linkage with California cap-and-trade program





The choices for each of the 5 key factors in ETS depends on the local/regional contexts and objectives

Rationale for selection of ETS mechanisms / features

Key considerations

Comparison of options

Common practices

Absolute cap - more clear,

predictable reductions, and

Hybrid approach (both)

with increasing portion of

aligns with national

sustainability goals

auctioning overtime



1. How to set cap?

Selected deep-dive in subsequent slides



2. How to allocate allowances? (multiple selections possible)

Absolute cap - preferred for longterm environmental outcomes and international credibility because of clear alignment with climate targets and predictability

Auctioning - efficient allocation of resources based on supply and demand and generates revenue for climate investments but requires a well-developed market

Intensity-based cap - offers better economic flexibility but more complex to administer and does not guarantee a specific level of emissions reduction

Free allocation1) - reduces initial burden on industries and minimizes resistance to adoption but could result in oversupply if allowances are

over-allocated

Reserve pool of allowances - acts as a buffer against price spikes or shortages by releasing allowances

Price stabilization fund - less frequently used due to concerns over market manipulation and administrative complexity

Price floor & ceiling and reserve pool of **allowances** are typically used together





3. How to ensure market stability and liquidity?

(multiple selections possible)

4. How to ensure transparency

(multiple selections possible)

Price floor & ceiling – prevents extreme price fluctuations, ensuring market predictability for industries and investors

Public reporting & 3rd-party verification – builds trust and ensures emissions data credibility

Independent regulatory oversight essential for preventing fraud and ensuring fair market operations

when needed

Registry systems - centralized tracking of allowances ensures accountability and simplifies market operations

All three options are typically used together to maximize transparency and integrity





5. Is cross-border trading available?

and integrity?

Domestic trading only – preferred for early stage to establish a functional market

Regional trading – often explored by countries with strong regional relationships and proximity (e.g., US-Canada and EU-whole etc.)

Global trading – advanced coordination required and so should be explored in later development stages

Domestic & regional trading - depending on local and regional context



¹⁾ Either based on international benchmarks or historical performance







Absolute cap is the more common approach as it guarantees a specific reduction in overall emissions and better aligns with national climate goals

Comparison of absolute-cap and intensity-based cap

Absolute cap

Description

Fixed limit on the total amount of emissions allowed within the covered sectors over a period - cap declines over time, ensuring emissions reductions

Intensity-based cap

Limit based on emissions per unit of economic output (e.g., tons of CO₂ per million dollars of GDP), allowing total emissions to vary with economic growth

Pros



• Environmental certainty: Guarantees a specific reduction in overall emissions



• Economic flexibility: Adapts to economic growth by allowing total emissions to increase, while reducing emissions intensity





Less risk of carbon leakage: Minimizes carbon leakage by permitting some emissions growth in expanding economies

Cons



• Economic risk: Less flexible to economic fluctuations, making it more costly to meet the cap during rapid economic growth



• Less environmental certainty: Does not guarantee emissions reductions, as total emissions may rise with economic growth



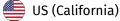
• Potential for carbon leakage: A stringent cap may drive businesses to relocate to regions with looser emissions regulations



 More complex: More challenging to design and administer due to the need for accurate measurement of economic output



Canada (Québec)





Mexico (National)





China (National)

Examples





Key takeaways

covered sectors:

option

• **Key consideration** in choosing

intensity-based cap is **how** quickly the jurisdiction aims to reduce emissions within the

- For faster and more certain

For greater flexibility, an

preferred option

intensity-based cap is the

Absolute cap is more common

and preferred for its better

alignment with national sustainability goals

total emissions reductions, an

absolute cap is the preferred

between an absolute cap and an

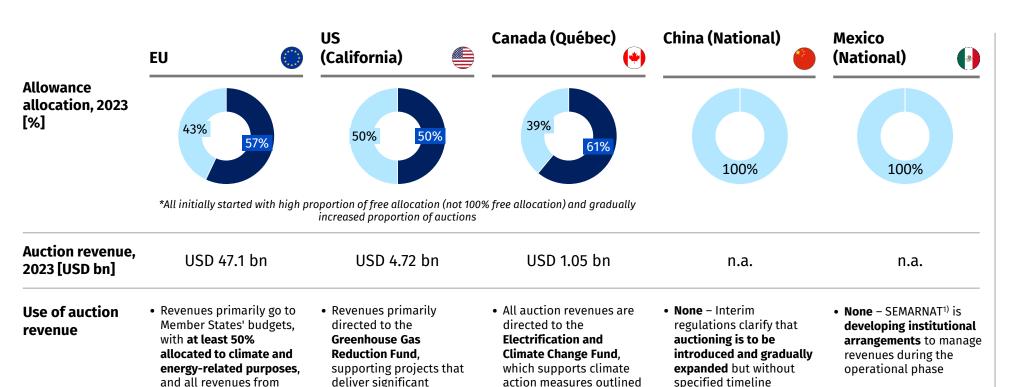
environmental, economic,

benefits across the state

and public health

Auctioning and free allocation promote fairness – Auction revenues can be used to support projects that further generate economic and environmental benefits

Allowance allocation in benchmarked countries



in the 2030 Green

Economy Plan

Key takeaways

- Auctioning and free allocation in ETS generate significant revenues for the government, which can then be directed toward environmental projects
- Many countries initially start off with a high proportion of free allocations and gradually increase the proportion of auctions to encourage marketdriven emissions reductions and ensure fairer distribution of allowances

Free allocation

mid-2023 onward must

support these objectives

¹⁾ Secretariat of Environment and Natural Resources





In setting up an effective ETS, there are three dimensions to consider:

Which sectors should be covered in the ETS?



Properly determining which sectors are included allows for targeted emission reductions, prevents loopholes or unintended consequences, and ensures that high-emission sectors contribute to substantial emissions reductions

How to design the mechanisms and features of the ETS?



Clarifying the key specifics of the ETS ensures smooth operation by defining how carbon allowances are allocated, traded, and monitored, while maintaining transparency and accountability in emission reductions



Source: Roland Berger







Climate-related ministries usually lead ETS implementation with additional support from NGOs & security exchanges – clear roles & responsibilities are key

Main institutions involved in ETS implementation in benchmarked countries

EU



US (California)



Canada (Québec)



China (National)



Mexico (National)





European Commission:

Establish the regulatory framework and centrally administers the EU ETS



California Air Resources Board: Design and implements the Cap-and-

Trade Program in California



Ministry of the **Environment, the Fight** against Climate Change, **Wildlife and Parks:**

Implement the cap-andtrade program in Quebec



Provincial-level MEE subsidiaries: Oversee ETS implementation, manage MRV²⁾, and ensure

Ministry of Ecology and

and oversees the system in

Environment: Set rules



compliance

China



Municipal-level authorities: Manage

n.a.

covered entities directly

China Carbon Emissions Registration and Clearing Co., Ltd.: Operate the CEA3) registry and clearing platform in China





SEMARNAT⁴⁾: Implement the ETS in Mexico



COCOSCE⁵⁾: Facilitate consultation and offers advice on the Pilot ETS in Mexico



Authorities of all EU Member States:

Implement, verify, and ensure compliance within their regions

Examples:



The Federal **Environment Agency** (Umweltbundesamt) in Germany



∃nea

The Netherlands **Emissions Trading** Authority (NEa) in

Netherlands



Western Climate Initiative, Inc.: Provide administrative and technical solutions to support GHG emissions trading programs, incl. administering auctions and maintaining the CITSS1) registry



Western Climate Initiative, Inc.: Provide administrative and technical solutions to support GHG emissions trading programs, incl. administering auctions and maintaining the CITSS1) registry



Shanghai Environment and Energy Exchange: Operate the CEA3) trading platform in China

XXX Regulatory & administrative bodies

XXX Trading platform operators

XXX NGO and supportive organizations

1) California Independent Entity Tracking System - online platform used to manage and track greenhouse gas emissions allowances; 2) Monitoring, Reporting, and Verification; 3) China Emissions Allowance; 4) Secretariat of Environment and Natural Resources; 5) Advisory Committee for Carbon Emissions Trading and Climate Change







Overall, ETS are typically implemented in phases, with cap adjustments, gradual sector coverage expansion, and refinement of rules to prevent carbon leakage

Development phases of ETS in benchmarked countries



EU

Covers cement/ concrete since 2005

US

Covers cement/ concrete

Phase 1 (2005-2007)

Bottom-up cap calculated from national allocation plans, covering power and industry sectors with a cap of 2,096 MtCO₂e

Cap set at 162.8 MtCO2e, covering

large industrial facilities, electricity

Phase 2 (2008-2012)

Decreasing cap, continuing bottomup cap approach with minor expansion to include more sectors, and extending geographical coverage

distributors, with consignment for

Phase 3 (2013-2020)

Single EU-wide cap starting in 2013, with **linear reduction factor**. covering new sectors like petrochemicals and aviation

Phase 4 (2021-2030)

Linear reduction factor adjusted, covering new sectors like maritime, and gradual adjustments to free allocation and carbon leakage rules

Deep-dive in subsequent slide

Key takeaways

introduced in

coverage and

expanding over

phases, starting

with limited sector

• ETS are

- 3rd compliance (2018-2020) **Decreasing cap.** covering the same sectors, with free allocation based on leakage risk and continued ongoing auctioning auctioning with consignment for utilities

4th compliance (2021 and beyond)

Decreasing cap, with continued free allocation for FITE2) sectors and

since 2013

Canada (Québec)

(California)

Covers cement/ concrete since 2013

1st compliance (2005-2007)

generation, and CO₂ suppliers

1st compliance (2013-2014)

Cap set at 23.2 MtCO₂e, **covering** electricity producers and industrial facilities, with free allocation and auctioning

2nd compliance (2015-2017)

2nd compliance (2015-2017)

Expanding coverage to fuel

utilities and continued free

allocation for EITE2) sectors

Expanding coverage to include fuel distributors, with cap adjustments, along with auctioning for fuel distributors

3rd compliance (2018-2020)

Decreasing cap, continuing free allocation for EITE2) sectors and auctioning

4th compliance (2021 and beyond)

Decreasing cap, with adjustments to free allocation and ongoing auctioning

Mexico (National)

Covers cement/ concrete since 2020

Pilot (2020-2021)

Testing the carbon market on a limited scale, focusing on energy and industrial sectors to refine system design and build market experience

Transitional phase (2022)

Gradual **refinement of market** mechanisms in preparation for full implementation

Operational phase (2024)1)

Full-scale implementation of ETS with carbon pricing system - sector and threshold coverage are not expected to change

time to include more industries

Caps and allowance allocation approaches are adjusted and continuously refined to address emerging challenges

China (National)

No specific phases for the Chinese national ETS (Officially launched in 2021 focusing on the power sector - Cement, Iron and Steel, and Aluminum Industries coverage began in 2025)

¹⁾ Delayed due to regulatory and technical challenges, including the need for further consultation and system design adjustments; 2) Energy-Intensive Trade-Exposed sectors refer to industries that consume large amounts of energy and are vulnerable to carbon leakage if subjected to carbon pricing







Case study: EU ETS is one of the most successful systems, owing to its multiple development phases that continuously integrated improvements into the system

Deep-dive: Development phases of EU ETS (applicable to cement/ concrete industry since 2005)



1. Cap-setting

Phase 1 (2005-2007)

Each country set caps through National Allocation Plans, no EUwide cap, which led to overallocations

Phase 2 (2008-2012)

- Required **stricter caps** in National **Allocation Plans**
- Total allowances reduced by 6.5% compared with 2005

Phase 3 (2013-2020)

- Shifted to single EU-wide cap
- Reduced cap annually by 1.74% (LRF1))

Phase 4 (2021-2030)

- 2021: LRF¹) increased to 2.2% annually
- LRF¹⁾ adjusted to 4.3% in 2024-2027. 4.4% from 2028-2030

Key takeaway

Centralized and progressively decreasing caps provide public clarity and measurable emissions target

Increase portion of auctioning



2. Allowances allocation

- No auctioning
- 95% of allowances were distributed for free
- Increased proportion of auctioning for selected sectors, but still focus on mainly on free allocation
- Set auctioning as default
- 100% auction for power sector, while at-risk industries²⁾ were allocated via free allowances
- Gradual phase-out of free allowances for sectors covered by CBAM3) in 2026-2034
- Cement sector subject to both free allocation and auctioning

overtime, while keep allowances to balance competition



3. Market stability and liquidity

No mechanisms for market stability, leading to price crashes due to overallocation of allowances

- 2015: Introduced MSR⁴) withdrawing auction portion based on surplus levels
- Allowed 24% withdrawal of surplus allowances annually in MSR4) to prevent over-supply

Market stability mechanisms are essential to prevent price crashes from overallocation



4. Transparency and • integrity

- Introduced MRV5) guidelines
- Introduced Community Independent Transaction Log (CITL) to track allowance movements across borders
- Replaced CITL with **Union Registry**⁷⁾ to streamline tracking of transactions and reduce fraud risks
- Introduced new reporting obligations for carbon removal projects
- Established Social Climate Fund8)

Constant efforts to increase transparency builds trust, improving market credibility and enforcement



5. Cross-border trading

- Allowed cross-border trading within EU
- **Expanded cross-border trading** to include Norway, Iceland, and Liechtenstein
- Linked EU ETS to Switzerland's ETS
- Maintains mechanisms for linking with other systems

cross-border linkages increase market scale



Revise and enforce EU ETS Directive, set cap, manage MSR⁶⁾

National Competent Authorities⁶⁾:

Allocate allowances, oversee MRV⁵⁾ and issue penalties

Expansion of market through

Main responsible institutions



European Commission:

1) Linear Reduction Factor; 2) Sectors that are vulnerable to carbon leakage; 3) Carbon Border Adjustment Mechanism; 4) Market Stability Reserve - mechanism designed to stabilize the supply of emission allowances and prevent extreme price fluctuations; 5) Monitoring, reporting, and verifying; 6) Any government entities responsible for overseeing and enforcing regulations and standards; 7) Union Registry is a more modern and integrated system that manages all aspects of the EU ETS; 8) Dedicated fund, financed through the auctioning of a portion of emissions allowances, to support climate related projects

Source: European Commission, Roland Berger 39



Case study: Mexico's ETS full-implementation has been delayed – sufficient stakeholder collaboration and regulatory clarity is crucial to mitigate these risks

Mexico's ETS implementation delays



Context

- Pilot phase of ETS started in 2020, covering cement/ concrete industry (first Latin America country)
- Full-scale implementation originally planned for 2024 but has been delayed with no definite timeline

Reasons for	delavs	in imr	lementation	of Mexico ETS	
NEGSUIIS IUI	u c lays	111 IIIII 	neinentation	OI MEXICO LIS	



Lack of sufficient support from stakeholders

Uncertainty and insufficient support from political leaders and stakeholders have slowed progress



Regulatory uncertainty

Delays in publishing full operational rules (expected prior to full implementation) makes it difficult for businesses to prepare for the ETS



Limited execution capacity

Limited capacity at Mexico's Ministry of Environment and Natural Resources (SEMARNAT) to manage the complexity of the system



Carbon pricing uncertainty

Growing public concerns on carbon allowance pricing, with a lack of clarity on price levels and their potential impact on businesses



State-level disparities

Varying carbon tax levels across states create challenges for aligning regional policies with the national ETS, adding complexity

Potential mitigation measures - key learnings

Engage with key industry groups early including environmental organizations and local governments to ensure their buy-in and alignment with the ETS goals

Prioritize the publication and finalization of operational rules with transparent timeline and regular updates to build confidence among businesses

Collaborate with international experts to obtain technical support in the design and implementation phases

Leverage market stabilization tools (e.g., price floor & ceilings and allowance reserves) to reduce price volatility and increase market confidence

Create a federal coordination body to facilitate cooperation and harmonization of state-level policies with the national ETS

¹⁾ Based on Mexico's Nationally Determined Contributions (NDCs)

Summary of key findings:

Carbon pricing instruments – Emissions trading systems (ETS)



- An Emissions Trading System (ETS) sets a cap on emissions for a sector (e.g., cement) and allows trading of carbon allowances
- It creates market incentives for emission reductions and generates revenue through allowance auctions, while ensuring emissions goals are met despite fluctuating carbon prices

Among the selected countries, which countries have an ETS and within those, which ones include cement and concrete industry?

- All benchmarked countries/regions have an ETS covering the cement and concrete sector: EU, China, Mexico, US (California), Canada (Quebec)
- -The **US lacks a national ETS** but has state-level systems like California's cap-and-trade and the Regional Greenhouse Gas Initiative (RGGI) in 11 states
- -Canada has both national and state-level ETS, with the national ETS covering states without their own carbon pricing policies.

What are the key dimensions to consider in designing and implementing an ETS?

- Sectors covered: Typically determined using a top-down approach, which aligns with national climate goals and is more common in large-scale systems determined by national climate goals; often includes sectors emitting over 25,000 tons of CO₂ /year
- Design mechanisms:
- -Set the cap, allocate allowances, ensure market stability, and maintain transparency
- -Design varies by local context (e.g., absolute caps or hybrid auctioning)
- Entities accountable: Climate-related ministries lead, supported by NGOs and securities exchanges for coordination

How to maximize chances of successful ETS implementation?

- Introduce ETS in phases, starting with limited coverage and expanding
- Refine caps and allowance allocations over time, as seen with the EU ETS' ongoing improvements

Source: Roland Berger



Key learnings and success factors:

Carbon pricing instruments – Emissions trading systems (ETS)



Consider top-down cap-setting approach

Top-down approach reduces operational complexity and ensures that the cap set is well-aligned with national climate goals, as exemplified by the USA (California) and China



Implement and refine ETS in phases

Implementation of ETS in phases with gradual expansion of sector coverage helps reduce risks and allows for continuous improvements in rules & regulations to maximize efficiency and minimize economic disruptions



Utilize combination of auctioning and free allocation

Combining auctioning with free allocation helps balance fairness, reduces windfall profits, and generates revenue to further fund additional climate-related projects



Define clear roles for institutions responsible for implementation

Climate-related ministries typically lead in ETS implementation with additional support from NGOs and security exchanges – clear roles and responsibilities help streamline implementation



Foster stakeholder collaboration early and ensure regulatory clarity

Extensive early engagement with industry groups, local governments, and environmental organizations, along with transparent regulatory frameworks, helps mitigate risks of implementation delays



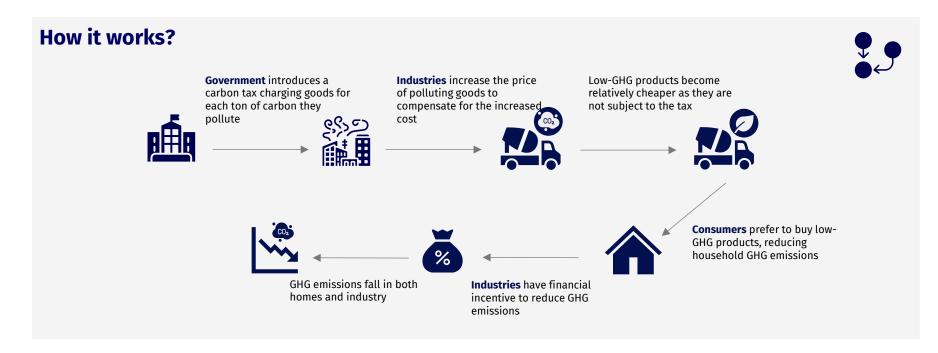
2.1.2 Carbon taxes





Carbon taxes make carbon-intensive activities more expensive, creating a market incentive to reduce emissions

Overview: Carbon pricing instruments – Carbon taxes



Benefits

- Drives innovation: Encourages industries to develop low-carbon guidelines and standards to remain competitive
- Reduces emissions: Directly incentivizes a decrease in carbon emissions
- Generates revenue: Provides governments with funds for investments in clean energy

Objective

To reduce greenhouse gas emissions by making carbon-intensive activities more expensive, a fixed carbon tax rate incentivizes businesses and consumers to shift towards sustainable practices, in contrast to an ETS where the carbon price fluctuates based on market dynamics

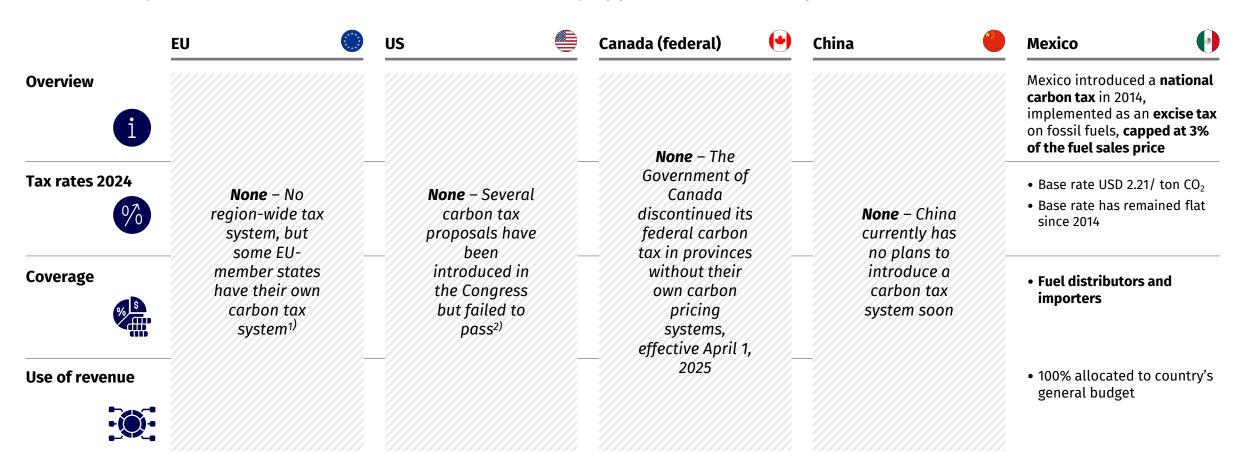






Mexico has introduced a carbon tax, primarily targeting fossil fuels distributors and importers, rather than directly targeting specific industries

Carbon tax system in benchmarked countries (not directly applicable to cement production)



¹⁾ EU member states with carbon tax include Austria, Denmark, Finland, France, Germany, Sweden, etc.; 2) US policies may change depending on the strategic direction of the current administration

Source: RFF, OECD, Government of Canada, Roland Berger







Although carbon tax targeting specific industries, including cement and concrete, is uncommon, it has been implemented in a few selected countries

Carbon tax system in selected countries (directly applicable to cement production)

households

	Singapore	South Africa	Chile	Taiwan	
Overview	Singapore implemented a carbon tax in 2019, the first carbon pricing scheme in SEA, supporting the transition to a low-carbon economy	South Africa introduced a carbon tax on June 1, 2019. Phase 1 has been extended to December 2025 (Phase 2 will begin in 2026)	Chile established a carbon tax in 2014 as part of wider tax reforms It went into effect in 2017 and was updated in 2020	Taiwan's carbon fee program, starting in 2025 , aims to reduce emissions from large-scale industrial emitters	
Tax rates 2024	USD 18.39¹) per ton of CO₂e	USD 10.13 ²⁾ per ton of CO₂e	USD 10.13 ³⁾ per ton of CO ₂	USD 9.09 ⁴⁾ per ton of CO ₂	
Coverage	Applies to industrial facilities with annual direct GHG emissions of at least 25,000 tons CO2e or more	Applies to companies with annual direct (Scope 1) GHG emissions of at least 25,000 tons CO2e or more	Applies to installations emitting 25,000 tCO ₂ or more, as well as those releasing more than 100 tons of particulate matter into the air each year	Applies to companies with annual direct emissions of at least 25,000 tons CO ₂ or more	
Use of revenue	Used to support decarbonization efforts , transition to a green economy, and cushion the impact on businesses and households	Used to facilitate the development of decarbonization solutions, support businesses' shift to low-carbon solutions, and cushion the impact on	Not publicly disclosed	Not publicly disclosed	

Key takeaways

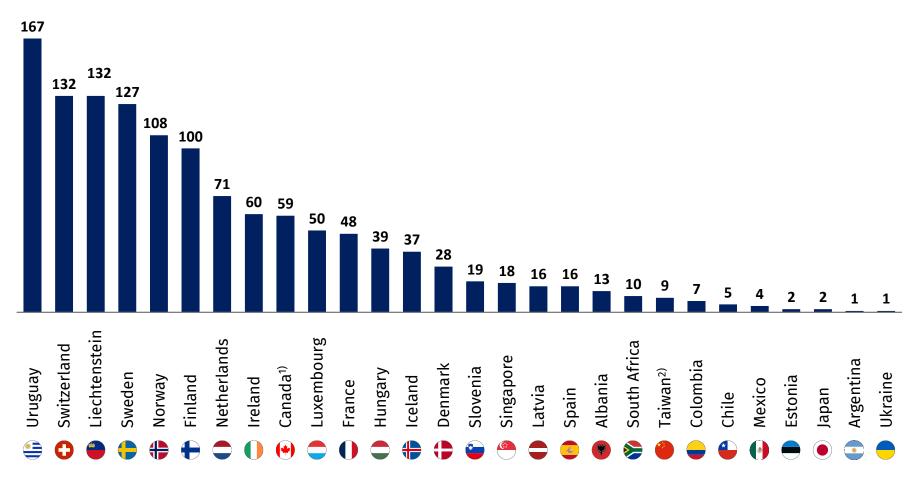
- Although carbon taxes specifically targeting industrial facilities like **cement production** are **uncommon**, they are implemented in a few countries, such as Singapore, South Africa, Chile, and Taiwan
- However, none of these countries—Singapore, South Africa, Chile, and Taiwan—currently have an active ETS alongside their carbon tax, likely to minimize administrative complexity

¹⁾ SGDUSD = 0.74 USD; 2) ZARUSD = 0.053; 3) CLPUSD = 0.001 USD; 4) NTDUSD = 0.03 USD, Effective January 1, 2025, Taiwan's Ministry of Environment (MOENV) confirmed that the carbon fee program will commence, following a delay from the initial plan to start in 2024



There is no single "correct" carbon tax rate – each country determines its rate based on factors such as economic impact, public support, and emissions goals

Carbon tax rate by country, 2024 [USD per ton CO₂]



Key takeaways

- Each country sets its carbon tax rate based on **key factors** including:
- Economic impact: Potential effects on economic growth, competitiveness, and inflation
- Emissions reduction target:
 Level of emissions reductions
 needed to meet national or
 international climate goals
- Public and political acceptance:
 Degree of support among the public and stakeholders, including equity considerations and fairness in implementation



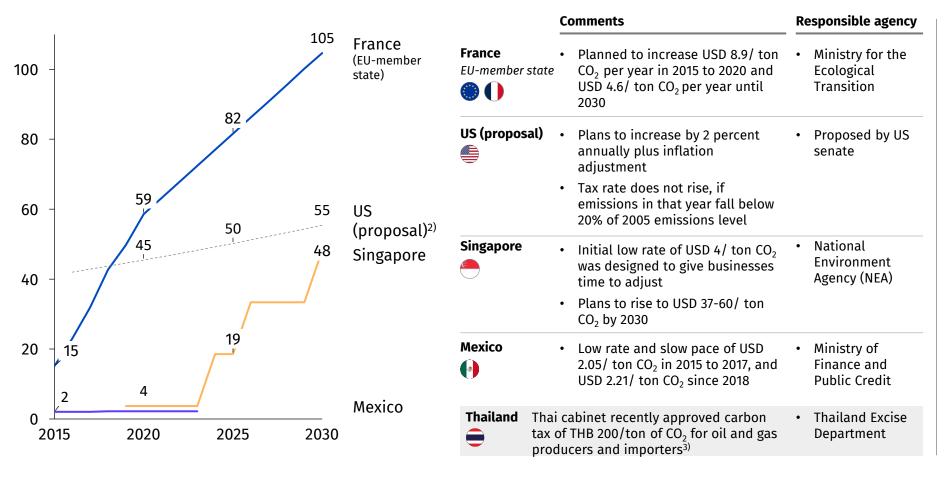
¹⁾ Fuel charge - discontinued effective April 1, 2025; 2) Carbon fee; Effective January 1, 2025, Taiwan's Ministry of Environment (MOENV) confirmed that the carbon fee program will commence, following a delay from the initial plan to start in 2024

Source: World Bank, Roland Berger



Gradual, phased implementation is key to successful implementation of carbon tax system – incremental rate adjustments minimize disruptions and opposition

Planned escalation of carbon tax rates in selected countries [USD/ ton CO₂]¹⁾



Key takeaways

- Carbon tax rates are designed to rise gradually over the years, encouraging greater decarbonization efforts while aligning with national climate goals
- France's planned incremental increases in carbon tax rates are among the most ambitious, highlighting the country's strong commitment to addressing climate change
- Singapore and Mexico began with lower rates and have adopted a gradual increase approach to balance economic competitiveness with their climate objectives

Source: NCCS, RFF, OECD, IGES, Roland Berger

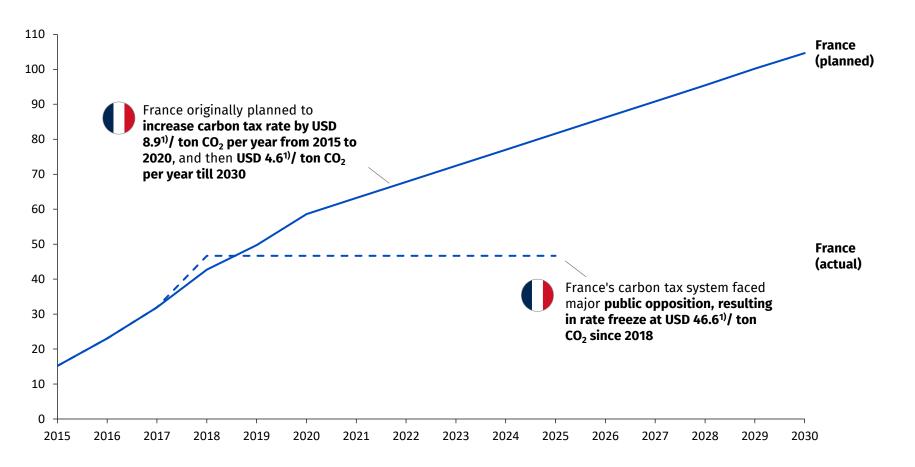
¹⁾ SGD 1 = USD 0.74; EUR 1 = USD 1.05; MXN 1 = USD 0.05 as of 27 Jan 2025; 2) Based on rates under the proposed American Opportunity Carbon Fee Act; 3) The new carbon tax will be included in the existing oil tax



Case study: Significant carbon tax hikes can spark backlash as seen in France – success stems from gradual increases, revenue recycling, and strategic timing.

Carbon tax rates in France, 2015 – 2030 [USD/ ton CO_2]¹⁾





France and Canada lead in Global Carbon Tax Revenue. In 2022, the top 15 countries generated approximately \$30 Billion in revenue from carbon taxes.

Key takeaways

- Ambitious carbon tax rate hikes over time can disrupt businesses; gradual increases are preferable to manage this disruption effectively
- Although France initially planned to recycle tax revenue, the lack of clear, fair mechanisms and poor communication hindered effectiveness
- France's carbon tax increases occurred during a period of rising global fuel prices, rather than during a period of stable energy prices

¹⁾ EUR 1 = USD 1.05 as of 27 Jan 2025





Many countries generally opt to implement either a carbon tax or ETS to avoid risks of increased administrative complexity and redundant costs

Key benefits and risks of different carbon pricing approach

Most common approaches

ETS only



Benefits

- Emissions certainty: Sets a firm cap on emissions, guaranteeing that overall reductions will be achieved
- Market-driven: Uses market mechanisms to discover the most efficient ways to reduce emissions

Risks

- Price volatility: Carbon price can fluctuate, creating uncertainty for businesses
- Complexity: Requires complex systems for allocating allowances, monitoring emissions, and trading

Examples







- China
- **South Korea**

Carbon tax only¹⁾



- Simplicity: Relatively easy to implement and administer, utilizing existing tax systems
- Price Certainty: Sets a predictable carbon price, providing clarity for businesses
- Emissions uncertainty: Does not guarantee a specific level of emission reductions
- Political resistance: May face strong opposition due to concerns about increased costs
- Japan







Colombia



Hybrid approach



- Complementary coverage: Can cover different sectors or sources of emissions with different instruments
- Combines strengths: Can combine the emissions certainty of an ETS with the price predictability of a carbon tax
- Increased complexity: Managing two systems can be administratively complex
- Overlap and inefficiencies: If not carefully designed, both instruments might lead to redundant costs





Sweden



Switzerland



Denmark



Norway

Source: Roland Berger 50

¹⁾ Currently without an ETS, but may have an ETS planned for the future



However, carbon tax and ETS can complement each other by covering more emission sources, but will require careful design for maximum effectiveness

Availability of carbon tax and emission trading system (ETS) across selected countries

		Carbon tax	ETS	Why?
Mexico		⊘	1)	 To target broader coverage as carbon tax covers fossil fuels, while ETS targets large industrial emitters
France	0	⊘		 To cover sectors that are not included in EU ETS e.g., transportation, residential heating, agriculture, fisheries
Germany				 To ensure wide coverage and transition to a more comprehensive carbon pricing approach
Switzerland	•			 To cover emissions from sectors not included in the ETS, and the linked ETS allows for broader market-based emissions reductions
Singapore			✓	 Carbon tax is simpler to administer, which suits Singapore's small market size However, Singapore plans to introduce an ETS as outlined in its Singapore Green Plan 2030
✓ Available	Plan ı	ned 🧽 Covers co	ement & concrete s	ector

Key takeaways

- Carbon tax and ETS can work together to address a broader range of emission sources, improving overall coverage of emissions
- However, major risks which must be managed:
- Double taxation: same emissions could be taxed under both systems, increasing costs for businesses
- Administrative complexity: coordination and management become more complex to avoid inefficiencies





In countries with both systems, carbon tax typically covers emissions from sectors excluded in the ETS, ensuring broader coverage without double taxation

Carbon tax and ETS sector coverage in selected countries

		Carbon tax only	Carbon tax & ETS	ETS only
Mexico		Fuel distributors and importers		Under development (planned)
			!	 Power generation
				 Industrial facilities¹⁾ emitting >100,000 tons CO₂ per year
			!	 High-emission commercial buildings
				 Large-scale manufacturing
France		 Fuel distributors and importers 		EU ETS
	U	,	No overlan in sector	 Power generation
			No overlap in sector coverage between	 Industrial facilities
			the carbon tax and ETS	 Aviation: Flights within the European Economic Area (EEA)
				Large-scale manufacturing
Germany		Fuel distributors and importers		EU ETS
,		•	i	 Power generation
				• Industrial facilities
				 Aviation: Flights within the European Economic Area (EEA)
			i	 Large-scale manufacturing
			L	

Key takeaways

- Countries such as Mexico, France, and Germany use both carbon pricing instruments to ensure comprehensive emission coverage across all sectors
- ETS typically targets large, centralized emitters, such as power plants and industrial facilities, while carbon tax primarily targets fuel producers, distributors, and importers



¹⁾ Applicable to selected sectors only (cement and concrete included)

Summary of key findings:

Carbon pricing instruments – Carbon taxes



What is carbon tax and how does it help drive emissions reduction?

A carbon tax increases the cost of carbon-intensive activities, creating an incentive to reduce emissions. It drives innovation, encourages low-carbon practices, reduces emissions, and generates revenue for governments to invest in clean energy.



Among the selected countries, which countries have carbon tax?

- Canada: Discontinued federal carbon tax in provinces without their own carbon pricing systems, effective April 1, 2025
- Mexico: National carbon tax on fossil fuels since 2014
- EU: No region-wide carbon tax, but some member states have their own
- US: No federal carbon tax, several proposals have failed
- Other countries: Carbon taxes specifically targeting cement are rare but exist in Singapore, South Africa, Chile, and Taiwan



What are the key considerations to determine the carbon tax level?

The carbon tax level is **based on economic impact**, **emissions targets**, **and public/political acceptance**



What are the key considerations for choosing between carbon tax and ETS?

- Carbon tax: Provides price certainty but lacks guaranteed emissions reductions
- ETS: Guarantees emissions reductions but can involve price volatility and complex systems
- Hybrid approach: Combines strengths but requires careful design to avoid inefficiencies and double taxation



How to maximize chances of successful carbon tax implementation?

To ensure successful carbon tax implementation, begin with a low rate and gradually increase the rate. A transparent revenue recycling plan and effective communication are key to gaining support and minimizing resistance



Which entities are accountable for managing carbon tax?

Entities accountable for managing a carbon tax can vary depending on the specific design and implementation of the tax in a jurisdiction. However, tax authorities, environmental agencies, and finance ministries are often the main government entities involved in the design and implementation of carbon tax





Key learnings and success factors:

Carbon pricing instruments – Carbon taxes



Consider carbon tax to complement ETS for more comprehensive coverage

Hybrid systems leverage the strengths of both mechanisms, covering gaps and accelerating decarbonization in specific sectors – However, sector coverage should be exclusive to each system to avoid redundant costs



Implement carbon taxes in phases to mitigate disruptions

Gradual phasing of carbon tax rates allows industries to adjust and prevents sudden economic shocks lead to industry confidence



Recycle revenue to build public support

Transparent utilization of revenue ensures fairness and builds trust in the system, can either redirect to households as rebates or reinvested in green initiatives (e.g., in Singapore)



Introduce carbon tax during periods of stable energy and fuel prices

The timing of carbon tax introduction is crucial, with periods of stable energy and fuel prices being ideal to ensure public acceptance



Foster stakeholder collaboration early and ensure regulatory clarity

Conduct stakeholder consultations and clear communication to the public reduce public resistance as learned from France



2.2 Supply-side regulatory measures – Mandates and industry guidelines

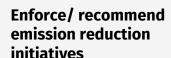
Governments issue mandates and guidelines with 2 main objectives: establish clear industry standards and enforce/ promote emissions reduction initiatives

Overview: Mandates and industry guidelines

How it works?

Goals/ purposes

Establish clear and measurable industry standards







Measures and tools

Mandates & guidelines on product certifications and labels
Ecolabels help manufacturers differentiate their sustainabili

Ecolabels help manufacturers differentiate their sustainability aspects of their products

Mandates & guidelines on production efficiency improvements

Promotion of emissions reduction activities in the midstream part of value chain – e.g., energy efficiency requirements





Mandates & guidelines on circular economy practices

Promotion of emissions reduction activities in downstream part of value chain – e.g., C&D¹¹) waste management

Objective

To align production processes with **sustainability goals** and **promote eco-friendly materials**, while ensuring **industry compliance with best practices for efficiency**, circular economy, and emissions reduction across the value chain



Benefits

- Improve transparency: Enables informed decisions for businesses and consumers
- Boost long-term industry competitiveness: By setting energy efficiency targets, companies are pushed toward adopting cleaner technologies, reducing long-term reliance on carbon-intensive methods
- Drives innovation: Encourages industries to develop low-carbon guidelines and standards to remain competitive



¹⁾ Construction & demolition

These mandates & guidelines help address challenges to emissions reduction in the cement and concrete industry – e.g., lack of low-carbon product standards

Industry challenges and needs for solutions





Mandates & guidelines on product certifications and labels

Challenges

- Limited consumer awareness: Many consumers are unaware of the environmental impacts of their purchases, limiting the demand for ecofriendly products in the market
- Lack of standardization: The lack of universal standards for sustainability certifications create confusion in the marketplace and lead to "greenwashing," where products may claim sustainability without meeting actual standards

Needs for solutions

- Market differentiation: Ecolabels help manufacturers differentiate their products based on sustainability aspects, which incentivizes manufacturers to adopt more sustainable production methods
- Consistency in sustainability claims: Ecolabels help serve as a guideline to ensure consistency in sustainability claims, building trust among consumers and ensuring that manufacturers meet recognized standards





Mandates & guidelines on production efficiency improvements

- Energy-intensive production: Cement and concrete production is highly energy-intensive, with kilns using vast amounts of fossil fuels
- High operational costs: Energy-efficient technologies often require significant upfront investment, so companies are often reluctant to voluntarily make such investments
- Incentivizing investments: Mandates can encourage manufacturers to invest in energy-efficient technologies by pushing the industry toward adopting cleaner technologies and practices, reducing overall emissions while improving operational efficiency





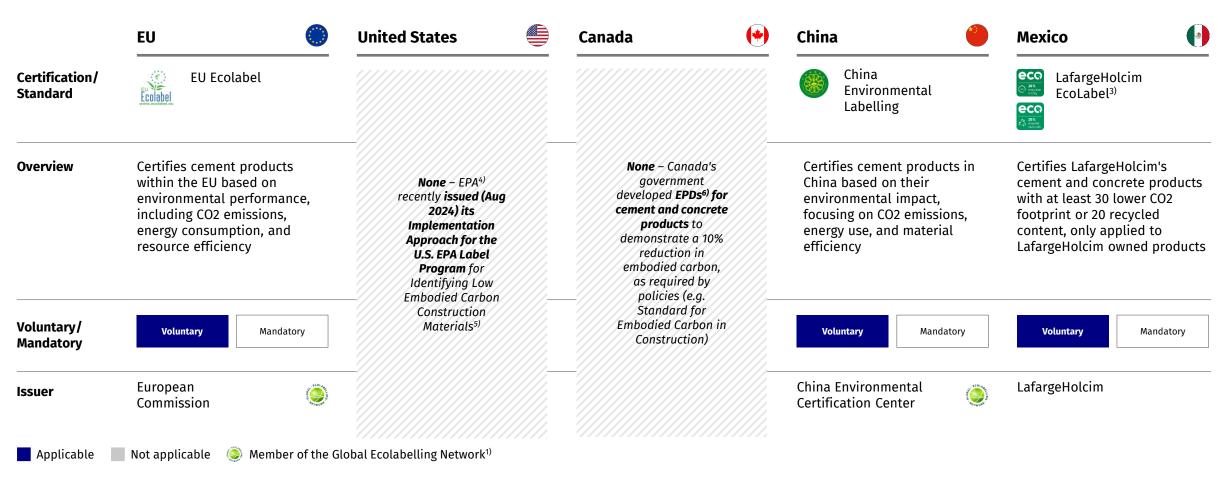
Mandates & guidelines on circular economy practices

- Waste generation: C&D¹⁾ waste often ends up in landfills, contributing to environmental degradation
- Fragmented industry practices: Circular economy practices in cement and concrete are not uniformly implemented across the industry, leading to low adoption rates of recycling and reuse practices
- Promoting waste reduction practices: Mandates for circular economy practices, such as C&D1) waste management, can help reduce waste generation by promoting recycling, reuse, and the use of recycled materials in production



Ecolabels help certify low-carbon cement and concrete products, helping manufacturers differentiate their products by highlighting sustainability aspects

Selected examples of ecolabels for low-carbon cement & concrete products

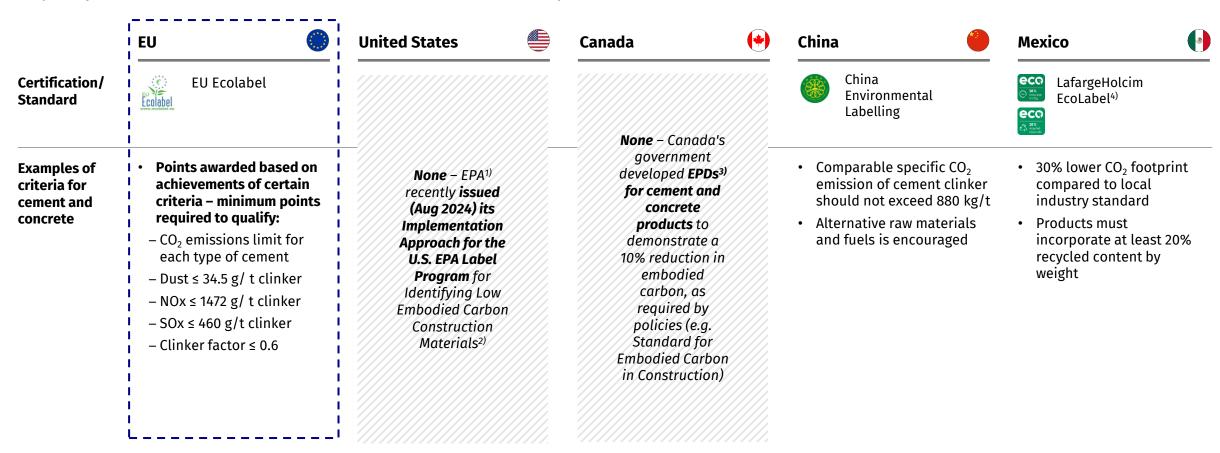


¹⁾ Leading network of the world's most credible and robust ecolabels; 2) Under EU's Product Environmental Footprint initiative; 3) Applicable for LafargeHolcim products only – Mexico currently does not have cement and concrete-specific carbon labels; 4) Environmental Protection Agency; 5) US policies may change depending on the strategic direction of the current administration; 6) Environmental Product Declaration (EPD)

2

These labels provide general guidelines for defining and identifying low-carbon cement and concrete products, but criteria often vary between different labels

Key requirements and criteria for cement and concrete products



Selected deep-dive next slide

¹⁾ Environmental Protection Agency; 2) US policies may change depending on the strategic direction of the current administration; 3) Environmental Product Declaration (EPD); 4) Applicable for LafargeHolcim products only – Mexico currently does not have cement and concrete-specific carbon labels

2

Case study: For example, EU Ecolabel utilizes a scoring system with specified criteria, covering metrics such as clinker factor and CO₂ emission intensity

EU Ecolabel criteria for precast concrete products or compressed earth blocks1)



EU Ecolabel uses a scoring system with specified min. total number of points required to qualify for EU Ecolabel:

Examples of scoring dimensions:

Environmental Management System for hydraulic binder production plant (optional)

Environmental Management System for hard covering production plant (optional)

Clinker factor	
CO ₂ emission intensity	
Emissions of dust, NOx and SOx to air	
Recovery and responsible sourcing of raw materials	
Energy consumption	

Environmentally innovative product designs (optional)

Key criteria for cement & concrete products with set threshold

1) Based on hydraulic binders or alternative cements

Examples of criteria and thresholds:

Clinker factor

For hydraulic cement binders: Up to 15 points can be awarded to applicants in proportion to how much the clinker factor of the hydraulic cement binder is reduced towards the threshold for environmental excellence of 0,60 (from 0 points for clinker factor \geq 0,90, up to 15 points for clinker factor \leq 0,60).

CO₂ emission intensity

The $\rm CO_2$ emissions associated with the production of Portland cement clinker, lime or alternative cements shall not exceed the relevant mandatory limits defined in the table below, when calculated using the relevant calculation method, also defined in the table below

Product type	Mandatory limit	Threshold of environmental excellence	CO ₂ calculation method	
Grey Portland cement clinker	816 kgCO ₂ /t clinker	751 kgCO ₂ /t clinker	According to Regulation (EU)	
Lime	1028 kgCO2/t hydraulic lime	775 kg/CO ₂ /t hydraulic lime	2019/331 or Regulation (EU)	
White Portland cement clinker	1063 kgCO ₂ /t clinker	835 kgCO ₂ /t clinker	No 601/2012, as appropriate	
Alternative cements	571 kgCO ₂ /t cement	526 kgCO₂/t cement	ISO 14067 carbon footprint for A1-A3 life cycle stages	



To accelerate the adoption of ecolabels, governments can lead by example by mandating them as a criterion in the selection process for public projects

Promotion of ecolabels in government project selection criteria

The EU Public Procurement Directives (2014/24/EU and 2014/25/EU) define the possibilities of using ecolabels in public tendering



Ministerial Regulation of Government Procurement for ELPs¹⁾ mandates higher preference for ELP-labelled products in public tendering











Labels can be used in 2 ways:

- To help draw up technical specifications to define the characteristics of the goods or services required
- To check compliance with these requirements, by accepting the label as one means of proof of compliance with the technical specifications

Environment Label Product Procurement List

was created in 2006 to serve as a central database that tracks certified products under government procurement item category

Further deep-dive on GPP in later section

Key takeaways

- China Environmentally-Friendly Certification is semi-mandatory, being voluntary for private projects but mandatory for public projects
- By providing third-party verification, ecolabels help save time while ensuring high environmental standards in public procurement
- Public procurers are often reluctant to state specific green criteria because of uncertainty about what exactly to ask for and the availability of compliant products on the market – ecolabels help streamline the procurement process

¹⁾ Environmental Labelled Products

Case study: Introduction of "environmental permits" in EU requires large cement producers to strictly comply with emission limits and Best Available Techniques

Industrial Emissions Directive (IED) 2010/75/EU



Industrial Emissions Directive (IED) **2010/75/EU** requires businesses with high potential environmental **impacts** to obtain IED environmental permits to ensure that these industrial activities comply with **Best Available** Techniques (BAT – failure to obtain this permit can result in penalties, fines, or suspension of operations)

Producers of cement clinker in rotary kilns with a production capacity exceeding 500 tons per day or in other kilns with a production capacity exceeding 50 tons per day are required to obtain IED permits:

Examples of key criteria – Best Available Techniques (BAT) for the production of cement, lime, and magnesium oxide



Performance management & monitoring

- Environmental Management Systems (EMS) focusing on compliance and pollution prevention
- Real-time data to assess performance
- Routine energy efficiency audits
- Input testing for metal concentrations¹⁾ in waste



Emission limits

- Set threshold for dust, NOx²⁾, SOx³⁾, CO⁴⁾, and mercury emissions⁵⁾
- Use of real-time sensors for gaseous pollutants and particulates
- Installation of fabric and hybrid filters⁶⁾ for dust control
- Suggest improving combustion, e.g. kiln draft⁷⁾, burner properties and configuration⁸⁾, to reduce CO₂ emissions



Waste utilization/ renewable energy

- Standards for using hazardous and non-hazardous wastes as fuels or raw materials
- Use of waste-derived fuels as renewable energy
- Recommend improving fuel handling with leak-proof feeding lines
- Encourages optimization of raw material use and input material purity standards



Energy efficiency

- Use of cogeneration systems e.g., waste heat recovery9)
- Development of **energy benchmarks** for plants based on best practices
- Deployment of precalciner kiln systems¹⁰⁾

Source: European Commission, Roland Berger 62

¹⁾ Pose threat to environmental and public health; 2) Nitrogen oxides; 3) Sulfur oxides; 4) Carbon monoxide; 5) Emissions from volcanoes, the weathering of rocks, forest fires, and soils; 6) The filters combine an electrostatic precipitator (ESP) with a fabric filter to capture large and small particles; 7) Airflow and motion that occurs within a kiln, provides oxygen for combustion and keeps kiln moving; 8) Includes burner design, flame shape, fuel injector, etc. can affect the combustion emissions; 9) Capture and reuse operational heat; 10) Helps preheat and partially calcine raw materials before rotary kiln burning process



Case study: EED¹⁾ requires large cement manufacturers to conduct routine energy audits, helping them pinpoint their inefficiencies and reduce emissions

Energy Efficiency Directive (EED) energy audit requirements (applicable to cement manufacturers)



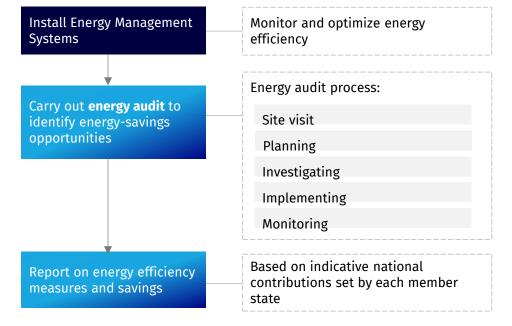
How it works?

EU Energy Efficiency Directive (EED) is a pan-European mandatory compliance scheme obligating large EU businesses (including cement and concrete manufacturers) to complete independent energy audits and reporting at least every four years for regulated products

Covered entities²⁾:

Enterprises with an average annual energy consumption higher than 85 TJ over the previous 3 years are obliged to implement an energy management system and carry out an energy audit

Enterprises with an average annual energy consumption higher than 10 TJ over the previous 3 years that do not implement an energy management system, must carry out an energy audit



Key impacts



Lower carbon footprint

Energy audits allow manufacturers to pinpoint inefficiencies in their operations, leading to actionable mitigation measures that lower energy consumption and subsequently lower carbon footprint



Longer equipment lifespan

Energy audits help identify equipment issues e.g., auditors can detect carbon monoxide emitted from equipment that has not been vented properly



Increased property value

Properties with higher energy efficiency ratings have a high market value from green premium

¹⁾ Energy Efficiency Directive; 2) There are variations between countries' in-scope qualification definitions



Governments can also play a more direct role in supporting cement producers optimize energy efficiency by offering technical assistance through programs

Selected examples of government-managed energy efficiency improvement programs

Energy Star Program – Certification program



For Canada

Natural

Resources

Canada (NRCan)



Better Plants Program - Improvement program





Objective: Helps businesses and consumers across industries achieve top 25% energy performance (EPI score ≥ 75) and gain market recognition by certifying energy-efficient products, buildings, and practices through expert guidance and standards

Benefits offered:

- Allows plants to assess energy efficiency relative to peers with EPI tool
- Certification and recognition

Impact: Participants across several industries typically report savings of 15-20% on energy costs annually

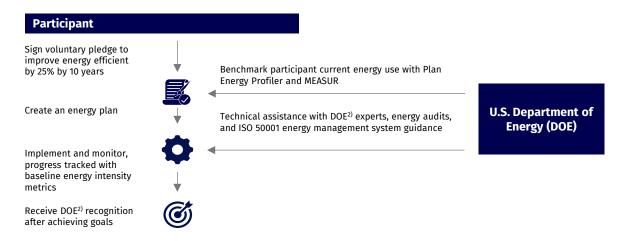
Participant Benchmark participant current energy use with EPI¹⁾ against industry peers For US Identify gaps and prioritize Provide case studies for industry-specific U.S. improvements improvements **Environmental** Implement and monitor Protection Agency (EPA) Annual verification Receive ENERGY STAR certification upon scoring 75+

Objective: Helps industrial facilities, including cement producers, enhance energy efficiency by 25% over 10 years, reduce emissions, and cut costs through expert technical support and resources

Benefits offered:

- 2-4 day In-Plant Trainings
- Access to DOE²⁾ tools and resources

Impact: Participants across several industries typically report savings of 20-30% on energy costs annually



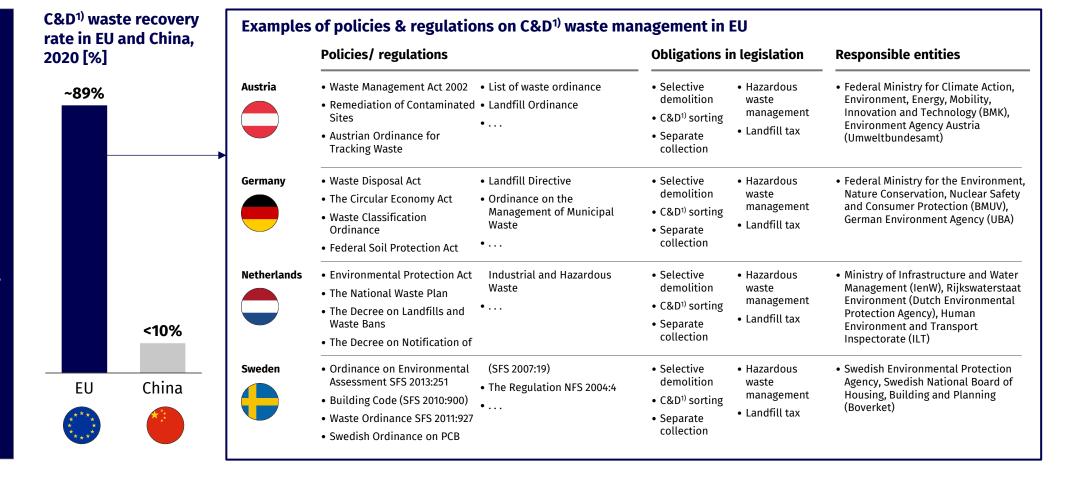
¹⁾ Energy Performance Indicator tool use to calculate energy efficiency score (out of 100) – Issued by U.S. Environmental Protection Agency; 2) Department of Energy

EU leads in C&D¹⁾ waste management with a recovery rate of ~89%, achieved through a comprehensive set of policies & regulations across its member states

EU C&D¹⁾ waste management performance

What is C&D¹⁾ waste management?

Recycling and disposal of construction and demolition debris, such as concrete - this allows for the reuse of materials like recycled concrete aggregates (RCA) in production, lowering emissions and DOE minimizing landfill waste



¹⁾ Construction & demolition



Other non-EU countries have also introduced regulations with similar mandates and obligations, such as selective demolition and C&D¹⁾ waste sorting

C&D¹⁾ waste management performance in selected other non-EU countries

Country	Policies/ regulations/ standards	Obligations in legislation		
Mongolia	 Solid Waste Management (2012) Funding of Waste Management and Transportation Operations and Consolidated of Waste Management Service Fees (2015) MNS 5606-1:2016 – Environmental protection MNS 5975:2009 – Grease catcher equipment in wastewater 	 MNS 5479:2005 – Protection against dangerous goods MNS ISO 11632:2005 – Determination of mass concentration of sulphur dioxide MNS 3438:1983 – Auxiliary raw material waste of nonferrous technical requirement 	 Selective demolition C&D¹⁾ waste sorting Separate collection Hazardous waste management 	
South Korea	 National Waste Management Law (1986) Act on Resource Saving and Recycling Promotion (1992) Volume-based Waste Fee (2018) 		 Selective demolition C&D¹⁾ waste sorting Landfill tax/ ban 	
Japan	 Waste Management and Public Cleansing Law (1970) Basic Act for Establishing a Sound Material-Cycle Society (2000) Construction Material Recycling Law (2000) 		 Selective demolition C&D¹⁾ waste sorting Separate collection Hazardous waste management Subsidies to C&D¹⁾ waste processing facilities 	
Vietnam	Decree No. 38/2015/ND-CPCircular No. 08/2017/TT-BXD		 Selective demolition C&D¹⁾ waste sorting Separate collection 	
United States	 Resource Conservation and Recovery Act (RCRA) (1976) Pollution Prevention Act (PPA) (1990) National Environmental Policy Act (NEPA), (1969) 	• Clean Water Act (CWA) (1972)	 Selective demolition C&D¹⁾ waste sorting Separate collection Hazardous waste management 	

¹⁾ Construction & demolition

Source: Switch Asia, EPA, Roland Berger

These policies promote C&D¹⁾ waste management in 5 main areas – landfill taxes and bans can be particularly effective in encouraging concrete recycling

Key focus areas for C&D¹⁾ waste management policies



Selective demolition

Government mandates deconstruction for material **recovery** and supports it with regulations prioritizing reuse over demolition

Examples:



South Korea

Vietnam



C&D¹⁾ waste sorting

Government mandates onsite waste sorting for recycling, supported by laws requiring segregation

Examples:



South Korea

Japan

Vietnam



Separate collection

Government mandates separate collection of C&D¹⁾ waste types and supports it with infrastructure and penalties for noncompliance

Examples:



Japan

Mongolia

Vietnam



Hazardous waste management

Government mandates **safe** handling of hazardous materials, supported by regulations, worker training, and penalties for improper disposal

Examples:



Japan

Mongolia

Germany



Landfill tax/ ban

Government mandates a landfill tax or ban to incentivize recycling, supported by progressive fees that increase disposal costs to encourage waste diversion

Examples:



Netherlands



👝 Germany 🛛 🎨 South Korea

Deep-dive available

¹⁾ Construction & demolition



Clear definition of waste, phased implementation, and robust recycling infras. are key to addressing landfill taxes/ ban implementation challenges

Policy development constraints for landfill taxes

Country	Context/ challenge
Germany	Unclear waste definition and inconsistent enforcement of landf ban
	 Context: Germany introduced landfill ban in 1993 firstly through TASi¹⁾ regulation to minimize environmental damage from landfills
	 Challenge: The TASi¹⁾ regulation initially had vague pre- treatment²⁾ standards and inconsistent enforcement across federal states

Consequences/ outcome

- **Ifill Consequences:** Some waste were initially classified as pre-treated despite exceeding organic content limits, and without uniform enforcement, some municipalities kept landfilling untreated waste
 - Outcome: The 2001 and 2002 ordinances were subsequently introduced to clarify the definition of "pre-treated waste" and establish uniform enforcement standards across all federal states in Germany

....Lessons learned

- Ensure clear and precise definition for waste classifications under regulations
- Implement the landfill ban uniformly across the nation to guarantee consistent enforcement and compliance in all federal states

Austria

Misalignment between national and federal states regarding landfill investment

- Context: Austria introduced its landfill tax in 1989 under the Clean-Up of Contaminated Sites Act, aiming to fund site remediation and encourage waste diversion
- Challenge: Some federal states, having invested in landfill infrastructure in the early 1990s, resisted the ban's timeline, citing financial losses and underutilized capacity

- Consequences: Some federal states requested deadline extensions to utilize their investments, leading to delays in full enforcement
- Outcome: The 1996 Landfill Ordinance imposed stricter controls, but a long lead-in period was granted, with phased landfill bans starting in 2004 and being fully implemented in 2008
- Ensure alignment between national and regional policies, especially when existing infrastructure investments may conflict with new regulations
- Implement phased transitions to minimize resistance and allow adaptation time

South Korea



Insufficient recycling infrastructure for C&D3) waste

- Context: South Korea's early 2000s landfill restrictions were part of a broader effort to reduce landfill reliance and promote recycling
- Challenge: The country struggled with inadequate infrastructure for waste sorting and recycling when landfill restrictions were phased in during the early 2000s
- **Consequences:** Investments in recycling plants in Korea were insufficient, limited processing capacity
- Outcome: Government initiatives, including specialized recycling facilities and resource circulation policies, boosted recycling rates, with over 95% of C&D³⁾ waste recycled by 2016. Advancements in crushing processes increased recycling plants from 509 in 2013 to 587 in 2019
- Prioritize building robust recycling infrastructure before imposing landfill bans
- Phased approaches ensure smoother transitions and prevent waste accumulation while enabling high recycling rates

¹⁾ Technical Instructions on Municipal Waste; 2) Municipal solid waste that has undergone processing (e.g., sorting) to reduce organic content and environmental impact before disposal; 3). Construction & demolition



Government mandates can set energy efficiency requirements and enforce regular energy audits to promote emissions reduction initiatives in the industry

Selected examples of energy efficiency standards and requirements (cement industry-applicable)

Challenges: Cement and concrete production is energy-intensive and costly – manufacturers are hesitant to invest in low-carbon
low-carbon technologies

Solutions: Mandates drive manufacturers to adopt energy-efficient technologies and practices, thereby reducing emissions and improving operational efficiency

Count	try	Policy/ regulation	Description	Key requirements	Responsible entities
***	EU	Industrial Emissions Directive (IED) 2010/75/EU	Require cement, lime, and magnesium dioxides	• Limits on emissions (e.g., CO2, NOx, SOx)	• European Commission
*****			producers to obtain IED environmental permits to ensure compliance with BAT¹)	• Energy consumption levels in preheating and precalcination	European Environment Agency (EEA)
Select	ed deep-dive in	Energy Efficiency Directive	Mandate energy audits and efficiency improvements for industrial sectors, including cement	Mandatory energy audits for firms that	• European Commission
	quent slides	(EED)		consumed energy above threshold	 European Environment Agency (EEA)
	United States ²⁾	ANSI/CSA Energy Standards	Provide mandatory energy performance standards for cement manufacturing	 Annual fuel utilization efficiency minimum efficiency of 95% 	 American National Standards Institute
			equipment and processes		 Canadian Standards Association (CSA)
*	Canada	Energy Efficiency Act	Require compliance with prescribed energy efficiency standards for regulated products including cement	Annual fuel utilization efficiency minimum efficiency of 95%	Natural Resources Canada (NRCan)
*3	China	National Energy Efficiency Standards for Cement Industry	Mandate energy consumption benchmarks and reduction targets for cement plants	• 30% of clinker production capacity must reach energy intensity of 100 kgce ³⁾ per ton of clinker	National Development and Reform Commission (NDRC)
		Energy Saving and Emission Reduction Action Plan	Mandate energy efficiency and emissions reductions in cement and other sectors	30% adoption of cement kilns using alternative fuel	State Council of China
				 10% use of fuel consumption in cement production 	
	Mexico	Minimum Energy	Specify the minimum energy efficiency requirements for 3-phase induction motors used in industrial boilers including cement plants	MEPS for motors must be 0.7 to 373 kW	Mexico Federal Official
		Performance Standards (MEPS) for Motor		• 96% minimum motor efficiency level	Gazette

¹⁾ Best Available Techniques; 2) US policies may change depending on the strategic direction of the current administration; 3) Kilograms of coal equivalent

Source: European Commission, SENER, Roland Berger



Summary of key findings (1/2):

Mandates and sustainability standards on industry practices from supply-side measures



What are the 3 types of mandates and industry guidelines and how do they help drive emissions reduction?

The 3 types of mandates and guidelines are:

- Product Certifications and Labels: Highlight product sustainability, improving transparency
- Production Efficiency Improvements: Promote energy efficiency and emissions reduction in the midstream value chain
- Circular Economy Practices: Encourage waste management and resource reuse in the downstream value chain

These help drive emissions reduction by **enhancing transparency, encouraging sustainable practices, and ensuring industries** (e.g., cement and concrete) **meet low-carbon standards** across the value chain



For mandates & guidelines on product certifications and labels:

- Which countries have made progress under this area?
- EU: EU Ecolabel
- China: China Environmental Labelling
- Mexico: Companies like LafargeHolcim introduced their own ecolabels
- US & Canada: Still in early stages of developing similar programs
- How is low-carbon cement/ concrete normally defined?
- Low-carbon cement and concrete are **defined based on CO₂ emission intensity, clinker factor, and use of alternative materials**. For instance, the EU Ecolabel uses a scoring system, while China sets a specific CO₂ emissions limit of 880 kg/t for cement clinker
- How does the government promote the adoption of ecolabels?
- Governments can **promote the adoption of ecolabels by mandating or promoting their use in public procurement processes**, as seen in the EU's Public Procurement Directives and China's semi-mandatory certification for public projects. Ecolabels streamline procurement, define green criteria, and provide third-party verification, ensuring compliance with environmental standards
- Which entities are accountable for these ecolabels?
- Ecolabels are typically **managed by government agencies, NGOs, or independent certification bodies**. For example, the EU Ecolabel is managed by the European Commission, and the China Environmental Labelling is managed by the China Environmental Certification Center

Summary of key findings (2/2):

Mandates and sustainability standards on industry practices from supply-side measures



For mandates & guidelines on production efficiency improvements:

- Which countries have made progress under this area?
- All benchmarked countries have made progress in setting production efficiency mandates
- Example: In the EU, cement producers must comply with emission limits and Best Available Techniques, while the Energy Efficiency Directive requires routine energy audits to identify inefficiencies and reduce emissions
- What are the key requirements/ obligations set?
- Key requirements include **emissions limits, mandatory energy audits for high-energy firms, and energy targets** like 95% fuel utilization efficiency and 100 kgce per ton clinker intensity. **Monitoring and performance management** through Environmental Management Systems (EMS) are also required
- Which entities are accountable for these mandates?
- Government agencies or regulatory bodies at national, regional, or local levels
- Standards associations may also be involved in designing and implementing mandates



For mandates & guidelines on circular economy practices:

- Which countries have made progress under this area?
- **EU leads in circular economy practices**, particularly in Construction and Demolition (C&D) waste management, achieving a recovery rate of approximately 89% through comprehensive policies and regulations across its member states
- What are the key requirements/ obligations set?
- Key requirements and obligations for circular economy practices in C&D waste management include **mandates for selective demolition**, **waste sorting on-site**, **separate collection of waste types**, **hazardous waste management**, **and landfill taxes or bans** to incentivize recycling, supported by penalties for non-compliance
- Which entities are accountable for these mandates?
- Climate-related ministries and environmental agencies typically lead the design and implementation of these mandates

Key learnings and success factors:

Mandates and sustainability standards on industry practices from supply-side measures



Promote ecolabels as a requirement in government projects

Governments can increase the adoption of ecolabels by incorporating them into the selection criteria for public projects through directives since voluntary ecolabels are not efficient



Set energy efficiency requirements and energy audits

Governments can enhance energy efficiency in the cement industry and reduce emissions by mandating specific energy performance requirements and regular energy audits, ensuring continuous improvement



Introduce "environmental permits" to enforce industry-wide compliance

Introduction of "environmental permits" can enforce strict compliance with best-in-class environmental practices; however, clear guidelines and criteria must be established beforehand to ensure effectiveness



Offer technical assistance to improve energy efficiency via gov't programs

Governments can play a more direct role in helping cement producers optimize their environmental practices by providing technical assistance, tools, and resources through dedicated optional programs



Explore C&D waste management mandates

Various C&D waste management mandates can be explored to effectively promote concrete recycling – landfill taxes/ bans could be particularly effective

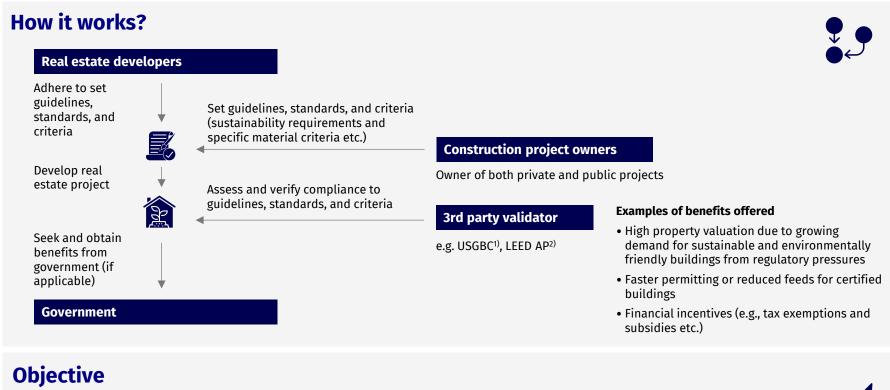


2.3 Demand-side regulatory measures - Green building standards & certification systems



Green building standards & certification systems create market incentives for developers and construction companies to use more sustainable materials

Overview: Green building standards & certification systems



Benefits

- Increased demand: Promotes the use of sustainable materials and lowcarbon products in construction projects
- Long-term savings: Energy-efficient buildings lead to lower operational costs over time, benefiting building owners

To promote sustainable construction practices, drive innovation in low-carbon technologies, and encourage the adoption of environmentally-friendly materials by influencing industry standards and building practices voluntarily





Source: Roland Berger



Use of low-carbon cement & recycled concrete and construction waste management are often key criteria for qualifying for green building certifications

Selected examples of green building standards & certification systems

Issuer	GBEL ¹⁾ 3-Star China's national green building certification system Ministry of Housing and Urban-Rural	BREEAM ²⁾ Europe's leading green building certification system Building Research Establishment	LEED ³⁾ US-originated green building certification with regional adaptation Canada Green Building Council	US-originated green building certification (globally accepted) U.S. Green Building Council (USGBC)	EDGE ⁴⁾ Global green building certification system developed by the IFC International Finance Corporation
issuei	Development (MoHURD)	(BRE)	(CaGBC)	0.5. Green building council (050bc)	(IFC)
Examples of low- carbon cement/ concrete criteria ⁵⁾	 10% of total weight of construction materials used shall be recycled Use locally produced low carbon cement (sourced within 500 km of site) 	Use life-cycle assessment to measure the impact of construction materials and calculates a score using BREEAM's tool	 Use of low-carbon cement/concrete products with 3rd party verified EPDs⁵⁾ Use of lower-carbon concrete made with recycled content, or cement alternatives in new construction projects Use life-cycle assessment to evaluate the environmental impacts of materials 	 Use of low-carbon cement/concrete products with 3rd party verified EPDs⁵⁾ Use of lower-carbon concrete made with recycled content, or cement alternatives in new construction projects Use life-cycle assessment to evaluate the environmental impacts of materials 	Use concrete with >30% pulverized fuel ash ⁶⁾ (PFA) content as a supplementary cementitious material (SCM)
Impact highlights	 Approximately 50 m tons of CO2e reduction from certified buildings as of 2022 Certification applied to over 800 m sq m. by 2023 	 50-60% energy usage reduction compared to typical buildings in 2021 30% reduction in carbon emissions in certified building in 2021 	 1.5 m tons of CO₂ reduction annually Generate operational energy savings of over CAD 200 m annually across buildings 	in 2022	 16,209 tons of CO₂ reduction annually as of 2022 Average energy consumption in certified projects lowered by 25%, water use by 22%, and waste by 20%
	Selected deep-dive i	n subsequent slides		Selected deep-dive in subsequent slides	

¹⁾ Green Building Evaluation Label; 2) Building Research Establishment Environmental Assessment Method; 3) Leadership in Energy and Environmental Design; 4) Excellence in Design for Greater Efficiencies; 5) Environmental Product Declarations; 6) Byproduct of burning pulverized coal in power plants - commonly used as a supplementary cementitious material (SCM) in concrete mixes

subsequent slides



Case study: China 3-Star certification issued by the Ministry of Housing promotes the use of locally produced low-carbon cement and recycled concrete

Green Building Evaluation Label 3-Star Certification (China)



Key criteria - selected examples

Points are earned based achievements of specified criteria – certain criteria recognize the use of low-carbon cement/ concrete products and construction waste management:

Low-carbon cement and concrete usage

- 10% of total weight of construction materials used shall be recycled
- Use locally produced low carbon cement (e.g., geopolymer cement)



*Low-carbon cement and concrete definition not clearly defined

Construction waste management



- Establish a construction waste diversion plan
- Develop a waste tracking system that measures and reports the amount of construction waste generated, recycled, and diverted

Validators



Ministry of Housing and Urban-Rural Development (MoHURD)

Benefits for project developers

Benefits depend on the level of certification achieved



Local subsidies (varies by region): offer direct financial subsidies of up to 10% of project construction costs



Floor Area Ratio (FAR) bonus: 3-5% FAR bonus, allow developers to increase usable space



Corporate tax: up to 15% CIT reduction under policies supporting environmentally-friendly construction



Utility incentives: discounts on electricity and water tariffs for achieving specified level



Green Financing Program: qualify for green loans at preferential interest rates offered by Chinese financial institutions

Impacts

- Approximately 50 m tons of CO2e reduction as of 2022
- 20-40% reduction in water consumption
- Reduced indoor pollutants by up to 50%
- Incorporate up to 30% recycled building materials e.g. green cement, fly ash concrete

¹⁾ China's National Building Energy Code; 2) Includes efficient irrigation systems, reduced turf areas, mulching, etc.

Case study: BREEAM uses the LCA¹⁾ approach to assess the environmental impacts of building materials, ensuring accurate and fair emissions calculations

BREEAM Certification (EU)





Life cycle assessment (LCA)

- LCA takes a lifetime perspective of a product, from raw material to final disposal
- LCA can both measure a building's lifetime impacts and quantify the impact of a single material in the building
- LCA covers the calculation of GHG emissions, ozone depletion, eutrophication, impact on human health, etc.
- Results obtained via LCA underpinned by ISO 14040 and ISO 14044
- Fair assessment:
 - Prevent greenwashing by full lifecycle data
 - Requires documented methodologies for peer review
 - Standardized metrics allow equitable material comparisons

Examples of BREEAM LCA requirements:

- Projects must conduct a whole-building LCA
- LCA evaluates air pollution impacts across the supply chain for material selection
- Projects using low embodied energy materials (identified by LCA) gain credits

Source: BREEAM, Roland Berger



Case study: LEED¹⁾ in the US promotes use of low-carbon cement and concrete products with verified EPDs¹⁾ and construction waste management activities

LEED¹⁾ Certification (United States)



Key criteria – selected examples

Points are earned based achievements of specified criteria – certain criteria recognize the use of low-carbon cement/ concrete products and construction waste management:

Low-carbon cement and concrete usage





*Low-carbon cement and concrete definition not clearly defined





- Develop and implement a construction and demolition waste management plan
- Provide dedicated areas accessible to waste haulers and building occupants for the collection and storage of recyclable materials





- Require projects to achieve at least a 10% reduction in global warming potential (GWP) compared to a baseline building
- Cover the building's structure and enclosure from design to demolition

Validators



USGBC²⁾ (Primary validator)



LEED AP³⁾
(Conduct independent building performance reviews)

Benefits for project developers

Benefits depend on the level of certification achieved



Tax credits: certified projects can claim up to USD 5 per sq ft. in tax deductions



State tax rebate (varies by region): CIT rebate up to 10% of project cost (New York), property tax credits from 25-100% depends on the certification level (Maryland), etc.



Floor Area Ratio (FAR) bonus: up to 10% FAR bonus for certain cities e.g., San Francisco, Seattle



Permitting fees waive: some cities waive permitting fees or reduce by 25-50%



Grants and funding: LEED-certified projects qualify for green bonds/low-interest loans (e.g., Massachusetts provides up to USD 150k in state grants)

Impacts

- ullet 200 m tons of $\mathrm{CO}_2\mathrm{e}$ reduction from certified buildings from 2000 2023
- Saved 7.4 bn gallons of water annually as of 2020
- 150,000 MWh energy reduction from 27 m sq ft. certified space
- 80% of construction waste is diverted from landfills in LEED-certified projects
- 20-30% localized temperature reduction

¹⁾ Environmental Product Declarations; 2) U.S. Green Building Council (USGBC); 3) LEED Accredited Professional; 4) Life-Cycle Assessment (LCA)



Green building requirements are mandated for public sector projects in some countries, with governments setting an example to promote broader adoption

Examples of mandatory green building requirements for public sector projects



GBEL¹⁾ 3-Star

China's national green building certification system



BREEAM²⁾

Europe's leading green building certification system



LEED3)

US-originated green building certification with regional adaptation



LEED3)

US-originated green building certification (globally accepted)



EDGE⁴⁾

Global green building certification system developed by the IFC



- 1 China Green Building Action Plan 2013
- 2 Shenzhen Green Building Regulation 2022
- Construction Strategy and the Sustainable Operations on the Government Estate (SOGE) mandates
- British Columbia Government Announcement 2008
- Green Building Standards Code

- Scope
- Nation-wide
- 2 State-wide

Nation-wide

State-wide

· State-wide

Minimum requirement

- Buildings that are invested by the government, e.g., schools, hospitals
- Affordable apartment in some cities
- 1 Public buildings over 20,000 sq m
- 2 All new buildings in Shenzhen must attain at least 1-Star rating
- UK: requires BREEAM for public buildings, and buildings that require significant government funding
- British Columbia: requires new public buildings achieve LEED Gold or equivalent certification
- New Mexico: requires new public buildings over 15,000 sq ft or electrical demand over 50 kW achieve LEED Silver

None

¹⁾ Green Building Evaluation Label; 2) Building Research Establishment Environmental Assessment Method; 3) Leadership in Energy and Environmental Design; 4) Excellence in Design for Greater Efficiencies



Meanwhile, appealing financial incentives (e.g., tax credits & exemptions) are used to encourage private sector participation in these certification programs

Examples of financial incentives offered through green building standards & certification systems



GBEL¹⁾ 3-Star

China's national green building certification system



BREEAM²⁾

Europe's leading green building certification system



LEED3)

US-originated green building certification with regional adaptation



LEED3)

US-originated green building certification (globally accepted)



EDGE⁴⁾

Global green building certification system developed by the IFC



• CIT⁵⁾ discounts up to 15%

 VAT⁶ reductions up to 5-10% in green-focused member states

• 10-15% property tax credits in Ontario

- Federal 179D tax deductions of USD 1.88-5 per sq ft. based on energy performance
- Property tax credits from 25-100%⁷⁾ in Maryland
- 5-10% property tax reductions in Mexico City and Guadalajara

Subsidies & grants

- Local subsidies up to 10% of project cost
- Discounts on electricity and water tariffs for achieving specified level
- Grants covering up to EUR 2 m per project

 State grants covering 10-20% of project costs

Low-interest loans

- Qualify for green loans at preferential interest rates
- Qualify for 2-3% low-interest loans

 Qualify for loan programs with partner bank - preferential interest rates from HSBC Mexico

Permit

- Accelerate permitting process up to 6 months of reduced timelines in Alberta
- 25-50% permitting fees waived in certain cities

FAR8) bonus

• 3-5% increase for qualified projects

• Up to 10% increase for San Francisco, Seattle, etc.

¹⁾ Green Building Evaluation Label; 2) Building Research Establishment Environmental Assessment Method; 3) Leadership in Energy and Environmental Design; 4) Excellence in Design for Greater Efficiencies; 5) Corporate Income Tax; 6) Value Added Tax; 7) Credits range depends on certification level; 8) Floor Area Ratio – Ratio of a building's total floor area (gross floor area) to the size of the piece of land upon which it is built



Many players in SEA also adopt similar green building standards & certification systems, with specific criteria for the use of low-carbon cement and concrete

Selected examples of green building standards & certification systems in SEA



LOTUS Rating System



Greenship
Rating System





Green Building Index





Green Mark Certification





Thai's Rating of
Energy and
Environmental
Sustainability (TREES)

Issuer

 Vietnam Green Building Council (VGBC) Green Building Council Indonesia (GBCI) Green Building Index Sdn Bhd (joint initiative by the Malaysian Institute of Architects (PAM) and Association of Consulting Engineers Malaysia (ACEM)

 Building and Construction Authority of Singapore (BCA)

 Thai Green Building Institute (TGBI)

Examples of low-carbon cement/concrete criteria

- Encourages the use of sustainable materials and implement strategies that minimize the use of concrete in buildings
- Examples: MR-1 credit points are awarded for strategies that reduce concrete in slabs, beams/columns, and nonstructural systems
- Use of materials with recycled content to reduce the need for new raw materials
- -To earn the maximum points for this criterion: where reused products/materials constitute ≥ 5% of the project's total material cost value
- Use of materials with recycled content to reduce the need for new raw materials
- -To earn the maximum points for this criterion: where reused products/materials constitute ≥ 5% of the project's total material cost value
- Similar criteria apply to both Indonesia and Malaysia

- Projects must use low carbon concrete certified by the Singapore Green Building Council (SGBC) or equivalent local certification bodies
- This concrete should utilize
 CEM II to V cements as per SS
 EN 197-1 standards for at least 80% of applicable superstructure works by volume
- Low environmental impact materials required: TREES mandates materials with minimal environmental impact
- Definition: Efficient production and short transportation distances are key factors
- Examples: Reused materials (5-10%), Green/Carbon labeled materials (10-20%)



Summary of key findings:

Green building standards & certification systems



What are green building standards & certification systems and how do they help drive emissions reduction?

Green building standards & certification systems incentivize the use of sustainable materials and low-carbon products in construction projects, promoting energy-efficient buildings that reduce operational costs over time. These systems help drive emissions reduction by encouraging the adoption of low-carbon technologies, recycled concrete, and efficient construction waste management, influencing industry standards and voluntary building practices.



Among the selected countries, which countries have green building standards & certification systems?

All the benchmarked countries have green building standards & certification systems:

- China: GBEL 3-Star
- EU: BREEAM
- US & Canada: LEED
- Mexico: Excellence in Design for Greater Efficiencies



What are the typical criteria to qualify for these certificates?

- Use of low-carbon cement, recycled concrete, and efficient construction waste management, for example:
- LEED: Low-carbon concrete with third-party verified Environmental Product Declarations (EPDs) and recycled content
- BREEAM: Life-cycle assessment (LCA) approach



What are the key benefits for project developers?

- Tax credits, exemptions, subsidies, and grants
- Access to low-interest loans
- Accelerated permit timelines and floor area ratio bonuses
- Encourages private sector participation in green building programs



Which entities are accountable for these green building standards & certification systems?

Green building councils or institutes (non-profit organizations) often manage green building standards and certification programs. In certain cases, such as in China, the Ministry of Housing is responsible for these programs.

Source: Roland Berger



Key learnings and success factors:

Green building standards & certification systems



Specify low-carbon cement and recycled concrete usage as criteria

Minimum use of low-carbon cement and recycled concrete in structural components can be set voluntarily as key criteria in green building certifications to promote use of environmentally friendly products



Specify EPD¹⁾ and LCA²⁾ for evaluating low-carbon construction products

EPDs and LCAs are vital tools for accurately assessing the environmental impact of low-carbon construction products – both should be used in certifying low-carbon products under green building standards



Balance emission reduction ambitions with practical and measurable metrics

Criteria for green building certifications should be ambitious yet realistic and achievable (e.g., use of 10-20% recycled concrete etc.)



Offer appealing financial incentives to promote voluntary participation

Certified projects and buildings should be well-rewarded to promote further adoption by government – financial incentives such as access to low-interest loans and floor-area-ratio bonuses can be offered



Establish mandatory green building requirements for public sector projects

Governments should lead by example, mandating green building certifications for all new public sector buildings and retrofits

1) Environmental Product Declaration; 2) Life Cycle Assessment - method for evaluating the environmental impacts of a product or process over its entire life cycle

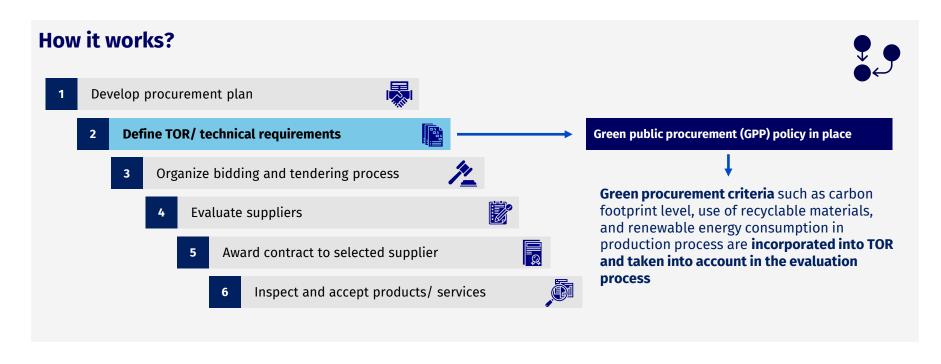


2.4 Demand-side regulatory measures - Green public procurement (GPP)

2

Green public procurement (GPP) plan is used by gov't and public authorities to promote the use of green products through their purchasing decisions

Overview: Green public procurement (GPP)



Benefits

- **Standard-setting:** Create demand and encourage industries to adopt green production to meet the criteria
- Creates market signals: Attract investment and drive competition to produce low-carbon products

Objective

To **leverage government purchasing power to create demand for low-carbon cement** and sustainable construction practices, driving the market towards innovation, emission reduction, and the adoption of environmentally friendly technologies









GPP is important and has been promoted at the international-level; a key example is the IDDI¹⁾ Green Public Procurement Pledge

IDDI¹⁾ Green Public Procurement

Industrial Deep Decarbonization Initiative (IDDI)



A global initiative led by UNIDO²⁾ to achieve decarbonization in cement/concrete and steel sectors by stimulating the demand for low carbon cement/concrete and steel

Main goals:

- Leveraging public procurement commitments to create early markets for low-emission products (starting with steel, cement and concrete)
- Working to harmonize emissions accounting and definitions for low/near zero emission products (including cement and concrete) needed for procurement, product regulations and other trade policies

IDDI launched the GPP Pledge in 2022

5 countries has already declared their GPP Pledge in driving the global decarbonization of cement and steel sectors by creating a market demand for low and near zero emission public procurement





Canada





Germany

UAE

Levels of pledge

Level 1

Starting 2025, require disclosure of the embodied carbon in cement/concrete and steel procured for public construction project

Level 2

Starting 2030, conduct whole project life cycle assessment for all public construction projects, and by 2025, achieve net zero in all public construction projects

Level 3

Starting 2030, require procurement of low emission cement/concrete and steel in public construction projects

Level 4

UK

Starting 2030, require procurement of a share of cement and/or crude steel from near zero emission material production for signature projects

IDDI's key outputs related with GPP



Procurement guidelines for government agencies



Best practices and examples from leading governments



Quantification of potential emissions savings of pledge makers, and associated methodology



Guidance on creating interoperable standards and definitions for low- and near-zero emission materials

Source: IDDI, Roland Berger

¹⁾ Industrial Deep Decarbonization Initiative; 2) United Nations Industrial Development Organization



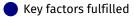
There are 6 key success factors for ensuring effective implementation of GPP for cement and concrete products - US and Canada excel in all these criteria

GPP performance across key success factors in benchmarked countries (cement and concrete)

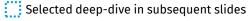
Key success factors:	US ¹⁾	Canada	EU	China	*	Mexico ²⁾	
Standard definition of low-carbon cement and concrete	Standards for defining low- carbon concrete	Standards for defining low-carbon concrete	There is no overarching mandate for the entire	Technical standard for ready-mixed concrete	•	N/A	
Carbon measurement transparency	Standards for measuring and verifying embodied carbon data	Standards for embodied carbon measurement and life cycle assessment	EU specifically covering cement and concrete However, several individual EU member	N/A		N/A	
Established guidelines on procurement process	Green purchasing requirements and database are available as a guideline	Legally-approved procurement document standard and evaluation basis available	states have implemented mandatory GPP policies	Procurement & evaluation process guideline are availab	le	N/A	
Dedicated funding to accelerate green procurement activities	USD 4.5 bn total funding allocated	USD 350,000 ³⁾ per year funding allocated		N/A		N/A	
Mandatory implementation	Mandatory for all public authorities, but with specific criteria	Mandatory for all public authorities, but with specific criteria	Mandatory for construction products sold in the EU ⁵⁾	Mandatory (in pilot stage)		N/A	
Provision of training & capability building assistance	Multiple training programs are available, including technical assistance	Multiple training programs and tools, such as LCA ⁴⁾ tools are available	GPP training toolkit is available	N/A		N/A	
Main entities responsible for GPP- related policies	≎EPA	Public Services and Procurement Canada	6)	 中华人民共和国国家发展和改革委员会 National Development and Reform Commission 国家市场监督管理总局 The Additional Section Section Section Section Section Section Section Section Sec		N/A	

Key

While Singapore, Thailand, and Indonesia have established GPP policies with varying degrees of mandatory implementation, other Southeast Asian countries are in the process of developing and promoting such policies



Key factors partially fulfilled
 Key factors not fulfilled



¹⁾ US policies may change depending on the strategic direction of the current administration; 2) Currently, no GPP for cement / concrete sector in Mexico; 3) CADUSD = 0.7 USD; 4) Life cycle assessment; 5) The EU's Construction Product Regulation (CPR), which covers cement and concrete, is mandatory for products sold in the EU and is also mandatory under GPP for EU member states; 6) Each national authority

Source: Roland Berger

Case study: The U.S. GPP mandates federal procurement, prioritizing sustainable materials aligned with EPA-recommended standards and ecolabels

United States - Green Public Procurement (GPP)¹⁾



U.S. GPP prioritizes sustainable procurement by enforcing EPArecognized standards and ecolabels, promoting life cycle environmental performance in federally funded projects



"U.S. Green Procurement Compilation (GPC)" provides federal agencies with a resource for sustainable procurement, emphasizing EPA²⁾ standards, ecolabels, and environmentally responsible products

Key Features³⁾



of emissions performance for federal contractors

- Mandatory disclosure Contractors with annual federal contracts over USD 50 m must disclose **GHG emissions** and climate-related financial risks
 - Those with USD 7.5-50 m in annual contracts must report Scope 1 and Scope 2 emissions



Mandatory lowcarbon cement/ concrete

• Priority is given to materials with the lowest global warming potential (GWP), starting with the top 20%, followed by the top 40%, and then above-average options



Use of **Supplementary Cementitious Materials (SCMs)**

- The EPA **recommends federal agencies** update their procurement programs for cement and concrete to include SCMs
- Coal fly ash, Ground granulated blast furnace slag (GGBF slag), Cenospheres, Silica fume



Certification Standards and Requirements

- Certification standards such as **ENERGY STAR and FEMP-designated** products are mandatory⁴⁾ for specific product categories under federal procurement guidelines
- Federal purchasing agencies must obtain EPDs⁵⁾ for cement used in federal projects

Key success factors

FEMP

- ✓ Low-Carbon Concrete Definition: Standard based on concrete compressive strength and types⁶⁾
 - E.g., GSA⁶⁾ set a target of 0.184 tons CO2e per ton of cement for low-carbon cement
- ✓ Carbon Measurement Transparency: Standard for measurement & verification of embodied carbon data
- Established guidelines: Clear tools and guidelines in the GPC outline green purchasing requirements, including those for cement and concrete
- ✓ Mandatory Criteria: Mandatory criteria for green procurement as **evaluation basis** for contractor
- ✓ Funding Support: The USD 4.5 bn for GSA⁷⁾ projects is funded by the U.S. federal government, benefiting contractors and material suppliers
- ✓ Training & Tools: Various training & tools are given to procurement officers, such as training programs for federal buyer & contracting officers on green procurement

¹⁾ US policies may change depending on the strategic direction of the current administration; 2) Environmental Protection Agency; 3) All mandatory requirements apply to government projects; 4) Exceptions to this mandate apply if the product category is not covered by ENERGY STAR or FEMP; 5) Environmental Product Declarations; 6) Include standard-mix, high early strength, and lightweight concrete, measured in kg CO₂e/m³; 7) General Services Administration

Case study: Canada's GPP requires government construction projects to set emission reduction targets to promote continuous improvements

Canada – Green Public Procurement (GPP)



Canada's GPP integrates environmental criteria, emphasizing low-carbon materials like cement and concrete in public infrastructure procurement



Canada's government GPP to support & prioritized low-carbon cement/concrete in Canadian infrastructure projects

Key Features1)



Standard of disclosure of emissions performance for all suppliers

- Starting in 2023, suppliers for Canadian government construction projects
 VSD 17 m²) are mandated to disclose their GHG emissions
- including embodied carbon from concrete (i.e., the carbon emissions generated during the production of concrete for the project are considered)



Standard of embodied carbon in construction

 Organizations are required to disclose and reduce the carbon footprint of concrete for projects exceeding USD 3 m²), secure the Embodied Carbon Disclosure Template³) before project completion, and submit a verified LCA⁴) report if EPDs⁵) are unavailable



Mandatory lowcarbon cement/ concrete The government mandates projects use concrete with at least 10% lower carbon emissions than the regional average



Mandatory emission reduction targetsetting

- As part of the emissions disclosure initiative, Canadian government construction projects are also required to set emission reduction targets
 - A 30% reduction in embodied carbon, beginning in 2025, is planned under the Buy Clean Strategy, which builds on the Greening Government Strategy (GGS)⁶⁾

Key success factors

- ✓ Low-Carbon Concrete Definition: Standards defining low-carbon concrete for construction use
- ✓ Carbon Measurement Transparency: Standard for embodied carbon measurement in construction projects and national whole-building life cycle assessment
- ✓ Established guidelines: Standardized, legallyapproved green procurement documents
- ✓ Mandatory Criteria: Mandatory criteria for green procurement as evaluation basis for contractor
- ✓ Funding Support: GPP funds ~USD 350,000 per year²) for the Buyers for Climate Action program to accelerate green procurement, funded by Canada's federal government
- ✓ Training & Tools: Various training & tools are given to procurement officers, such as Green Procurement Micro-Credential program and LCA⁴) tools

¹⁾ All mandatory requirements apply to government projects; 2) CADUSD = 0.69 USD; 3) a standardized document used to report the amount of GHG emissions associated with the materials and construction processes used in a building project; 4) Life cycle assessment; 5) Environmental product declarations; 6) a Cabinet Directive and the established policy framework guiding low-carbon procurement and government operations



Case study: While most EU member states recognize the importance of GPP in achieving climate goals, few binding requirements exist to compel its adoption

EU – Green Public Procurement (GPP) (covers cement and concrete sector) (1/2)

Countries without mandatory GPP (voluntary or no GPP)





Countries with mandatory GPP

European Commission estimates that about one-third of Member States have introduced legal obligations to consider environmental impact for specific product groups if the contract value is above a certain threshold¹⁾

GPP mandatory in EU's member states (country-level)²⁾ Overview EU members1) **Mandatory GPP in cement/concrete** Mandatory GPP GPP in the EU Mandates require public projects to: is **voluntary** • use concrete with min. 30% clinker to date: substitution member • do Whole life-cycle GHG emissions states can determine As part of IDDI, key mandates: the extent to • federal buildings to meet certain which sustainable building standards, incl. GER policies or cement/concrete criteria are • life cycle assessment applied

Key takeaways

- EU's GPP implementation in the cement/concrete sector remains low. primarily due to its voluntary nature, as reported by Bellona and OECD
- Bellona. an international environmental NGO, advocates for mandatory GPP
- An OECD survey²⁾ found most countries agree that a **mandatory** aspect is needed to boost GPP uptake

Source: European Commission, OECD, Roland Berger 90

¹⁾ According to European Commission, 2021e; 2) Based on OECD (Organization for Economic Co-operation and Development) survey in 2022 for 38 countries, the majority are EU member states, adjustment applied

Case study: The CO₂ Performance Ladder provides a bidding advantage to low-carbon products, leveling the playing field despite higher production costs

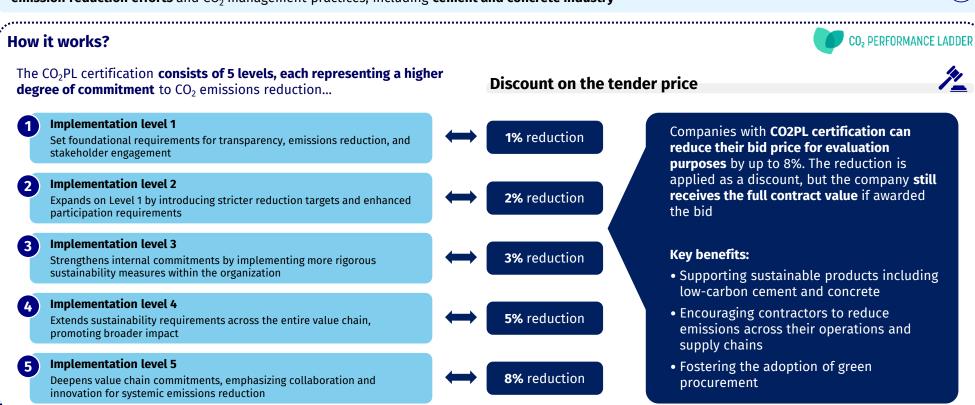
The Netherlands - the CO₂ Performance Ladder (CO₂PL)



CO₂ Performance Ladder (CO2PL)

A green procurement tool in the Netherlands that offers companies an opportunity to receive up to 8% award advantage in tenders based on their emission reduction efforts and CO₂ management practices, including cement and concrete industry





Key takeaways

- Integrating the CO₂ Performance Ladder with Green Public Procurement (GPP) fosters a more competitive market for low-carbon cement and concrete, ensuring that they can compete fairly with traditional materials despite higher cost of production
- The Ladder incentivizes contractors to adopt sustainable practices. aligning procurement processes with climate objectives and driving emissions reductions

Source: SKAO, Roland Berger

Summary of key findings:

Green public procurement (GPP)



What is green public procurement (GPP) and how does it help drive emissions reduction?

Green procurement is the **practice of buying goods and services that have a reduced environmental impact throughout their life cycle.** GPP leverages government purchasing power to drive demand for low-carbon cement and sustainable construction by:

- Including embodied emissions limits for public construction projects and/or specific materials in procurement policies and net zero government strategies
- Implementing limits by including environmental criteria—such as carbon footprint requirements, recyclable materials, and renewable energy use—into technical requirements (TOR) and evaluation processes
- Joining international pledges such as IDDI GPP Pledge



Among the selected countries, which countries have implemented GPP?

- Mandatory GPP:
- U.S. & Canada Require public authorities to prioritize low-emission materials based on defined criteria
- China Implementing a mandatory GPP framework at the pilot stage
- Partial/Voluntary GPP:
- EU No overarching mandate for cement and concrete, but several member states enforce mandatory GPP policies
- No GPP for Cement & Concrete:
- Mexico No specific policies in place



What are the key success factors for ensuring effective implementation of GPP for cement and concrete products?

Effective GPP implementation requires clear requirements, transparent emissions measurement based on established standards, guidelines for practitioners, and dedicated resources and funding. Particularly, mandatory policies drive adoption and ensure compliance across all government projects. Additionally, training and defined roles for key entities further support market participation and effective execution.



Which government entities are accountable for the implementation of GPP?

- All government ministries that own real property Typically responsible for following GPP policies as they pertain to construction projects
- Inter-ministerial committees Oversee GPP policy development and implementation, typically involving ministries of finance and environment
- Procurement agencies Manage policy guidance, purchasing processes, and compliance enforcement



Key learnings and success factors: Green public procurement (GPP)



Define low-carbon cement and concrete

Establish a standardized definition of low-carbon cement and concrete to guide the industry in identifying and differentiating low-carbon products



Specify emission measurement standards

Common emission measurement standards such as those for measurement of embodied emissions and life-cycle assessment are essential for project owners and contractors to measure their baseline condition and for suppliers to demonstrate they can provide low-emission cement and concrete to meet procurement requirements



Establish standard evaluation process and procurement tools

Standardized green products criteria and requirements are important to ensure consistency, complemented with various procurement tools such as database, legal procurement documents, etc



Allocate funding and address the price-only approach

As the lowest price criteria often limits the adoption of green products, GPP policy (e.g., reforms to the procurement process, such as allowing for green premiums) could address this by offering both financial (e.g., dedicated funding, performance bonuses) and non-financial incentives (e.g., green certification) for suppliers



Execute GPP as mandatory with stage-wise implementation

GPP should be mandatory to optimally drive low emission product demand. This requires commitments set in the green procurement policy or greening or net zero government strategy, followed through with procedures for procurement teams. Mandatory requirements should be established based on robust consultation with the local supply chain and should be introduced gradually. They should give advance notice to suppliers and can be applied to a sub-section of projects to start, either by ministry, or project size or value, and then expanded over time



Facilitate training & capability building program

Government should communicate the GPP policy and ensure uniform understanding across multiple public-private procurers by setting up a training program and technical assistance committee



2.5 Direct funding - Subsidies, grants, and direct investments

2

Governments provide direct funding to businesses to incentivize and support their efforts in implementing initiatives that reduce emissions

Overview: Subsidies, grants, and direct investments

How it works?





Funds dedicated from the national budget for green initiatives



Carbon revenue generation

Funding from carbon pricing instruments, including Emissions Trading Systems (ETS), carbon credit sales, and carbon taxes



Funding approach



Grants

Non-repayable funds for specific projects or technologies



Subsidies

Financial aid to reduce costs for adopting energy-efficient and low-carbon technologies



Government

Direct investments

Gov't investments in businesses focused on decarbonization, often as equity stakes

Fu m

Funding allocation mechanism

Funding criteria to set to allocate the funds effectively

- Sustainability
- Economic benefits
- Public and social benefits
- Technological benefits
- Policy compliance
- Monitoring and reporting

iv Areas of funding

- Renewable energy
 E.g., Wind and solar projects
- R&D

E.g., New low-carbon technologies

- Low-carbon technologies
 E.g., Energy-efficient building
 materials
- Emission reduction projects
 E.g., CCUS technology
- Others¹⁾

E.g., Regulatory incentives for businesses



Funding accountability



Regulatory steering committee function



Implementation & administration function



Advisory function

Objective

To create a foundation for industries to adopt decarbonization practices at scale by **removing operational barriers, lowering costs for companies** transitioning to green technologies



Benefits

- **Reduces financial barriers**: Lowers costs for companies adopting green technologies
- Market confidence: Public spending signals market confidence and attracts private funding

Source: Roland Berger

¹⁾ Funding may also support infrastructure, regulatory frameworks, and incentives that enable decarbonization across sectors



Two common sources of funding to drive emissions reduction in the cement & concrete sector are national budget allocations and carbon revenue generation

Overview of government funding sources for emissions reduction projects

Typical government funding source based on benchmark

1

National budget allocation (green budget)

Description

Funding sourced directly from the national government's annual budget after legislative process and approval

Pros

- Stable and predictable: fixed timeline and amounts within the fiscal framework
- Flexibility: government can allocate budget for multiple sectors

Cons

- Budget competition: competes with other national priorities
- Political dependence: budgeting may fluctuate with political or economic changes

Key examples



US Industrial Demonstrations Program (IDP), source from:

- Federal budget through US Bipartisan Infrastructure Law and Inflation Reduction Act
- Budget: USD ~6.3 bn (since 2023)



Canada Strategic Innovation Fund (SIF), source from:

- Canadian federal budget
- Budget: USD ~12.83 bn¹⁾ (since 2017)

2

Carbon revenue generation

Funding sourced from revenues generated by carbon pricing instruments, including Emissions Trading Systems (ETS), the sale of carbon credits and carbon taxes

- Self-sustaining: collect revenue from emission reduction, while at the same time incentivize for continuity
- Dedicated budget: focus only on emission reduction funding
- Implementation complexity: requires robust systems to monitor, collect, and allocate revenue effectively
- Volatile: specifically, for ETS, funding is dependent on the fluctuating carbon market and pricing



EU Innovation Fund, source from:

- EU ETS
- USD ~41 bn²⁾ (for 2020-2030)



China Clean Development Mechanism Fund, source from:

- Carbon credit
- Budget: USD 13.9 27.9 bn³⁾
 (annually)



Mexico Carbon Fund (terminated), source from:

- Carbon credit
- Budget: N/A⁴⁾

Deep-dive next slide

1) EURUSD = 1.04 USD; 2) CADUSD = 0.69 USD; 3) CNYUSD = 0.14 USD, The CCDMF aims to allocate about CNY 100 - 200 annually; 4) Not publicly disclosed

Source: Roland Berger

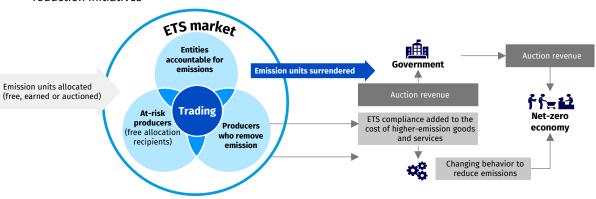
Funding from carbon pricing instruments, including ETS, carbon credit sales through offsetting schemes ...

Carbon revenue generation mechanisms (1/2)

Auction proceeds in an **Emission Trading Systems (ETS)**

How it works?

- Government generates revenue by auctioning emission allowances, which companies purchase to cover their emissions
- This revenue can be allocated to support a net-zero economy, including funding various emission reduction initiatives



Key example

EU generated **EUR 33 bn** in 2023 from ETS auctions, and regulates all ETS revenue must be spent on climate and energy related actions. including to fund the EU **Innovation Fund**

Other countries (Selective):

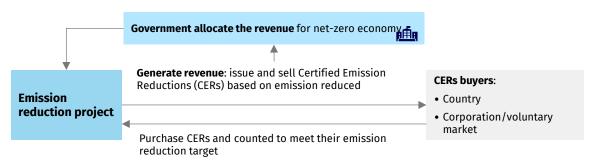








Sales of carbon credit through offsetting schemes



China, through the CCDMF¹⁾, collects a portion of the revenue generated from CERs²⁾ to **finance** emission reduction projects

Other countries (Selective):









Key takeaways

- Governments can secure funding by allocating revenue from carbon markets
- This approach is particularly effective in countries/regions with established carbon pricing instruments, creating a self-sustaining mechanism that incentivizes industry players in the long-term
- Government's role is crucial in determining sectoral allocation, demonstrating a strong commitment to emission reduction goals

¹⁾ China Clean Development Mechanism Fund (CCDMF); 2) Carbon credit sales (CERs)

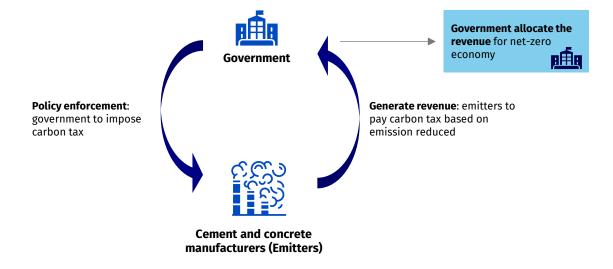
...and carbon taxes generate revenue for gov'ts, which can be leveraged to provide financial support to businesses to pursue emissions reduction initiatives

Carbon revenue generation mechanisms (2/2)

Carbon taxes

How it works?

- The government imposes a carbon tax on cement and concrete manufacturers based on the CO₂ **emissions** generated during production
- This tax increases the cost of high-emission cement, incentivizing companies to adopt lowcarbon alternatives, such as SCMs¹⁾, or CCUS technologies



Key examples

Sweden generated USD 2.3 **bn**²⁾ (2019) from carbon tax. allocated to the general budget for climate policies and industry transition, including biofuels for cement production

Other countries (Selective):









Key takeaways

- · Governments generate significant revenue through carbon taxes, which can be reinvested into green **projects**, like low-carbon cement production
- The government's role in setting and adjusting tax rates, as well as determining sectoral allocations, is vital in driving national climate action





Grants, subsidies, and direct investments are the primary forms of direct funding provided by governments, usually through dedicated funds

Main types of funding

	1 Grants	2 Subsidies	3 Direct Investments
Definition:	Non-repayable financial assistance for specific projects	Financial support to lower costs or make activities more competitive	Capital provided, often in exchange for ownership or a return on investment
Repayment requirement:	Not required	Not required, but may have conditions	Typically expected, through returns or equity
Purpose:	To fund specific projects or initiatives (e.g., research, development)	To reduce costs for companies or consumers to encourage specific behaviors (e.g., low-carbon tech. such as CCUS)	To finance a project or company in exchange for equity or returns
Conditions:	Project-specific conditions (e.g., emissions reduction targets)	Cost reduction or specific economic behaviors	May involve ownership, equity stake, or a financial return
Focus:	Innovation, research, or specific initiatives	Cost reduction or competitiveness	Long-term involvement and potential for profit
Examples:	US: USD 20 bn in grant awards under two competitions, including the National Clean Investment Fund and the Clean Communities Investment Accelerator	US: The 45Q and 48C tax credits implemented to advance cement carbon capture projects	Canada: SIF funding ¹⁾ (~USD 104.2 m ²⁾) supports Lafarge Canada's CCU project, reducing emissions by injecting CO ₂ into cement and improving properties

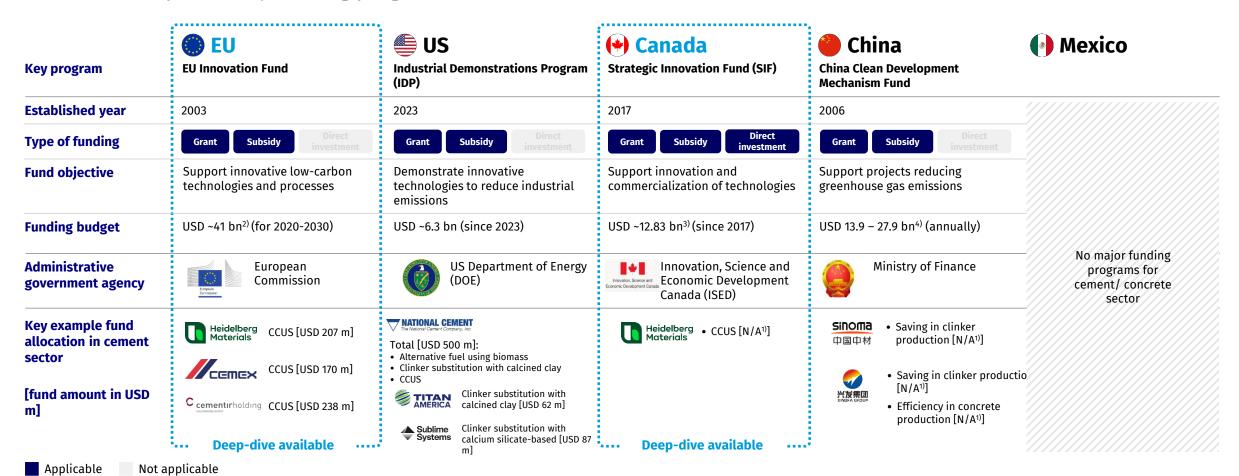


Government direct funding is usually executed via dedicated financial funds

¹⁾ Strategic Innovation Fund (SIF); 2) CADUSD = 0.69 USD

Dedicated funds are established to support the development and deployment of low-carbon technologies and projects that contribute to emissions reduction

Selected examples of key funding programs in benchmarked countries



¹⁾ Not publicly disclosed; 2) EURUSD = 1.04 USD; 3) CADUSD = 0.69 USD; 4) CNYUSD = 0.14 USD, The CCDMF aims to allocate about CNY 100 - 200 annually

5

Case study: EU Innovation Fund adheres to milestone-based financing, ensuring funded-projects are progressing on-track and achieving the desired outcomes

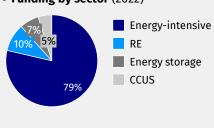
EU Innovation Fund

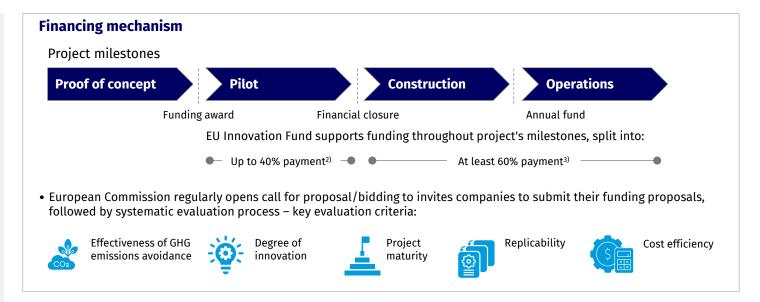


Overview

EU Innovation Fund is one of the world's largest funding program for the deployment of net-zero and innovative technologies

- Objectives:
- help businesses invest in clean energy & technology
- boost economic growth
- create future-proof jobs
- reinforce EU technological leadership on a global scale
- Funding budget: USD ~41 bn¹) (for 2020-2030)
- Funding by sector (2022)





Selected case study¹⁾

2023 outcome:

USD 5.2 bn funding value

85 projects awarded out of 337 total applications



Heidelberg • USD 207 m funded for Heidelberg's GeZero **Materials** project – CCS development in Germany



• USD 170 m funded for Cemex & Linde- CCS development in Germany



 EUR 238 m funded for Cementir Holding & Air Liquide – CCS development in Denmark Most recent subsidies & grants in the cement sector focus on **CCS projects**, aligning with the EU's priority in this program

Key takeaways

Offering end-to-end funding throughout project milestones, along with a rigorous evaluation process, is crucial for attracting industry leaders and ensuring successful implementation, as proven by the active participation of leading cement players (e.g., Heidelberg Materials, Cemex, Cementir Holding etc.)

1) EURUSD = 1.08 USD; 2) Not-depending on verified emissions avoidance; 3) Depending on verified emissions avoidance

Case study: Canada defines priority sectors for investment by aligning them with the country's 2030 Emission Reduction Plan and Net-Zero 2050 goals

Canada Strategic Innovation Fund (SIF)



Overview

SIF is a multi-sector funding instrument by the government of Canada to support innovative projects

- Founded: 2017
- Administrator: ISED¹⁾
- Total SIF investment2): USD 6.6 bn³⁾, 129 projects
- Budget source: Canadian federal budget
- Key features:
- Wide sector coverage for Canada's economic growth
- Single funding program with streamlined process
- Provides advisory services/assistance

Funding structure

Objective

To support Canada's emission reduction by 40-45% by 2030, and net zero by 2050

Funding priority⁴⁾







Net zero accelerator

Critical minerals

Biomanufacturing and Life Sciences

Pillars in netzero accelerator

Decarbonization of large emitters

Key sectors:

- Oil and gas
- Heavy industries (cement, steel, aluminum mining, minerals, chemicals)

Industrial transformation

Key sectors:

- Transportation Electricity
- Aerospace

Clean technology & battery ecosystem development

Key sectors:

- CCUS
- Hydrogen
- Battery/ EV

All key sectors align with Canada's 2030 Emissions Reduction Plan and Net-zero 2050

Funding example



• Heidelberg's Edmonton plant secured funding from the Canadian federal government for a CCUS project involving a ~USD 1 bn investment to capture 1 m tons of CO₂ annually

Key takeaways

- A centralized investment policy or program targeting multiple sectors offers a streamlined process for industry players -However, clear priorities and scope must be defined
- To determine which sectors to fund, the government should align its decisions with the country's climate action plan, which reflects the unique sectoral emissions profile of each nation

Source: Government of Canada, Roland Berger 102

¹⁾ Innovation, Science and Economic Development Canada; 2) As of April 2024; 3) CADUSD = 0.69 USD; 4) Remains committed to supporting excellence in innovation across all sectors of the economy

Budgeting process for emission reduction funds follows a 3-step approach: policy review and forecast, budget detailing & planning, and continuous MRV²⁾

Deep dive on national budget allocation based on UNDP¹⁾ guideline

Budgeting (focus area) Budget sources collection **Budget allocation** Related to government's national tax/duties collection How to set up budget for emission reduction fund (green budget) in the national budget? **Pre-preparation Preparation Approval** Objective • Ensure alignment between country's Embed emission reduction consideration into • Ensure the **approved** budget aligns with emission reduction goals with overall fiscal national budget, ensuring sufficient priority with continuous monitoring & policies allocation based on priority evaluation • Prepare detail action plans and costing to • Engagement with legislative to secure **Key activities** Conduct emission reduction policy review inform budget allocation approval • Conduct forecast of emission reduction • Establish MRV²⁾ mechanism financial impact and cost of adaptation • **Prioritization** of programs/initiatives • Identify fiscal risk & opportunities • Design budget codes and tagging system to track emission reduction expenditures • Clear budget breakdown/components • Institutional structure with clear • Transparency and regular reporting, Key including audits and public disclosure coordination & accountability (typically lead requirements • Traceability through tagging and tracking by ministry of finance, consist of emission mechanism reduction policy bodies, central bank, and private experts)

Key takeaways

- 3 key steps to do budgeting for emission reduction fund at national-level:
- Pre-preparation: analytical work for policy review, impact-cost forecast, risk & opportunity mapping
- Preparation: detail out the budget with clear breakdown and tracking mechanism/tools
- Approval: engagement with legislative, establish MRV²⁾
- 3 key factors for successful budgeting:
- Define clear roles, responsibilities, and coordination in the institution
- Detail, forecast-driven, traceable
- Implement continuous MRV²⁾

¹⁾ United Nations Development Programme; 2) Monitoring, Reporting, Verification

5

Funding criteria aim to maximize impact through emission reductions, innovation, economic growth, social benefits, and policy alignment for sustainability

Key funding criteria observed in major funds



Key takeaways

 Major funding criteria focus on multiple impact areas, with emission reduction potential as a key factor, alongside other considerations such as economic growth (e.g., job creation, investment) and social benefits (e.g., community development)





5

Case study: Gradual direct funding from study-to-implementation are crucial for the government to assess the feasibility and scalability of tech, through PPP¹⁾

Example of CCUS investment in Norway - Brevik CCS (Longship project)

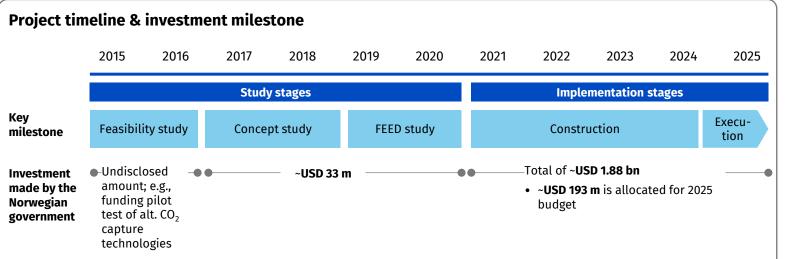


Overview _

The Longship project, Europe's first complete value chain CCS, aims to achieve net-zero cement production. It encompasses CO₂ capture, followed by transport, injection, and storage 2,600 meters below the North Sea seabed

- Location: Norway
- Project owner: Heidelberg
- Plant capacity: 1.3 m tons cement/ year
- **Status:** mechanical complete in Dec 2024, planned testing and operations in 2025
- Investors (PPP1)):
- Norwegian government:80% (~USD 2.3 bn)
- Private: 20%







OECD perspectives on CCS

"Given the high costs associated with implementing CCUS, it is recommended to explore cluster-based infrastructure approaches—particularly those that enable shared carbon capture and storage (CCS) between sectors such as the petrochemical and cement and concrete industries"

CCS expert, Organization for Economic Co-operation and Development (OECD)







Funding is primarily allocated to key areas to maximize impact: low-carbon technologies, renewable energy, R&D, and project-based initiatives

Overview of direct government funding in cement/concrete emission reduction (indicative comparison)

	EU	US	🙌 Canada	China	Mexico
Renewable energy	European Investment Bank (EIB) plans USD 62.5 bn ²⁾ for renewable energy	Invested USD 40 bn in renewable energy technology development across industries in 2021	Invested over USD 90.3 m to clean energy innovation projects ³⁾	Invested USD 83.4 bn ⁴⁾ in renewable energy in 2020	
Implementation of low- carbon technologies (esp. CCUS)	Major funding through Horizon Europe, strategic CCUS projects for cement industry beginning 2025	Major funding under the IRA ¹⁾ and DOE programs for cement industry beginning 2030	Funding for large CCUS project, operations planned in 2026	the facility typically lower scale	Deep-di
R&D on low-carbon technologies	Invested USD 7.3 bn ²⁾ for innovative technologies through Horizon Europe in 2024	Nearly USD 150 m in government funding for low-carbon technologies	Invested over USD 347 m in R&D funding for low-carbon technologies	Invested USD 52 bn for innovative technologies	No key funding programs for cement/ concrete sector
Project-based cement and concrete emission reduction opportunities	CLCT ⁵⁾ offers USD 1 bn ²⁾ in funding to directly support cement plants' emission	Received substantial government support in the form of technology grants	USD 13.9 m ³⁾ per year via programs (e.g., Emissions Reduction Alberta)	Some provincial programs (E.g., USD 7 m ⁴⁾ fund in Shanghai plants)	-
Circular economy nitiatives	Robust funding for circular economy initiatives through Circular Economy Action Plan	US government is funding the SWIFR program [©] totals USD 275 m from 2022 - 2026	Solid Waste Management Innovation Fund (SWMIF) supports projects aimed at improving waste mgmt. practices	Typically focus on industrial waste use, backed by provincial programs	

1) Inflation Reduction Act; 2) EURUSD = 1.04 USD; 3) CADUSD = 0.69 USD; 4) CNYUSD = 0.14 USD; 5) The Cement Low Carbon Tech (CLCT) program, which began in 2020, is one of many EU projects that offer USD 1 bn in funding over the next decade to directly support cement plants' emission reductions; 6) The Solid Waste Infrastructure for Recycling program (SWIFR)

Source: Roland Berger

Investments in renewable energy infrastructure are primarily focused on 2 areas for robust supply chain: Utility-scale energy production and grid expansion

Selected examples of renewable energy infrastructure development

Context

- Energy demand (incl. fuel and electricity) in the cement sector will rise alongside increased production volumes and decarbonization efforts (e.g., CCUS, drying new types of alternative raw materials)
- This growing demand will need to be met with renewable energy production (supply) and grid expansion (distribution & demand)



	EU	US E	Canada 🙌	China (a)	Mexico 🕞
Investment in clean energy in 2024 [USD bn] ¹⁾	410	300	<100	659	<100
Utility-scale	Wind farm	Solar power	Northern REACHE program	Solar power	Capacity upgrade
renewable energy	European Commission co- financed the first floating wind farm in France for EUR 210 m investment	152 new and expanded solar plants are planned with investment nearly USD 20 bn	Government funding of CAD 300 m for wind, solar, geothermal, hydro, and biomass	Kubuqi Desert solar power generation with installed capacity of 2 GW	Based on the National Strategy for 2030, gov't plans to invest USD 12 bn i CFE, the electricity SOE, to add 13 GW, incl. from renewable sources
Grid expansion/ modernization	Great Sea Interconnector designed as world's longest submarine electrical grid	Grid expansion & upgrades by 13 GW of grid capacity across 18 states to meet	Smart Renewables and Electrification Pathways Program (SREPs)	Infrastructure upgrades and sectoral integration	Transmission & distribution infra.
	connecting Cyprus, Greece,	industrial load growth	Government funding of	Chinese NDRC ²⁾ increased target of renewable energy	Based on the National Strategy for 2030, gov't
	and Israel with total investment of EUR 1.2 bn		USD 3.1 bn for deployment of clean electricity infrastructure, including	consumption to 5 bn tons of SCE ³⁾ by 2030 (36% uplift from 2025) – investments	plans to invest USD 7.5 bn and 3.6 bn in CFE, for transmission infra. and

modernize and strengthen

electricity grid

in

distribution projects

respectively

across value chain would

be done such as capacity,

energy storage, and

network

Source: IEA, Roland Berger 107

¹⁾ Total public and private investment in the country/region, consists of renewable power, power grids and storage, nuclear and other clean power, energy efficiency and end-use, and low-emissions fuels; 2) National Development and Reform Commission; 3) Standard coal equivalent

Investments in low-carbon technologies are primarily concentrated on CCUS for its high emission reduction potential despite significant CAPEX required to scale

Selected examples of direct funding for low-carbon technologies

Context

- CCUS is a key lever of cement decarbonization
- CCUS is projected to contribute 36-45% towards the cement industry net zero by 2050³⁾
- The high capex requirement is a key challenge for CCUS implementation – government support through direct investment has become recent a trend in leading countries

Low-carbon technology	Contribution to net-zero	Investment cost (USD) ¹⁾	Technology readiness ²⁾	Eu: Norway's "Northern Lights" project involves USD 800 m public funding, capturing co ₂ from EU cement plants Key decarbonization technology	
CCUS (Carbon capture, utilization, and storage)	36-45% ³⁾	200 m – 1 bn	0		
Advanced cement grinding technology	22%	10 m - 30 m		EU: FLSmidth secured a EUR 25 m deal with Saudi Cement Group in 2019 to install their OK [™] mill, enhancing energy efficiency	
Alternative fuels (waste, biomass)	11%	1 m – 5 m ⁴⁾	•	Canada: Lafarge Canada invests USD 38 m in a low-carbon fuel facility at Exshaw, supported by USD 10 m from ERA	
Alternative clinker materials (e.g., fly ash, slag)	9%	5 m - 50 m ⁴⁾		US: CEMEX USA and Heidelberg Materials have implemented fly ash extensively, supported by USD 50 m in federal credits	
CO ₂ sink through recarbonation	6%	100 m – 500 m		EU: LafargeHolcim has invested over USD 104 m in various CO ₂ mitigation technologies across their global operations	
Renewable energy for cement kilns	5-15%	1 m - 20 m ⁴⁾	•	Mexico: CEMEX (Mexico) saved 12% on emissions using waste heat recovery	



Countries with more developed CCUS ecosystem (e.g., EU, US, Canada) prioritize the PPP model – joint investments allow for risk sharing, synergies, and incentivize the investments from private players

Key

insight

¹⁾ USD per plant, based on investment projects observed in markets; 2) Indicative analysis; 3) GCCA's projection is 36%, CEMBUREAU is 40%, TCMA is 45%; 4) varies by plant size and logistics

Government R&D funding drives innovation in decarbonization and clean technologies across key industries, including the cement/ concrete sectors

Selected examples of government direct funding for R&D

Overview

- Governments are increasing funding for clean energy innovations and decarbonizing heavy industries like cement
- Major economies are boosting green tech R&D spending by 10-15% annually¹)
- Key objectives
- Accelerate carbon reduction in energyintensive sectors
- Promote innovation in lowcarbon materials, renewable energy, and cleaner manufacturing
- Foster international R&D collaborations



	EU		US 🍧	Canada 🙌	China e	
Investment in R&D in 2024	USD 7.9 bn (USD 97 bn during 2021-2027)		USD 12.6 bn	USD 3.6 bn	Not publicly disclosed	
Supporting program(s)	Horizon Europe 5	e, Cluster	Industrial Demonstrations Program (IDP), DOE ²⁾³⁾	Strategic Innovation Fund (SIF)	Clean Development Mechanism (CDM), state-run funds	
Focus areas/ technologies	• Climate, ener mobility	gy and	• Clean energy technologies	 Clean technology innovation 	 Clean energy development 	
targeted	 Energy efficiency 		• CCS	• CCUS	• CCUS	
	Green and cir	cular	 Hydrogen 	Low-emission and budgeses	 Renewable energy 	
	economy • Renewable hy	/drogen	 Advanced manufacturing 	hydrogen technologies	Electric vehicles	
Example projects	P2X solutions		Lehigh Hanson HEIDELBERGCEMENTGroup	Teck	延長石油國際有限公司 YANGHANG PETROLEUM INTERNATIONAL LIMITED	

Mitchell, Indiana

• Lehigh Hanson: Receives

for FEED study of carbon

Lehigh Cement Plant in

capture project at its new

USD 3.7 m U.S. DOE Funding

• P2X-FuE Project: Received

USD 31.28 m⁵⁾ from Horizon

Europe to develop Power-

to-X and green hydrogen

production technologies

• Teck Resources: Funded by

the SIF. Teck is advancing

storage R&D

clean hydrogen and battery

Shaanxi Yanchang

in Shanxi

Petroleum Group: Received

funding from MOST for R&D

on CCUS technologies at

coal and cement facilities

Mexico

USD 1.7 bn

CONAHCYT⁴⁾, Green Technology Initiatives

Energy efficiency

Renewable energy

Scholarships for Mexican

and international students

• Public health

CONTEX

ConTex Initiative:

CONAHCYT and the

to support doctoral

students

University of Texas System

committed over USD 31 m

¹⁾ The US Department of Energy's clean energy R&D budget increased by 15% in 2024, reaching USD 12.6 bn. China allocated USD 52 bn in 2024 (10% growth), and the EU set USD 14 bn in 2024, with plans to double funding in the 2028–2034 period; 2) The U.S. Department of Energy; 3) US policies may change depending on the strategic direction of the current administration; 4) CONAHCYT (National Council of Humanities, Sciences, and Technologies) is Mexico's primary government agency responsible for promoting scientific and technological development; 5) EURUSD = 1.04 USD



Governments worldwide also fund various emission reduction initiatives in the cement/concrete sector to accelerate widespread decarbonization

Selected examples of government direct funding for other related to cement/concrete production

	of emission reduction in cement/concrete		EU	US	Canada 🙌	China (a)	Mexico
ĕ	Savings in clinker production	Project type	Saving in clinker production	Clinker substitution	Efficiency in concrete production	Saving in clinker production	Efficiency in concrete production
₩	Decarbonization of electricity	Project description	Utilize Bauxite residue as cement	Utilize clay to minimize the use of	Implement high-tech monitoring sensors	Utilize domestic waste as cement	Utilize demolition materials as
<u>*</u>	Clinker substitution		alternative raw material	clinker	& software to reduce energy consumption	alternative fuel and raw material	concrete alternative raw material
	Efficiency in concrete						
	production Carbon Capture in	Operator (private sector)	Holcim	Titan America	Giatec Scientific	Conch	Bordo Poniente and Miguel Hidalgo
CEN CEN CEN	cement plants (already covered)	Fund provider	EU Community's Horizon (ReActiv	US Department of Energy	Canada Ministry of Environment and	Chinese Ministry of Industry and	Mexican government
<u></u>	Efficiency in design and construction		project across 12 countries)	Lifeigy	Climate Change	Industry and Information Technology	
CO ₂	CO ₂ sink recarbonation	Funding value	USD 9 m	USD 62 m	USD 18 m	Undisclosed	Undisclosed



Gov't funding program typically involves multiple stakeholders for regulatory, implementation, and advisory functions - clear roles & responsibilities are key

Main stakeholders involved in financial incentives (incl. subsidies and grants) in benchmarked countries



EU

EU Innovation Fund



European Commission: Handle the program's overall management



European Climate. Infrastructure and Environment Agency (CINEA):

Implement the end-toend program (e.g., managing calls for proposals & bidding, evaluation process, monitoring, technical support)



European Investment Bank:

Provide financial and technical advisory



US

Industrial Demonstrations Program (IDP)



US Department of Energy (DOE):

Handle the program's overall management



Office of Clean Energy **Demonstrations (OCED):**

Implement the end-toend program



Canada

Strategic Innovation Fund (SIF)



Innovation, Science and Economic Development Canada (ISED):

Handle the program's overall management and end-to-end implementation



Multiple regulatory agencies:

Provide technical and regulatory advisory in particular aspect (e.g., **Innovation Advisory** Committees, Natural Resource Canada, Transport Canada)



China

China Clean Development Mechanism (CDM) Fund



Inter-ministerial steering committee: Set

the policy guidance, cochair by the Ministry of Finance, Ministry of **Ecology** and Environment, and the National Development and Reform Commission



Ministry of Finance:

Implement the end-toend program and manage the fund



Mexico

No major funding programs for cement/ concrete sector

XXX Regulatory steering committee function

XXX Implementation & administration function

XXX Advisory function

Summary of key findings:

Direct funding - Subsidies, grants, and direct investments

What is direct funding and how does it help drive emissions reduction?

Direct funding refers to **government financial support** provided to businesses to incentivize and assist with the implementation of emission-reduction initiatives. It helps remove operational barriers, lower costs, and encourage the adoption of green technologies at scale, facilitating the transition to a low-carbon economy.

What are the main sources of funds?

- National budget allocations (green budgets) Dedicated government funding for green initiatives
- Carbon revenue generation Funds from carbon pricing instruments, including Emissions Trading Systems (ETS), Carbon credit sales, Carbon taxes

What is the typical funding approach?

- Grants Non-repayable funds for specific projects
- Subsidies Financial aid to reduce costs for energy-efficient and low-carbon technologies
- Direct investments Government equity stakes in decarbonization-focused businesses

What is the funding allocation mechanism?

Funding is allocated based on criteria such as **emission reduction potential**, **economic benefits** (e.g., job creation), **public and social benefits** (e.g., community improvements), **technological benefits** (e.g., innovation), **policy compliance** (e.g., alignment with national goals), and **monitoring and reporting** (e.g., emissions tracking)

Which areas are typically prioritized for funding?

Priority areas for funding include **renewable energy projects** (e.g., wind and solar), **low-carbon technologies**, **emission reduction** projects, and **R&D** initiatives. Additionally, **regulatory incentives** for businesses are also a common focus

Which entities are accountable managing these funding programs?

- Regulatory steering committees Ministries (e.g., Finance, Ecology, Environment) set policy direction
- Implementation agencies Manage program execution, evaluation, and reporting
- Advisory agencies Provide technical and regulatory guidance



Key learnings and success factors:

Direct funding - Subsidies, grants, and direct investments



Define prioritized sectors for funding support based on national climate goals

Align funding with national climate goals and sectoral emissions profiles (e.g., Canada aligns funding with their Net-zero 2050). Target all projects stages (e.g., feasibility studies to implementation)



Broaden funding criteria beyond sustainability to drive impact

Establish funding criteria that account for not only emissions reduction potential but also technological innovation, economic viability, public and social benefits, and policy alignment. This ensures funding is channeled into projects with high impact across multiple dimensions



Explore revenue sources from carbon pricing instruments for funding

Leverage mechanisms such as revenues from ETS1), carbon credits, or a carbon tax where available and combine these with traditional sources such as national budget allocations to ensure sustainable funding



Target investments to address high-CAPEX technologies esp. CCUS

Prioritize funding for high-CAPEX technologies, such as CCUS²⁾, to accelerate early adoption and overcome initial capital investment barriers. Public funding can help de-risk projects to attract private investors



Ensure tangible impact through milestone-based financing

Adopt milestone-based financing to ensure funding is tied to tangible progress. his builds public trust in the government's emission reduction efforts and reassures enterprises and investors of consistent support

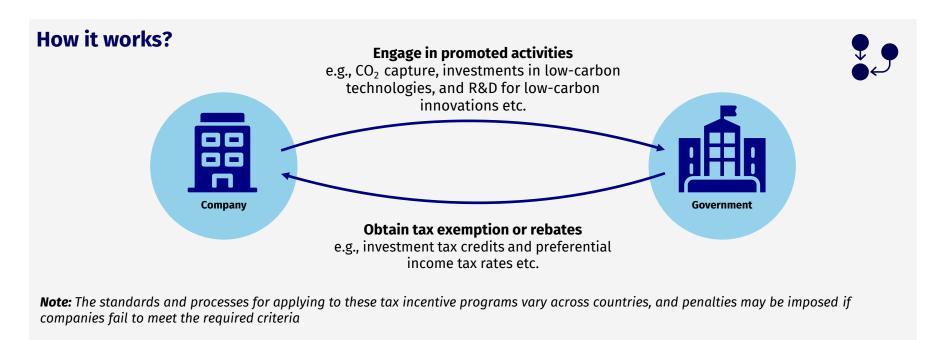


2.6 Financial incentives – Tax credits and exemptions



Tax credits and exemptions reward companies for voluntarily implementing emissions reduction initiatives

Overview: Tax credits and exemptions



Objective

To motivate industries to integrate decarbonization practices into their operations by tying financial benefits to their adoption, making decarbonization investments more attractive and reducing long-term operational costs



Benefits

- Rewards performance: Offers financial benefits for concrete decarbonization achievements
- Encourages voluntary compliance: Reduces reliance on corrective measures like emissions taxes
- Flexible use: Firms can choose how to invest saved costs in other green activities



EU1)



Tax incentives specifically for cement & concrete sector focus mainly on low-carbon tech (esp. CCUS) with eligibility criteria set based on 3 metrics

Selected examples of tax incentives in benchmarked countries

Tax incentives specifically for cement and concrete sector are limited

Eligibility criteria based on production output

Limited specific incentives at the **EU-member states**

> R&D Tax Credit (Section 41) tax credit (amount of credit varies depending on project) on qualified research expenses such as low-carbon technologies

Scientific Research and Experimental Development Tax Incentive Program – 15-35% tax credit on expenses in R&D activities (incl. low-carbon tech and new cement product etc.)

R&D Tax Credits Program -30% tax credit on expenses and investments in R&D that exceed the average R&D expenses incurred in the last 3 years (scope includes lowcarbon tech)

High and New Technology Enterprises Tax Incentives preferential CIT3) rate of 15%4) for businesses conducting R&D on new energy and energy conservation technology



Canada



Mexico



China



450 Tax Credit – tax credit of at I least USD 60 per ton of CO2 captured per year (for CCUS facilities)

US¹⁾

Deep-dive in subsequent slides

48C Advanced Energy Project

specifically designed to reduce

installation of equipment

GHG by at least 20%

(retrofitting)

CCUS ITC – tax credit on CCUS expenditures for entities that capture CO2 (10% of which is either permanently stored or used to produce concrete)

Limited specific incentives for cement and concrete industry

Limited specific incentives for cement and concrete industry

Eligibility criteria based on total investments

regional level - each design and offer their own programs

Accelerated Capital Cost Credit – tax credit of up to 30% **Allowance** – accelerates on qualified investments incl. depreciation schedule for I eligible equipments such as

Deep-dive in subsequent slides

Heat Recovery Equipment²⁾

Limited specific incentives for cement and concrete industry

Limited specific incentives for cement and concrete industry

Eligibility criteria based on R&D activities

1) US policies may change depending on the strategic direction of the current administration; 2) Used to capture and reuse the waste heat generated during the cement manufacturing process, particularly from the kiln and clinker cooling stages; 3) Corporate income tax: 4) 10% reduction from statutory CIT rate



Case study: US IRA offers tax credits of up to USD 85 per ton of CO₂ captured for operating CCUS facilities that capture at least 12,500 tons of CO2 per year

Section 45Q Credit for Carbon Oxide Sequestration¹⁾



Tax Credit for Carbon Sequestration under the Inflation **Reduction Act Section 45Q**

Objective: Incentivize investments in carbon capture and sequestration

Government agency: Internal **Revenue Services** (IRS)



Key criteria

- Eligible for entity who owns the capture equipment and physically or contractually ensures the disposal, utilization, or use as tertiary injectant of the CO2
- Equipment placed in service after 31st Dec. 2022 and construction beginning prior to 1st Jan. 2033
- Power plants: capture at least 18,750 m tons and a capture design capacity not less than 75% of baseline emissions
- DAC²⁾ facilities: capture at least 1,000 m tons
- Other canture facilities: canture at least 12,500 m tons

Applicable to CCU facilities at cement plants



- Credit amount Geologically sequestered CO₂: Base credit of USD 17/ mtCO2 (USD 36 for DAC²⁾), increased to USD 85 (USD 180 for DAC²⁾) for facilities that pay prevailing wages⁵⁾ during the construction phase and during the first 12 years of operation
 - Geologically sequestered CO₂ with EOR³⁾: Base credit of USD 12/ mtCO₂ (USD 26 for **DAC²⁾**), increased to USD 60 (USD 130 for DAC2) for facilities that pay prevailing wages5 during the construction phase and during the first 12 years of operation
 - 12-year claim period once facility is placed in service, reduced to 5 year if transferred

Applicable to CCU facilities at cement plants



Gaps/

- Some policymakers and stakeholders view policies promoting CCS as subsidizing for fossil fuel dependency
- Lack MRV⁴⁾ processes to validate CO₂ sequestration
- Lack safeguards to address carbon leakage (stored CO₂ escaping back into the atmosphere)

Source: US Congress, Roland Berger 117

¹⁾ US policies may change depending on the strategic direction of the current administration; 2) Direct Air Capture - Technology that removes carbon dioxide directly from the air and stores it or utilizes it for various purposes (different from CCUS technology); 3) Enhanced Oil Recovery - Technique used to extract additional oil from a reservoir by injecting substances like CO2, steam, or chemicals to improve oil flow and increase production; 4) Monitoring, Reporting, and Verification; 5) Minimum hourly wage rates, benefits, and overtime pay that must be paid to workers on certain construction projects



Case study: CRA incentivizes investments in low-carbon technologies for cement production by allowing accelerated depreciation for these equipments

Accelerated Capital Cost Allowance (ACCA)



Accelerated Capital Cost Allowance

Objective: Incentivize investments in green technology, machinery, and equipment by allowing businesses to depreciate their assets faster

Government agency: Canada Revenue Agency (CRA)



Key criteria

The following systems and equipments are relevant to the cement and concrete industry and are eligible:

- Heat recovery equipment captures waste heat from cement kilns to improve energy efficiency
- Specified-waste fueled heat production equipment uses industrial waste as alternative fuels in kilns
- Systems to convert biomass into bio-oil produces bio-oil from biomass for use as a low-carbon fuel in kilns
- Landfill gas and digester gas collection equipment captures biogas for use as fuel in cement production
- **Cogeneration systems** generates electricity from waste heat
- . . .



Credit amount • Accelerated depreciation schedule - 30% or 50% of equipment's remaining value per year over the equipment's lifetime duration (rate depends on the eligibility of equipment category)



Gaps/ challenges

• Lack MRV¹⁾ processes to validate CO₂ sequestration

 While ACCA accelerates capital investment recovery, it does not directly address acquisition cost and operational costs, which are also critical for making low-carbon technologies economically viable

1) Monitoring, Reporting, and Verification





To ensure tangible impact is generated from these tax incentives, quantifiable and clear eligibility criteria are often specified

Selected examples of eligibility criteria for tax incentives

45Q Tax Credit



48C Advanced Energy Project Credit



CCUS ITC



Entity who owns the capture equipment and physically or contractually ensures the disposal, utilization, or use as a tertiary injectant of the CO₂ are eligible.

Annual capture requirements

- Power plants: capture at least 18,750 metric tons and a capture design capacity not less than 75% of baseline emissions.
- DAC facilities: capture at least 1,000 metric tons
- Other capture facilities: capture at least 12,500 metric tons (including CCU facilities at cement plants)

Eligible projects include:

 Industrial Decarbonization Projects (formerly named Greenhouse Gas Emissions Reduction **Projects):** An advanced energy project qualifies under this category if it involves retrofitting an industrial or manufacturing facility, particularly in energy-intensive sectors such as cement, iron and steel, aluminum, and chemicals. The retrofit must include the installation of equipment specifically designed to reduce greenhouse gas emissions by at least 20 percent

CCUS ITC is available for **CCUS** projects to the extent that 10% or more of the captured CO_2 is used in an eligible use

Eligible uses are:

- The storage of captured carbon in dedicated geological storage
- The use of captured carbon in producing concrete in Canada or the United States using a qualified process for sequestration of the captured CO₂ in concrete



Case study: Transferable tax credits scheme in the US enhances flexibility by allowing companies to monetize credits upfront to finance green projects

Other selected example – Tax credit transferability scheme under the Inflation Reduction Act



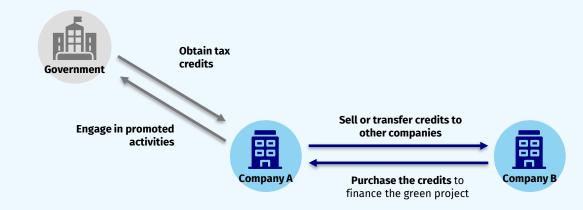
Tax credit transferability under the Inflation Reduction Act

Objective: To broaden private sector investment in clean energy by creating a liquid market for tax credits, reduce financing barriers for developers, and accelerate deployment of green technologies

Government agency: U.S. Department of the Treasury and Internal Revenue Service (IRS)

How it works?

- **Government** (U.S. Treasury/IRS¹¹) **issues tax credits** to companies developing eligible clean energy projects under the Inflation Reduction Act²¹ (e.g., solar, wind, CCUS)
- Project developers who cannot fully use these credits (due to low tax liability) are allowed to sell or transfer credits to other companies
- Buying companies (incl. those in non-green sectors) purchase the credits at a discount and use them to reduce their federal tax liabilities, while the seller receives cash to finance the green project



Key benefits of tax credit transferability



Improved liquidity: Allows early monetization of tax credits, reducing financial strain during early project phases



Wider investor participation: Attracts investors (e.g., banks, tech firms) who buy credits to offset tax liabilities, expanding funding sources

Key takeaways

- Transferable tax credits can serve as an effective financial tool for the cement and concrete industry, particularly for capital-intensive projects with long payback periods such as Carbon Capture, Utilization, and Storage (CCUS)
- By enabling early monetization of tax benefits, they help improve project cash flow and accelerate investment returns



¹⁾ Internal Revenue Service; 2) Eligible projects for tax credit transfer under the U.S. Inflation Reduction Act include solar, wind, hydrogen, battery storage, carbon capture (CCUS), clean manufacturing, electric vehicles (EVs), and other clean energy technologies, subject to specific technical criteria and labor standards. In contrast, projects related to fossil fuels, conventional combustion-engine vehicles, non-energy building construction, and industrial facilities without emissions abatement are generally not eligible

Source: US Department of Energy, Roland Berger

Summary of key findings:

Financial incentives – Tax credits and exemptions



What are tax credits and exemptions and how do they help drive emissions reduction?

Tax credits and exemptions provide financial incentives for businesses that implement emissions reduction initiatives by:

- Rewarding concrete decarbonization efforts with financial benefits
- Reducing reliance on corrective measures like emissions taxes
- Allowing cost reinvestment into green activities, such as CO₂ capture and low-carbon technology adoption



What are the different types of tax credits and exemptions available?

Tax credits and exemptions for the cement and concrete sector mainly target low-carbon technologies, particularly carbon capture, utilization, and storage (CCUS). Eligibility is typically based on 3 criteria: production output, total investment, and involvement in research and development activities.



How to ensure tangible impact is generated from these tax incentives?

- Clear, measurable eligibility criteria, ensuring accountability
- Defined benchmarks, such as:
- U.S. 45Q tax credit Requires CCU facilities to capture at least 12,500 metric tons of CO₂
- Canada's CCUS ITC Mandates at least 10% of captured CO₂ be used in eligible applications (e.g., geological storage, CO₂-sequestered concrete production)



Which entities are accountable for managing implementation of these tax incentives?

- National tax authorities E.g., the Ministry of Finance, overseeing financial administration
- Sector-specific agencies Ensuring alignment with sustainability goals and verifying eligibility



Key learnings and success factors:

Financial incentives – Tax credits and exemptions



Explore multiple types of tax incentives for comprehensiveness

Variations of tax benefits can be offered (e.g., tax credits for CO₂ captured, accelerated depreciation for environmentallyfriendly equipments (e.g., retrofitting), and tax credits on investments in low-carbon tech) to ensure comprehensiveness



Set up clear and quantifiable criteria to ensure tangible impact

The government can ensure effective incentive implementation by establishing clear emission reduction criteria (e.g., CO₂ reduction targets, utilization methods) to ensure tangible impact and outcomes



Promote R&D activities

Beyond tax incentives to promote investments and emissions reduction initiatives, the government should also promote R&D activities in low-carbon tech to support next generation of solutions for long-term impact



Focus on low-carbon technologies (esp. CCUS)

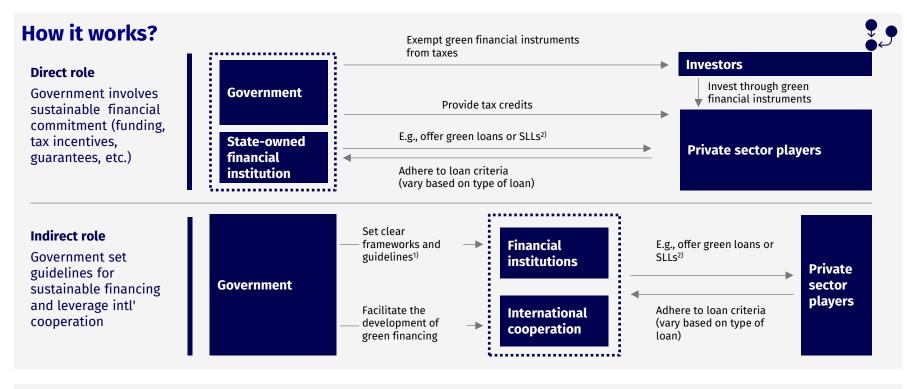
Tax credit programs should primarily promote low-carbon technologies for their high emissions reduction potential (especially CCUS technologies as seen in the US and Canada)



2.7 Financial incentives – innovative financing mechanisms (debt instruments)

Government can establish sustainability financing frameworks and offer loans via stateowned institutions to improve industry access to sustainable finance

Overview: Innovative financing mechanisms (debt instruments)



Benefits

- Private capital: Attracts privatesector investments, increasing funding capacity
- Diversifies financing options:
 Reduces reliance on government spending

Objective

To enhance **access to sustainable finance** for the cement and concrete industry by providing **direct loans** through state-owned institutions or **establishing frameworks and standard** to support decarbonization efforts

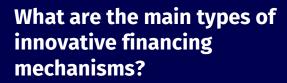




¹⁾ It can be either a mandatory requirement or a general guideline suggestion for financial institutions; 2) Sustainability-linked loans



There are three key questions to address for the government to introduce effective, innovative financing mechanisms:





Identifying the main types of innovative financing mechanisms helps diversify funding sources, supports sustainable investments, and provides flexibility in addressing different emission reduction needs

What roles should the government play in this area?



Defining the government's role in innovative financing mechanisms ensures clear coordination, provides regulatory support, and creates incentives for private sector participation in emission-reducing initiatives

How to promote the utilization of innovative financing mechanisms?



Promoting the utilization of innovative financing mechanisms encourages broader adoption, increases access to capital for sustainable projects, and fosters collaboration between public and private sectors to drive emission reductions

Green loans/ bonds & sustainability-linked loans/ bonds are common financing mechanisms for driving emissions reduction in the cement and concrete industry

Main types of green and sustainability-linked financing mechanisms

	1 Green bonds	Sustainability-linked bonds (SLBs)	3 Green loans	Sustainability-linked loans (SLLs)
Description	Debt raised to fund projects with positive environmental impact	Bonds with interest rates linked to sustainability performance targets at the organizational level	Loans used to fund projects with positive environmental impact	Loans with interest rates tied to the borrower's achievement of measurable sustainability KPIs specific to the funded project
Issuer	Governments, corporations, financial institutions	Governments, corporations, financial institutions	Governments (via state-owned banks), financial institutions	Governments (via state-owned banks), financial institutions
Use of funds	Financing of specific environmental projects (e.g., renewable energy, clean infrastructure)	General financing, flexible use for sustainability-related activities	Financing of specific environmental projects (e.g., renewable energy, clean infrastructure)	Financing of specific environmental projects linked to measurable KPIs
Interest/Returns	Fixed interest rate (coupon)	Interest rate adjusted based on achievement of predefined sustainability KPIs	Usually fixed, occasionally flexible based on specific financing agreements	Interest rate adjusted based on borrower's progress toward predefined KPIs
Examples	Cirnate Awsterness Bonds	₽ HOLCIM	ÇİMSA	HSBC NBN I MANAGE MANAGER MANAGER

Cimsa secured a USD 70 m green loan

energy, alternative fuels, and cement

from IFC3) in 2024 for renewable

transformation at its plants

Holcim Group issued USD 750 m in

and low-carbon cement production

technologies

2021 to fund sustainable construction

1) EURUSD = 1.04 USD; 2) Climate Awareness Bonds (CABs); 3) International Finance Corporation (IFC); 4) HKDUSD = 0.13 USD

EIB¹⁾ issued USD 4.16 bn¹⁾ in CABs²⁾ in

energy efficiency projects

2023 to finance renewable energy and

Bonds Loans

Semen Baraturaja, subsidiary of

Semen Indonesia Group, secured

low-carbon cement production

~USD 59.9 m SLLs from HSBC, CIMB,

Bank Negara, and Bank Mandiri for

These mechanisms are widely implemented across countries, covering a broad range of clean energy and green projects, incl. the cement and concrete sector

Overview of green financing mechanisms across benchmarked countries

	EU 💮	US 🕌	Canada 🙌	China 🎱	Mexico 🕑
Green bonds	The EU issued over USD 67.6 bn ⁴⁾ in green bonds through the NextGenerationEU (NGEU) program	California State issued USD 500 m for renewable energy infrastructure	Government of Canada issued USD 1.38 bn ⁵⁾ for clean energy transition	CDB ¹⁾ issued USD 1.1 bn ⁶⁾ for Belt and Road projects, focusing on renewable energy, and clean logistics	SHCP ²⁾ launched its 2024 sustainable financing program with the issuance of a new USD 2.2 bn ⁷⁾ bond
Sustainability-linked bonds (SLBs)	Enel raised USD 1.5 bn ⁴⁾ in 2019, with interest tied to 55% renewable electricity	The issuance is expected to reach around USD 1 trillion in 2024 ⁸⁾	Ontario Power Generation issued USD 1 bn ⁵⁾ for decarbonization efforts	State Grid Corporation of China issued for clean energy projects	CEMEX issued USD 530 m ⁷⁾ for low-carbon cement manufacturing
Green loans	USD 109 m ⁴⁾ green loan for Heidelberg Materials for innovative product & process development to reduce CO ₂ emissions	US has Green Banks across the states, providing green loan	Export Development Canada (EDC) provided USD 345 m ⁵⁾ loan to Hydro- Québec for emission- reducing technologies	CDB ¹⁾ issued ~USD 28 bn ⁶⁾ green loan for decarbonization	National Bank of Mexico provided USD 265 m ⁷⁾ loan to rural farmers for sustainable agriculture
Sustainability-linked loans (SLLs)	EIB provided USD 520 m ⁴⁾ SLL for Enel's innovation & digitalization, with emission reduction & Capex aligned with EU Taxonomy Deep-dive available	Clean Energy Fuels Corp. secured USD 150 m SLL for its growth strategy, tied to decarbonization goals	Bell Canada amended USD 3.5 bn ⁵⁾ to an SLL with ESG targets	Chinachem Group secured USD 128 m ⁶⁾ with HSBC for energy/water reduction	Cementos Argos secured USD 300 m ⁷⁾ linked to carbon reduction and gender diversity

¹⁾ China Development Bank, a stated-owned bank, amount in the first five months of 2024; 2) Mexico's Ministry of Finance and Public Credit (SHCP); 3) People's Bank of China, a Chinese central bank; 4) EURUSD = 1.04 USD; 5) CADUSD = 0.69 USD; 6) CNYUSD = 0.14 USD; 7) MXNUSD = 0.053 USD; 8) According to the S&P Global Ratings; 9) International Finance Corporation, a member of the World Bank Group

Case study: EU, through EIB, issues green bonds to raise capital for financing environmental and social projects, incl. those in the cement and concrete sector

Deep-dive on EU's innovative financing mechanism

Overview



The European Investment Bank, one of the world's biggest multilateral financial institutions and providers of climate finance, is committed to financing projects that drive economic growth, support climate action and promote social progress across Europe and the globe

Strategic priorities

Climate	EUR 50.7 bn
Digitalization and tech innovation	EUR 14.4 bn
Security and defense	EUR 1 bn
A modern cohesion policy ¹⁾	EUR 38.2 bn
Social infrastructure	EUR 8.7 bn
Agriculture and bioeconomy	EUR 6.4 bn
High impact global investment	EUR 8.4 bn

Where does funding come from?

In 2024, **EIB raised EUR 63.4 bn by issuing bonds**, including EUR 18.3 bn in green and sustainability formats, across 13 countries

Examples in the cement and concrete sector



EIB lends EUR 29 m to Derba Midroc Cement company (DMC) in Ethiopia to help **build and operate a 2.1 m** ton cement factory, with a focus on sustainable production practices

Key takeaways

Targets emissions

reduction projects in hard-to-abate

sectors including

cement and

concrete

Governments can leverage green bonds to raise substantial capital, which can then be used to issue green loans and sustainability-linked loans (SLLs) for financing sustainability projects and other strategic national priority areas

¹⁾ EIB plays a central role in fostering cohesion across the European Union by financing projects that reduce regional disparities, promote sustainable development and enhance economic and social integration



There are three key questions to address for the government to introduce effective, innovative financing mechanisms:

What are the main types of innovative financing mechanisms?



Identifying the main types of innovative financing mechanisms helps diversify funding sources, supports sustainable investments, and provides flexibility in addressing different emission reduction needs

What roles should the government play in this area?



Defining the government's role in innovative financing mechanisms ensures clear coordination, provides regulatory support, and creates incentives for private sector participation in emission-reducing initiatives

How to promote the utilization of innovative financing mechanisms?



Promoting the utilization of innovative financing mechanisms encourages broader adoption, increases access to capital for sustainable projects, and fosters collaboration between public and private sectors to drive emission reductions

The government can play a role in issuing these debt instruments and help establish frameworks and guidelines for sustainable financing in the industry

Potential roles of government



Direct Role



Issuing green bonds and loans

Governments issue green bonds and provide green loans through state-owned banks to support sustainability initiatives, such as financing low-carbon cement production technologies or using recycled materials in concrete manufacturing



Providing guarantees



Governments can offer loan guarantees or credit enhancements to reduce risks for investors and encourage investment, such as providing guarantees for projects in the cement and concrete sector, like the adoption of CCUS tech



Offering tax incentives¹⁾

Governments may directly offer tax exemptions or rebates for companies using green or sustainability-linked financing, thereby reducing the overall cost of funding projects

Deep dive in the previous section



Governments can play both direct and indirect roles in supporting financing



Indirect Role

Setting guidelines and regulating standards



By collaborating with financial institutions, governments facilitate the use of green and sustainability-linked financing through national standards and regulations, such as those encouraging financing for low-carbon cement production, which enhances transparency and attracts investment



Leveraging international cooperation

Governments can collaborate with international bodies and financial institutions to develop green and sustainability-linked financing tools, such as working with organizations like the World Bank and IMF to create standardized green bond frameworks that attract global investors to fund sustainable infrastructure projects



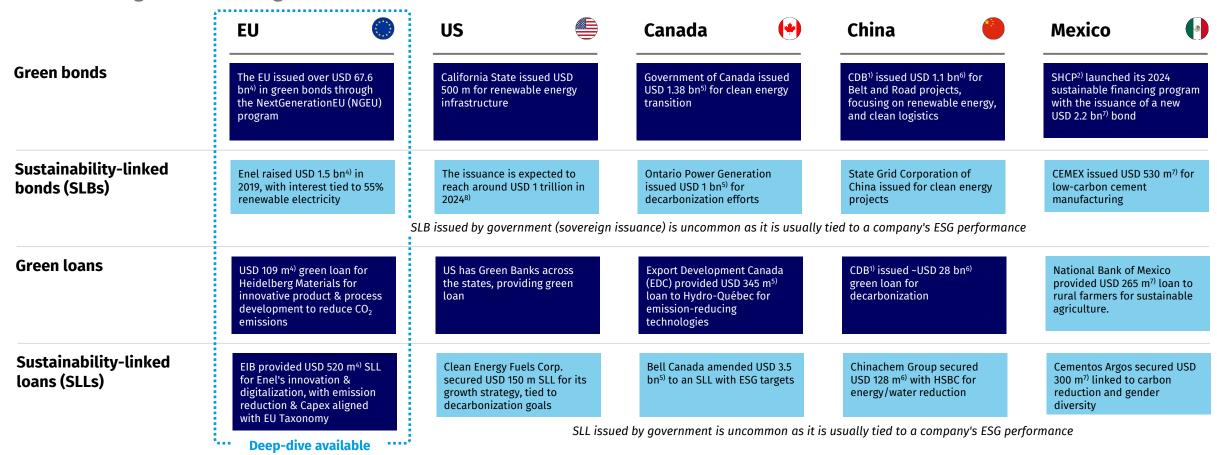
Deep dive available



2

Green loans and bonds issued by the government are more common, while SLBs/ SLLs are more relevant for private sector institutions

Overview of green financing mechanisms across benchmarked countries



¹⁾ China Development Bank, a stated-owned bank, amount in the first five months of 2024; 2) Mexico's Ministry of Finance and Public Credit (SHCP); 3) People's Bank of China, a Chinese central bank; 4) EURUSD = 1.04 USD; 5) CADUSD = 0.69 USD; 6) CNYUSD = 0.14 USD; 7) MXNUSD = 0.053 USD; 8) According to the S&P Global Ratings; 9) International Finance Corporation, a member of the World Bank Group

Issued by financial institutions or corporations

Issued by government entities or state-owned banks

Green financing frameworks can be established by governments or businesses to provide guidelines for their involvement in green financing activities

Overview of green financing frameworks



What are green financing frameworks?



Government-issued standards (voluntary)

Guidelines, regulations, or frameworks set by the government to promote sustainable investment and financing practices, often aligned with national climate goals or international commitments



Market-based standards

Market-based standards for green financing are developed by industry bodies, financial institutions, or privatesector stakeholders, focusing on sectorspecific needs and practices in sustainability and responsible investment

What are the main areas covered?



Definition and scope of green projects



Transparency and reporting requirements



Management of proceeds



Project evaluation and selection including eligibility criteria



Other considerations¹⁾

1) e.g., risk management

The EU and China have comprehensive green financing frameworks, while other benchmark countries primarily rely on market-based standards¹⁾

Overview of green financing frameworks and guidelines across benchmark countries

	EU			Canada	•	China		Mexico	
Green bonds	EU Green Bond Standard (EU GBS) suggests detailed reporting on the use of proceeds for green projects			Green bond frame aligns with the 20 emission reductio	30	China's Green B Guidelines issu PBOC ³⁾ to align a more structur	ed by with create	Green Bond Princip which are based or Green Bond Princip (GBP) by ICMA ⁴⁾	n the
Sustainability-linked bonds (SLB)	EU guidelines for SLB establish criteria on sustainability targets and KPIs	No formal nationwide framework In the U.S., green bond disclosures are largely		No formal nations framework	wide	PBOC ³⁾ 's guidel SLBs, where sus targets and KPI mandatory, add ICMA ⁴⁾	stainability s are	No formal nationwing framework	ide
Green loans	EU Green Loan Standard (EGLS) sets eligibility and reporting standards, with the ISF ²⁾ offering capital relief for infras. projects	guided by voluntary market-based standards, such as the Green Bond Principles (GBP) by ICMA ⁴ or the Climate Bonds Standard ⁵⁾⁶⁾	,	No formal nation framework	wide	PBOC ³⁾ 's guidel their Green Bot Guidelines, sup environmental projects	nd pporting	No formal nationw framework	ide
Sustainability-linked loans (SLL)	EU Sustainable Finance Disclosure Regulation (SFDR) ensures transparency of sustainability targets			No formal nation framework	wide	PBOC ³⁾ 's guidel SLLs requiring metrics for eac	clear	No formal nationw framework	vide
	Deep-dive available						Appl	lied No/limited app	olication

¹⁾ Guidelines or frameworks that are established through voluntary participation by market players, rather than being enforced by government regulations or mandates; 2) Infrastructure Support Factor (ISF); 3) People's Bank of China, a Chinese central bank; 4) International Capital Market Association; 5) Climate Bonds Standard is developed and governed by the Climate Bonds Initiative (CBI), a UK not-for-profit organization; 6) US policies may change depending on the strategic direction of the current administration

Case study: While EU GBS is a relatively new framework, cement manufacturers such as Heidelberg have begun issuing green bonds according to its principles

Deep dive on EU's indirect role – EU's green bond standard



About EU Green Bond Standard (EU GBS)

The EU Green Bond Standard (EU GBS), established in 2023 by the European Commission, is a voluntary framework that companies and public authorities can adopt when issuing bonds labeled as EU Green Bonds, aiming to scale up and enhance the environmental goals of the **EU** green bond market

How EU GBS works

EU GBS establishes 4 key requirements to be fulfilled by all bond issuers:



Taxonomy-alignment: all bonds must be fully allocated to projects aligned with EU Taxonomy for Sustainable Activities



Transparency: issuers must give full transparency on how the **bond** proceeds are allocated through detailed reporting¹⁾



External review: external registered reviewer must check all EU green bonds to ensure compliance



Supervision of reviewers: the external registered reviewers must be registered with and supervised by ESMA2)

Key impacts of EU GBS

For green bond issuers:



- Potential lower cost of capital due to increased investor confidence (green premium3))
- Enhance credibility & competitiveness to investor: signaling strong commitment to sustainability, credible capex pipelines, green activities, governance



Increased cost related with external review and enhance transparency



For investors Increases confidence in green investment with:

• Better clarification in the use of proceeds, better assurance of allocation, better transparency for decision making

Access for high-quality green bond with EU taxonomy alignment



Still limited consequences for non-compliance

Example of green bond issued by cement manufacturer in accordance with the EU GBS framework



Heidelberg Materials:

Issued EUR 700 m (~USD 725 m) green bond in 2024 - Their Green Finance Framework is aligned with the EU GBS and focuses on projects such as modernizing plants to increase the use of alternative fuels and expanding carbon capture technologies

Source: European Investment Bank, Roland Berger

¹⁾ Including pre-issuance of a green bond factsheet, post-issuance of an allocation, impact report, pre and post-issuance performance of external reviews; 2) European Securities Markets Authority; 3) A condition where investors are willing to pay extra or accept lower yields in exchange for sustainable impact

2

Case study: ISF policy reduces capital requirements for eligible EU infrastructure projects, supporting bank lending and guiding green finance structuring

Deep dive on EU's indirect role – Infrastructure Support Factor (ISF)



About EU Infrastructure Support Factor (ISF)

The Infrastructure Support Factor (ISF) is a voluntary regulatory guideline introduced under Article 501a of the Capital Requirements Regulation (CRR) in the European Union. It allows banks to apply a 25% reduction in the minimum amount of regulatory capital¹⁾ for specific infrastructure **project** exposures that meet defined eligibility criteria, thereby encouraging investment in sustainable infrastructure projects

Selected eligibility criteria under CRR Article 501a



Type of obligor/ exposure: Must be a project-specific entity, with repayment from project revenues, not the sponsor's balance sheet



Nature of the project: Involves essential, long-term infrastructure (e.g., energy, transport, water) with stable demand



Contractual and financial structure: Fully secured by project assets and cash flows, with robust contracts (e.g., O&M²⁾, concessions)



Revenue predictability: Predictable, long-term income from PPPs, concessions, or reliable long-term contracts



Risk management and governance: Key risks must be mitigated with strong governance, oversight, and experienced sponsors

Key benefits of ISF



Lower capital requirements: Banks benefit from a 25% reduction in the minimum amount of regulatory capital¹⁾ they must hold for eligible infrastructure exposures, improving capital efficiency



Enhanced bank lending capacity: Frees up capital, enabling banks to lend more to infrastructure projects without increasing risk exposure



Regulatory recognition of low risk: Provides regulatory acknowledgement of the lower credit risk associated with well-structured infrastructure projects



In emerging markets, the ISF's effectiveness is constrained by regulatory disincentives and higher perceived risks; therefore, the World Bank suggests complementary measures—such as guarantees or blended finance—to offset these risks and help unlock long-term infrastructure investment

¹⁾ The minimum amount of regulatory capital that banks are required to hold to cover potential losses and ensure financial stability is defined under the EU's Capital Requirements Regulation (CRR) and aligns with international Basel III standards; 2) Operations and maintenance (O&M)



There are three key questions to address for the government to introduce effective, innovative financing mechanisms:

What are the main types of innovative financing mechanisms?



Identifying the main types of innovative financing mechanisms helps diversify funding sources, supports sustainable investments, and provides flexibility in addressing different emission reduction needs

What roles should the government play in this area?



Defining the government's role in innovative financing mechanisms ensures clear coordination, provides regulatory support, and creates incentives for private sector participation in emission-reducing initiatives

How to promote the utilization of innovative financing mechanisms?



Promoting the utilization of innovative financing mechanisms encourages broader adoption, increases access to capital for sustainable projects, and fosters collaboration between public and private sectors to drive emission reductions

9 •

To promote adoption of green financing, the government can provide incentives for businesses issuing green bonds or leveraging these financing mechanisms

Overview of government incentives to promote adoption

Tax Benefits



Tax credits

Governments **provide a direct reduction in the tax amount** owed by
companies investing in green projects



Governments exempt certain green financial instruments (e.g., green bonds) or activities from taxes

Tax exemptions

• Reduces tax burden for companies

Encourages investment in green initiatives

Makes green investments (e.g., SLBs) more attractive than regular bonds

• Encourages investment in green initiatives

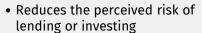
\$EPA

US: According to U.S. EPA²⁾, municipal green bonds are often exempt from federal taxes, and in some cases, from local and state income taxes as well

Guarantees

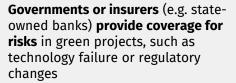


Governments provide guarantees for a portion of the repayment of green loans or bonds for specific green projects, such as renewable energy or CCS



 Enhances investor/ lenders confidence in green financing

2 Insurance



- Reduces financial loss from unforeseen project risks
- Enhances investor/ lenders confidence in green financing

Examples

Description

Key Benefits

EN_RGY

US: The U.S. CREBs and QECBs program¹⁾ allows municipalities to issue taxable bonds for clean energy, with bondholders receiving up to 70% of the coupon as a tax credit



vice: Camey's USD 500

Mexico: Cemex's USD 500 m³⁾ Green Bond was guaranteed by the government-backed NAFIN⁴⁾ to finance the adoption of renewable energy and alternative fuels through SLLs



Germany: KfW Bank⁵⁾ works with private insurers to offer risk coverage for energy-efficient retrofits through its Energy Efficiency Financing Program⁶⁾

¹⁾ The U.S. federal government's Clean Renewable Energy Bonds (CREBs) and Qualified Energy Conservation Bonds (QECBs) program; 2) the United States Environmental Protection Agency; 3) EURUSD = 1.04 USD; 4) Nacional Financiera (NAFIN) is a government development bank in Mexico; 5) KfW Bank is a German state-owned development bank; 6) Energieeffizienz Finanzierungsprogramm

Summary of key findings:

Financial incentives - Innovative financing mechanisms (debt instruments)



Innovative financing mechanisms are financial instruments that governments use to increase access to sustainable finance, thus supporting decarbonization efforts. By offering loans, guarantees, and tax incentives, these mechanisms help reduce risks and lower the cost of green technologies, encouraging investment in projects that drive emissions reduction, such as low-carbon cement production or renewable energy initiatives.

What are the main types of innovative financing mechanisms being used?

- Green Bonds: Debt raised to fund environmentally beneficial projects
- Sustainability-linked Bonds (SLBs): Bonds with interest rates tied to an organization's sustainability performance targets
- Green Loans: Loans used to fund projects with positive environmental impacts
- Sustainability-linked Loans (SLLs): Loans with interest rates linked to the borrower's achievement of sustainability KPIs

What roles should the government play in this area?

- Direct role: Issue green bonds/ loans and provide guarantees/ tax incentives to reduce financial risks
- Indirect role: Set guidelines for sustainable financing and collaborate with international bodies to develop standardized frameworks that attract global investors

How to promote the utilization of innovative financing mechanisms?

- Providing tax incentives, such as credits or exemptions for green projects
- Offering guarantees like credit guarantees or insurance to reduce investment risks
- Establishing clear regulations and frameworks for green financing to enhance transparency and attract private investments

Which entities are accountable for managing these innovative financing mechanisms?

- Government agencies typically manage these mechanisms and collaborate with international organizations to develop global frameworks for green financing
- Financial regulators, in partnership with financial institutions, set standards and ensure transparency

Key learnings and success factors:

Financial incentives – Innovative financing mechanisms



Offer green financial instruments and leverage incentives to drive market Governments can foster decarbonization businesses by providing direct loans or using tax incentives and guarantee tools to promote green financing transactions



Align where to fund and the country's decarbonization targets and priorities

Government could allocate & prioritize where to fund by aligning with country's decarbonization plan (e.g., EU Green Deal). This alignment would ensure consistency and on-point financial decision



Establish mandatory standards for financial institutions

Financing frameworks must include mandatory standards aligned with the national decarbonization plan to ensure compliance, transparency, and investor participation. General standards may not be effective



Ensure financing programs offered are accessible by businesses of all sizes

Government should realize inclusive economic development by setting up tailored financing mechanism across project's stages & business' maturity (e.g., new business, SME, large investment)



Complement financing mechanism with advisory services

Advisory services in key areas such as financial, technical, capability building would be critical enabler, help enhancing the quality of projects and maximizing the financing impact



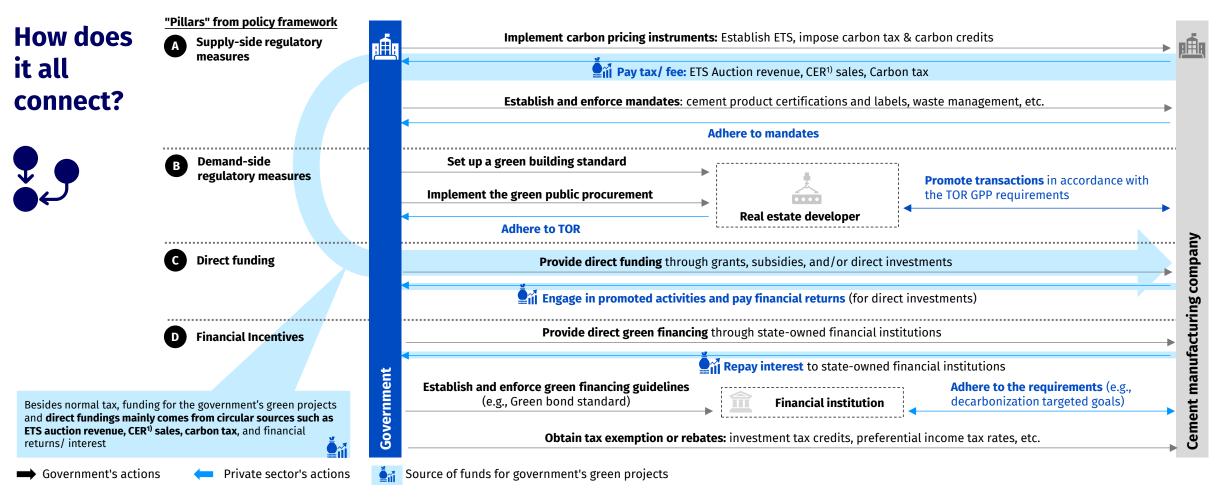




3. Enablers for a comprehensive policy framework in cement & concrete decarbonization

To enable the policy framework "pillars", the government, cement players, and other stakeholders need to orchestrate an interconnected mechanism

Interconnected mechanism to enable policy pillars in cement/ concrete



¹⁾ Certified Emissions Reduction (Carbon credits)

Six key enablers are essential for supporting the design and implementation of policies aimed at achieving net-zero in the cement and concrete sector

Key enablers for a comprehensive policy framework in cement & concrete decarbonization

Policy framework Targets/objectives 4 pillars of key policy areas Supply-side **Demand-side** regulatory regulatory Direct **Financial Incentives** measures measures funding

Key enablers 6 key enablers of the framework

		Definition	Why it is important		
•	Infrastructure development	Development and enhancement of physical infrastructure essential for decarbonizing the cement and concrete sector, including CCUS networks, renewable energy, and circular economy infrastructure	 Provides the foundational infrastructure needed to deploy large-scale decarbonization technologies Enables economy of scale, reduces costs, and accelerates implementation through shared and optimized infrastructure solutions 		
•	Institutional structure	Clearly delineate roles and responsibilities among government agencies and stakeholders (e.g., cement manufacturers) for policy design and implementation	 Provides clarity on role, responsibility, and coordination flow for seamless policy design and implementation 		
	Monitoring, reporting, and verification	System for measuring, documenting, and independently verifying emissions and progress toward decarbonization goals in the cement and concrete sector	 Facilitates evidence-based policymaking and evaluation Enhances transparency and builds trust among stakeholders 		
iv	Multi-stakeholder collaboration	Coordinated efforts between stakeholders from various sectors, such as government, industry, academia, finance, and civil society, to achieve shared decarbonization goals	 Leverages resources and capabilities to address policy & implementation complexity Enhances scalability and accelerates the adoption of sustainable practices 		
V	Promotion of sector & market awareness	Efforts to educate and engage stakeholders across policymakers, industry players, and consumers, about the importance of decarbonization and low-carbon alternatives	 Increases demand for low-carbon alternatives Builds public and industry support for decarbonization policies, reducing resistance to change Raises general awareness on importance of climate change 		
Vi	Social and workforce development	Programs and initiatives that equip the workforce with the skills needed for a decarbonized cement and concrete industry and enable a Just Energy Transition	 Ensures transition by providing reskilling and upskilling opportunities for workers Enhances public acceptance by demonstrating the social and economic benefits 		

Given the high CAPEX for key infrastructures, particularly CCUS, government support in establishing these is crucial for long-term emission reductions

Selected examples of required government infrastructure investments

Key infrastructure	Subcategory	Definition	Example
CCUS (Carbon capture, utilization, and storage) infrastructure	Shared CO ₂ hubs and terminals	Infrastructure for transporting and permanently storing captured CO₂ from cement kilns and industrial clusters . CCUS is a critical solution for process-related emissions that cannot be avoided through energy transition only	UK: A shared pipeline network at east coast cluster for multiple emitters, incl. construction materials industries
	CO ₂ transport & storage network	Centralized CO₂ collection points serving multiple cement and industrial sites . These hubs improve cost-efficiency, enable smaller producers to access CCUS, and support development of regional decarbonization zones	EU: Norway's "Northern Lights" project involves USD 800 m public funding, capturing co₂ from EU cement plants Primary focus of this section
Grid expansion/ modernization infrastructure	Utility-scale renewable energy	Large-scale solar and wind projects supplying low-carbon electricity to cement grinding and auxiliary operations. As cement plants electrify parts of their processes, affordable and clean grid power becomes essential	US: Over 150 solar projects under development with ~ USD 20 bn in investment, accelerating grid decarbonization
	Grid modernization	Enhances grid stability to support electrification of cement plant operations (e.g., grinding, material handling) and integration of on-site renewables or waste heat recovery systems . A reliable, modern grid enables smoother decarbonization transitions for energy-intensive plants	China: Grid upgrades under NDRC support industrial electrification and flexible clean energy use
circular economy infrastructure	Waste-to-Energy (WtE) plants	Facilities that convert municipal or industrial waste into energy—providing an alternative thermal input (e.g., RDF or biomass) to replace fossil fuels in cement kilns. This reduces both fuel-related CO ₂ and landfill waste	Canada: SWMIF supports WtE innovation, including co-processing waste in cement production

CCUS infrastructure is key to reducing process emissions from clinker production by enabling large-scale CO2 capture and management at cement plants

Overview of CC(U)S activities along the CO₂ value chain

Carbon capture

- Capture and concentrate waste CO₂ from large point sources such as heavy industry or fossil fuel power plants
- Focus on capturing process emissions from calcination of limestone, which account for ~60% of total emissions in cement production
- After capturing, the CO₂ may need to be stored or liquified before transportation



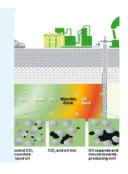
Transportation

- Transportation of CO₂ from source to off-taker in either gaseous or liquid form
- Transportation possible by pipeline (gaseous), ships and truck (liquified) or cylinders (small scale liquified)
- Cement plants are often located far from storage sites—cost-effective pipeline or truck-based **solutions** are key for hub development

CO₂ utilization and storage

CCU: Utilization/ offtakers

- Mineralization of CO₂ into concrete products (e.g., precast blocks)
- Carbon curing in concrete production to enhance strength and durability
- Conversion of captured CO₂ to produce synthetic fuels
- etc.



CCS: Storage

- Underground storage of captured CO2 in empty oil & gas fields, saline aguifers or basalt formations with the aim of preventing CO₂ emissions into the atmosphere
- For hard-to-abate process emissions, long-term geological **storage** is often the viable mitigation option





Typically require significant government investment due to high capital costs and are best shared across industries to leverage economies of scale



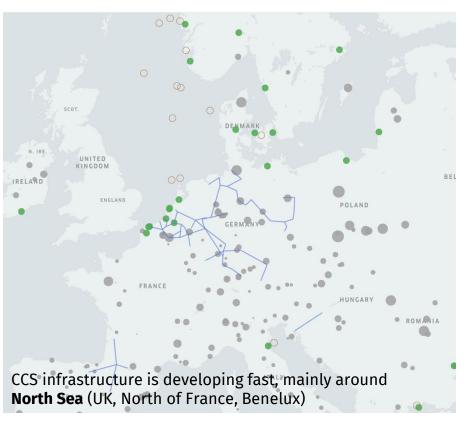


Deep dive available

Case study: CO₂ pipeline infras. is essential; targeting high-emission clusters, shortening routes, and coordinating efforts enables cost-effective scale-up

Examples of CCUS investment in Europe





CC) _a trans	port pi	peline	infras	tructure
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Metric	2024 (Current)	2030	2050
Total pipeline length	Very limited / early-stage ²⁾	6,700–7,300 km	15,000 – 19,000 km
Deployment cost estimate	N/A	USD 7.38 – 22.14 bn ³⁾	USD 10.55 – 26.23 bn ³⁾
CO₂ captured, transported, stored	Minimal operational volume ⁴⁾	≥50 MtCO₂/year	≥250 MtCO₂/year

Additional CCS infrastructure will emerge, after 2030, in areas combining emissions and access to CO₂ (onshore) storage capacities

Key takeaways

- A phased approach prioritizing areas with high emission volumes and capture potential (e.g., North Sea in EU)
- Integrated infrastructure planning by mapping capture, transport, and storage sites to minimize transport distances and associated costs
- CCS infrastructure, particularly CO₂ transport networks, will often have cross-boundary dimensions, making cooperation among stakeholders crucial



CCS export hub (EU only)1)

Offshore geological storage

Cement plants

Announced CO₂ pipeline project

¹⁾ Future CCS export hubs: under development or study; 2) The JRC 2024 study states the network is in early phases of deployment and largely absent across most of the EU, aside from pilot projects and clusters in the North Sea region; 3) The EU lacks commercially proven CO₂ storage capacity in the early phase of CCS deployment.; 4) EURUSD = 1.1

Case study: Gradual direct funding from study-to-implementation are crucial for the government to assess the feasibility and scalability of tech, through PPP¹⁾

Example of CCUS investment in Norway - Brevik CCS (Longship project)

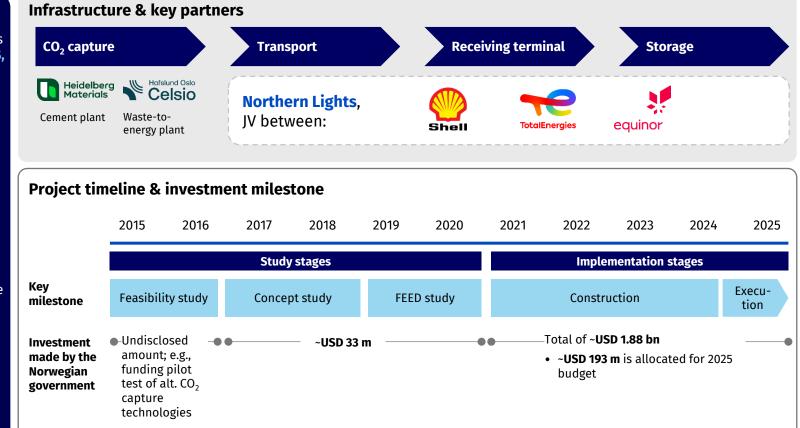




Overview

The Longship project, Europe's first complete value chain CCS. aims to achieve net-zero cement production. It encompasses CO2 capture, followed by transport. injection, and storage 2,600 meters below the North Sea seabed

- Location: Norway
- Project owner: Heidelberg
- Plant capacity: 1.3 m tons cement/ year
- Status: mechanical complete in Dec 2024, planned testing and operations in 2025
- Investors (PPP¹)):
- Norwegian government: 80% (~USD 2.3 bn)
- Private: 20%





OECD perspectives on CCS

"Given the high costs associated with implementing CCUS, it is recommended to explore cluster-based infrastructure approaches—particularly those that enable shared carbon capture and storage (CCS) between sectors such as the petrochemical and cement and concrete industries"

CCS expert, Organization for **Economic Co-operation and Development (OECD)**



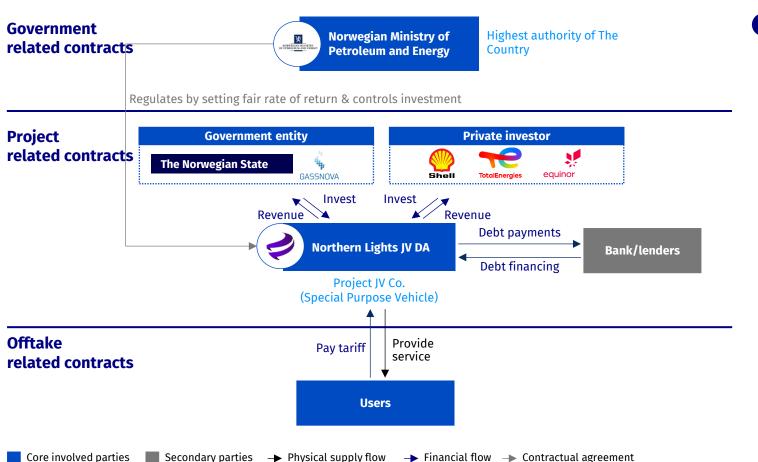
¹⁾ Public-private partnership

Case study: A potential commercial structure for shared CCUS infrastructure could be in the form of JV with a consumption-based tariff imposed on users

Commercial structure for shared infrastructure: Norway - Brevik CCS (Longship project)







Key takeaways

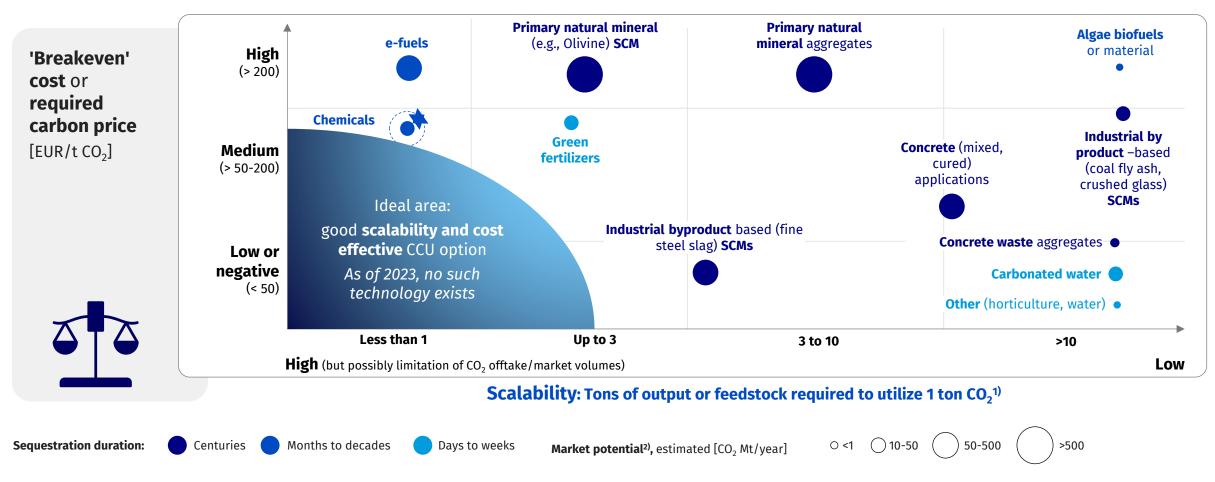
Public-Private Joint Venture (JV) for cement and concrete sector CCUS infrastructure

- A government entity establishes a Joint Venture (JV) with a private operator - Public shareholding enables knowledge transfer and positive signaling to private investors to unlock investment
- Both shareholders invest in Project Co. for construction of CCUS infrastructure e.g., pipeline - Ownership shares are attributed according to the injected capital
- With higher desired degree of control The Country government entity to keep majority share of investment (>50%)
- With lower desired degree of control The Country government entity to keep minority share of investment (<50%)
- Project JV Co. develops, constructs and operates asset and collects tariff from users to refinance the investment
- Tariff is a consumption-based model that is paid based on individual user's throughput



However, for carbon capture and utilization (CCU), plants located far from CO₂ infrastructure are unlikely to achieve scale, given current technologies

Segmentation of CCU options for the cement industry



1) Example: 2 tons of olivine-based aggregates to mineralize 1 ton of CO₂; 2) in 2040 for Europe, North America

Source: IEA, Nature, Roland Berger

Several distinct government bodies assume these roles & responsibilities and collaborate with one another to effectively drive emissions reduction

Examples of established institutional structures in benchmarked countries

		· · · · · · · · · · · · · · · · · · ·				•						
Roles & responsibilities <u>EU</u>		EU		US		Cana	da 🙌	China		Mexico		
⊗ ××	Setting strategic direction	Europeen Cammission	European Commission		U.S. Department of Energy (DOE)	C anadä	Environment and Climate Change Canada (ECCC)	STATE COUNCIL 國务院	The State Council	INECC 81118 th Augustus 1 Lident Lident	National Institute of Ecology and Climate Change (INECC)	
	Regulatory framework & policy development	European Parliament	European Parliament & Member States		EPA's Office of Policy (OP) ¹⁾	C anadă	Canadian Environmental Assessment Agency (CEAA)		Ministry of Ecology and Environment (MEE)	SEMARNAT (Secretariat of Environment and Natural Resources (SEMARNAT)	
	Policy implementation & enforcement	K EEA	European Environment Agency (EEA)		EPA's Office of Air and Radiation (OAR) ¹⁾	C anadă	Environment and Climate Change Canada (ECCC)		Provincial-level MEE	PROFEPA TESSATE USBASE	Federal Attorney for Environmental Protection (PROFEPA)	
	Financial instruments & investment facilitation	European Investment Bank	European Investment Bank (EIB)		Department of Energy (DOE)	CIB ∳ BIC	Canada Infrastructure Bank (CIB)	MOF 财政部	Ministry of Finance (MOF)		National Infrastructure Fund (FONADIN)	
	Research & innovation development	UROPEAN COMMISSION	Joint Research Centre (JRC)	CONREL	National Renewable Energy Laboratory (NREL)	Natural Resour Canada	Natural Resources Canada (NRCan)	② ガギス学 Tilgha Unvesty	Tsinghua university		Universidad Nacional Autónoma de México (UNAM)	
	Workforce and social development	Engage Cera Engage Cera of Woodway Turang	European Centre for the Development of Vocational Training		Department of Labor (DOL)	Canadă	Employment and Social Development Canada (ESDC)		Ministry of Human Resources and Social Security (MOHRSS) p-dive	STPS	Ministry of Labor and Social Welfare (STPS)	

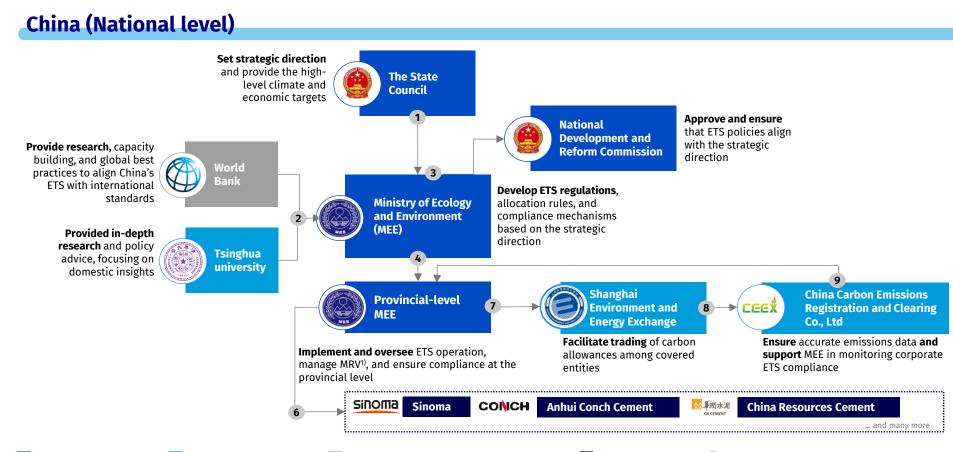
¹⁾ Environmental Protection Agency (EPA)

Case study: Extensive collaboration among government departments is crucial to address the complexities of ETS implementation, as demonstrated in China

Cement players

x Order of sequence

Flowchart of China's National ETS implementation



Supportive organizations e.g., NGOs



Key takeaways

- Collaboration between government agencies is essential in implementing complex mechanisms such as FTS
- **Key success factors** for collaboration are:
- Clear roles and responsibilities - prevents overlap and ensure accountability
- Strong regulatory
 framework enacts clear,
 comprehensive legislation
 to empower agencies and
 ensure a level playing field
- Mutual understanding and shared goals - ensures alignment on objectives and reduces conflicts

Government bodies

State-owned entities

¹⁾ Monitoring, Reporting, and Verification (MRV)

(1111

MRV¹⁾ is a set of procedure used to track, report, and verify emissions data and climate actions, ensuring transparency and effectiveness of policies/ measures

Overview of Monitoring, Reporting, and Verification (MRV)

MRV Framework

consists of 3 aspects

2 Reporting

- Manufacturers are responsible for reporting emissions data in compliance with regulator's standards (e.g., EPA³⁾ Greenhouse Gas Reporting Program)
- The data is submitted to regulatory bodies (e.g., EPA or national climate authorities) for public disclosure and transparency

Monitoring

- Manufacturers measure GHG emissions using activity data and emission factors²⁾, tracking changes over time
- Data on mitigation actions is gathered to assess their impact
- Examples of data to monitor in emission reduction policies: Emissions data and mitigation actions

3 Verification



 Accredited third-party verifiers (e.g., SGS Group, Bureau Veritas, DNV GL in the EU) verify the accuracy of reported data and provide feedback to emitters for improvement

Benefits

- Enhanced transparency: Provides reliable data for stakeholders to track progress and build trust in emissions reduction efforts
- Informed decision-making:
 Supports policy-makers, industries, and investors in identifying opportunities for decarbonization and innovation
- Compliance and accountability:
 Ensures adherence to national and international climate goals through accurate tracking and reporting



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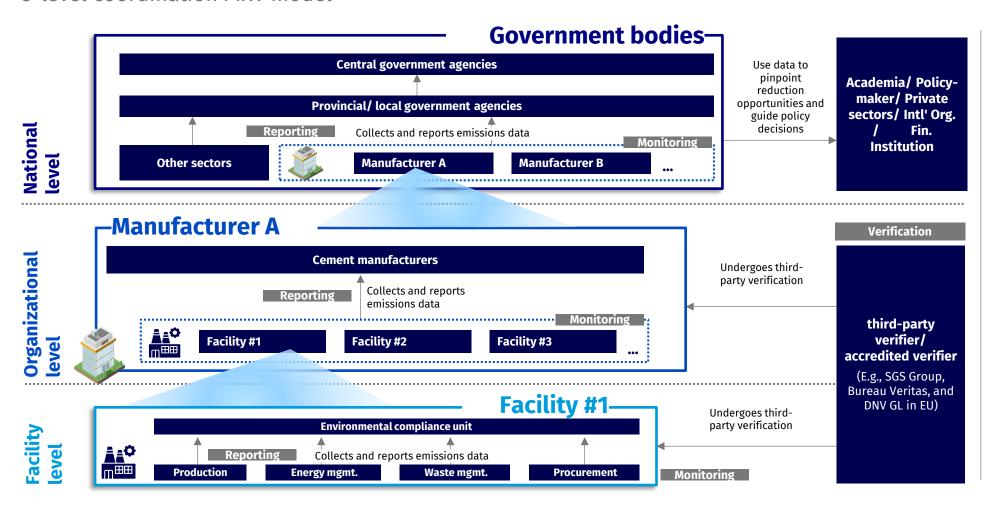
1) Monitoring, Reporting, and Verification; 2) The amount of a pollutant emitter per unit of activity; 3) US. Environmental Protection Agency

Source: World Resources Institute, Roland Berger

(iii

MRV is conducted at 3 levels and requires strong coordination between relevant stakeholders to ensure consistency, credibility, and effective management

3-level coordination MRV model



Key takeaways

- A 3-level MRV system ensures accurate national data, tracks progress on emission goals, and supports policy decisions
- Key success factors:
- Clear roles for data collection, reporting, and verification
- Stakeholder coordination for consistent and credible data
- Robust data management for accurate and transparent reporting



MRV compliance mandates for large industrial emitters (cement manufacturers) are common to improve visibility of major emissions sources

Examples of MRV compliance mandates in benchmarked countries (1/2)

		·				
	EU	US 🥌	Canada 🙌	China 🥚	Mexico •	
Mandate	Commission Implementing Regulation (EU) 2018/2066	Greenhouse Gas Reporting Program (GHGRP)	Greenhouse Gas Reporting Program (GHGRP)	National ETS	National Emissions Registry (RENE)	
Overview	A regulation governing the monitoring and reporting of greenhouse gas emissions under the EU ETS (EU Emissions Trading System)	A program mandating major GHG emitters to report annual emissions for policy decisions and tracking	A program mandating major GHG emitters to report annual emissions for policy decisions and tracking	The world's largest carbon market with the objective of contributing to the effective control and gradual reduction of carbon	A registry mandating major GHG emitters to report annual emissions, ensuring data for policy decisions and tracking	
Issuer	European Commission	SEPA United States Environmental Protection Agency	Environment and Climate Change Canada	MEE 生态环境部	Mexican Congress	
Issue date	December 2018	October 2009	March 2004	July 2021	April 2012	
Disclosure frequency	Annually	Annually	Annually	Annually	Annually	
Entities required to disclose	Entities running industrial facilities (e.g., power plants, factories) and airlines	Facilities emitting > 25,000 m tons of CO ₂ e per year, including large GHG sources, fuel and industrial gas suppliers, and CO ₂ injection sites Deep-dive available	Facilities emitting > 10,000 m tons of CO ₂ e per year and facilities engaged in carbon capture, transport, and storage (CCTS) regardless of their emission levels	Companies in the power sector with annual emissions > 26,000 m tons of CO₂e. (Required entities will be further expanded in the future)	Facilities within the energy, industrial, transport, agricultural, waste, commerce, and services sectors that have annual emissions > 25,000 m tons of CO ₂ e	

Key insight Targeting large emitters with mandatory compliance, independent verification by accredited third-party verifiers, and robust reporting mechanisms will strengthen transparency and accelerate emissions reduction efforts

Under these mandates, key metrics measured and reported incl. GHG emissions, production data, and calculation methods to track facility-level performance

Examples of MRV compliance mandates in benchmarked countries (2/2)

		A				
	EU	US 🖷	Canada 🙌	China 🎱	Mexico 🕞	
Mandate	Commission Implementing Regulation 2018/2066-67	Greenhouse Gas Reporting Program (GHGRP)	Greenhouse Gas Reporting Program (GHGRP)	National ETS	National Emissions Registry (RENE)	
Measured Data	CO ₂ emissions	All greenhouse gas emissions ¹⁾	All direct greenhouse gas emissions ²⁾	CO ₂ emissions (expanding to include more gases as sectors grow)	Specific GHG emissions, including: CO ₂ , CH ₄ , N ₂ O, Black carbon, and any additional GHGs identified by the IPCC ³⁾	
Reported Content	 Total CO₂ emissions Emission factors Materials/ fuel consumption Ton-kilometer data Operational changes 	Total GHG emissions Calculation methodologies used Operational data supporting emissions calculations	 Total GHG emissions Facility information Additional activity-specific details (e.g., emissions from combustion, industrial processes, etc.) 	 Total CO₂ emissions Production data Supporting materials, including fuel use and emission factors, to verify accuracy 	Total GHG emissions from their operations	
Verified Content	Annual emissions reports is verified by independent, accredited third-party verifiers, using Risk-Based Verification ⁴⁾ to optimize resources and ensure data accuracy	Submitted data is verified through automated electronic checks in the e-GGRT system, follow-up audits, and additional information requests to ensure accuracy and	While third-party verification is not mandatory, ECCC conducts data quality checks and may require clarification	Reported GHG emissions data undergoes third-party verification to confirm accuracy, completeness, and compliance with ETS regulations, ensuring data integrity	Reported emissions data is reviewed every 3 years by an accredited third party to ensure accuracy, completeness, and alignment with established methodologies and guidelines	

¹⁾ GHG emissions, including carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and other GHGs, based on fuel consumption and industrial processes; 2) Direct GHG emissions, including CO₂, CH₄, N₂O, HFCs, PFCs, and SF₆; 3) Intergovernmental Panel on Climate Change (IPCC); 4) Verification efforts on areas that have a higher likelihood of inaccuracies or non-compliance



Case study: The US mandates carbon reporting for large emitters, providing consolidated data to identify reduction opportunities and guide policy decisions

EPA's Greenhouse Gas Reporting Program (GHGRP)



EPA¹⁾ Greenhouse Gas Reporting Program (GHGRP)

Monitoring

- Manufacturers emitting over 25,000 tons of CO₂e annually, including cement and concrete sectors, must monitor and report emissions
- The EPA¹⁾ conducts audits and inspections to ensure compliance

Reporting

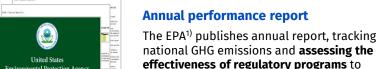
- The reporting is primarily the responsibility of the manufacturing companies which required to report:
- Process emissions: CO₂ emissions from calcination in each kiln
- Combustion emissions: CO₂, CH₄, and N₂O emissions from each kiln and other combustion units
- Deadline: Total annual emissions must be reported by March 31st of the following year
- Civil penalties by the EPA¹⁾ of up to USD 55,808 per day, per violation²⁾

Verification

• **EPA**¹⁾ currently performs the primary verification role for GHGRP

The EPA's GHGRP database





Interactive datasets & tools

The EPA¹⁾ database is accessible by all stakeholders, allowing private sector players to benchmark their ESG performance and for research institutions/ academia to conduct effective policy research

further make data-driven policy decisions



FISCAL YEAR 2025



1) US. Environmental Protection Agency; 2) Violations include failure to report, late reporting, inaccurate reporting, failure to monitor and record emissions as required, and failure to comply with verification requests



Emissions reduction efforts in the cement and concrete sector require extensive collaboration and coordination among various stakeholders

Main stakeholders involved in emissions reduction efforts in the cement and concrete sector



Government (policy-makers)

- Establish and implement regulatory/ policy frameworks
- Implement green public procurement
- Provide financial incentives and support (e.g., tax credits, subsidies, or grants)
- Support research and innovation initiatives

International organizations

- Provide knowledge sharing, and capacity-building initiatives
- Facilitate international collaboration and funding
- Assist in the development of policy frameworks.

Academia/ researcher institutes

- Conduct research on new materials, processes, and technologies
- Develop educational programs to train engineers and professionals

Financial Institutions

- Offer financial products and mechanisms to support low-carbon investments
- Evaluate and fund sustainable projects aligned with net-zero targets

Private-sector businesses/industrial associations

- Align their business operations with decarbonization policies and regulations
- Conduct/ invest in R&D to develop green materials and technologies
- Engage with government agencies in policy discussions and provide industry perspectives

Examples























Scope of collaboration among these entities focuses on six key areas, with the government acting as the central coordinating point

Main stakeholders involved under each scope of collaboration

Setting Strategic Direction:

Establishing national decarbonization strategies & goals

Regulatory and Policy development:

Develop emission standards/policy/ regulatory

Policy Implementation:

Implement, oversee, and align actions with policies

Financial and **Investment Support:**

Provide financial support and incentives

Research and **Development:**

Conduct research and develop low-carbon materials/technology

Workforce and Social Development:

Upskill workers for green practices



Government (policy-makers)



Set strategic direction



Establish policy/ regulations



Implement and oversee policy



Grant. subsidize green innovations



Support research and innovations



Develop training programs for regulators



International organizations



Develop global climate action strategies



Provide global best practices recommendations



Oversee global CO₂ reduction compliance



Fund green projects



Support R&D Initiatives in Low-Carbon materials



Provide training programs and skill development



Academia/ researcher institutes



Provide inputs on national strategies



Provide researchbacked feasibility insights.



Provide inputs on implementation



Provide inputs on funds direction



Research on lowcarbon materials



Host low-carbon knowledge sharing session



Financial Institutions



Lesser extent of involvement



Provide inputs on gov't guidelines



Establish ESG criteria based on established policy



Invest in green financings



Lesser extent of involvement



Lesser extent of involvement



Private-sector businesses



Provide industry's insights and feedback on goals/ objectives



Assist in policy/ regulatory design



Align actions with established policies



Fund green projects



Conduct R&D for green technology



Upskill workers to green practices





Lesser extent of involvement

1) Nationally determined contributions

Stakeholders have distinct roles in each collaboration, typically as knowledge and strategy partners, implementation partners, or resource support partners

Selected examples of multi-stakeholder collaboration programs in benchmarked countries



Emission reduction policy

Collaboration context

Type of collaboration

With whom to collaborate?

EU

EU Green Deal

- Government: EU Commission
- International Org: UNFCCC

EU-UNFCCC partnership in

setting strategic direction

Set Strategic Direction

for CO₂ emission reductions

US

Industrial Demonstrations Program¹⁾

Public-private partnership in community benefits to meet IDP goals and invest in the workforce development

Workforce and Social Development

- Government: DOE²⁾
- Private: cement/ concrete companies

Pan-Canadian Framework³⁾

Canada

Funding partnership to support clean growth under the Pan-Canadian Framework through green financing/ investment

Financial and Investment Support

- Government: ISED⁴⁾
- Financial Institution: RBC5)

Academia: Tsinghua Uni

development

• International Org: World Bank

ÎĬ

China

ETS development

China ETS

FTS

partnerships to establish

Regulatory and Policy

Government: MEE⁶⁾

Private: Power Sector

emission caps and trading

mechanisms and implement

Mexico

Cemex – Tecnologico de **Monterrey project**

Research and innovation partnerships in climate and emissions reduction by deploying innovative technologies for CO2 capture

Research and Development

- Private: Cemex
- Academia: Tecnologico de Monterrey

Roles & responsibilities

- Government:
- International organization:
- 1
- Government:
- Private & Academia:



- Government:
- Financial Institution:



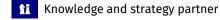
- Government:
- Private:
- Academia & International organization:

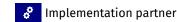


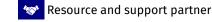
- - Academia:

• Private:









¹⁾ Under Inflation Reduction Act (IRA) - US policies may change depending on the strategic direction of the current administration; 2) U.S. Department of Energy; 3) Pan-Canadian Framework on Clean Growth and Climate Change; 4) Innovation, Science and Economic Development Canada; 5) Royal Bank of Canada (RBC); 6) China's Ministry of Ecology and Environment

Case study: MEE engaged with various stakeholders, incl. industrial association, World Bank, and JCGLT, to collaborate on the design of China National ETS

Chinese collaboration for designing the China National ETS market





MEE obtained valuable insights and expertise from diverse stakeholders across the cement and concrete sector are leveraged to design ETS policy

Ministry of Ecology and Environment (MEE) - Government

- Collaborate with key stakeholders to gather research data and expert insights
- Integrate findings into the framework to align with global best practices and support effective implementation, ensuring the National ETS framework reflects industry realities and compliance challenges







CCA¹⁾ and power sector -Private sector

 Provide insights to help MEE understand compliance challenges, emission data accuracy, impacts, and benchmarks



Shenzhen municipal government - Government

• Provide pilot experience to MEE including allowance allocation, MRV²⁾, enforcement mechanism to help MEE develop ETS



Tsinghua-CTG Joint Center

- Academia
- Provide expertise in designing ETS, including cap-setting, allowance allocation, and MRV2) mechanisms
- Facilitate knowledge exchange with global carbon markets (e.g., EU ETS) to align China's policies with international standards



THE WORLD BANK

World Bank

- International organizations
- Assist MEE under the Partnership for Market Readiness Project with capsetting, allowance allocation, MRV²⁾ systems, and aligning China's ETS with global standards

Key takeaways

- Involvement of diverse stakeholders is essential in implementing complex mechanisms such as ETS
- Key success factors for multistakeholder collaboration are:
 - Clear roles and responsibilities: e.g., prevents overlap and ensure accountability
- Efficient communication and data sharing: provide accurate data and compliance feedback to align on key design elements
- Expertise and capacity **building**: e.g., partnership with Tsinghua-CTG Joint Center and World Bank

¹⁾ China Cement Association (CCA); 2) Monitoring, Reporting, and Verification (MRV)

Case study: FutureGen, a PPP to implement CCUS in the US, failed due to unclear role delegation – A well-defined collaboration structure is crucial for success

US FutureGen cross-collaboration management



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Program Overview

FutureGen was a joint public-private partnership between the DOE¹⁾ and the FutureGen Alliance, aimed at implementing a near-zero coal-fired power plant with CCS technology



Operating year: 2003-2015

Stakeholder roles



Government: DOE1)

- Provided primary funding (planned USD 1 bn)
- Initiate the project and oversaw implementation and site selection



Private sector: FutureGen alliance (a consortium of coal and energy companies)

- Contribute funding (planned USD 250 m)
- Lead the design, construction, and operation of the plant











However, the FutureGen program faced significant cross-collaboration issues and was canceled due to 4 main challenges:



Poor project management and misaligned objectives

- The FutureGen Alliance sought increased autonomy, while the DOE emphasized the need for greater oversight
- While DOE focused on demonstration, the FutureGen alliance focused on commercial viability
- Unclear decision-making and oversight led to cost overruns and delays
- Site selection process was protracted politically charged²⁾, but the final choice of Matoon, Illinois faced great local opposition



Funding and cost overruns

- Estimated cost escalated from USD 1 bn to USD 1.65 bn
- Alliance struggled to secure its committed share of funding, due to perceived high risk of the project (declining natural gas prices made coal less competitive)



Technology risks

 The project relied on unproven tech. at a commercial scale, led to difficulty to secure private financing

¹⁾ United States Department of Energy; 2) Several states competed to host the plant led to delay in process



Raising awareness of decarbonization, low-carbon benefits, green financing, and innovations is key to promoting sustainability in cement and concrete

Overview of essential information to be communicated

Why is raising awareness important?

- Promotes sustainability:
 Awareness of emission reduction and eco-friendly benefits contributes to climate change mitigation
- Boosts innovation:
 Highlighting green financing and technologies attracts investment and fosters solutions
- Increases demand:
 Educating stakeholders drives market interest in low-carbon cement and concrete



Emission reduction national strategies and regulations

- Share the government's vision, targets, and strategies for emissions reduction in the cement and concrete sector
- Communicate new regulations, policies, and action plans to align stakeholders



2 Benefits of lowcarbon alternatives

- Demonstrate the environmental impact through reduced emissions
- Emphasize long-term cost savings and minimized penalties/ carbon taxes
- Raise awareness about the importance of green construction practices across the supply chain



Green financing opportunities

- Highlight funding options for developing green technologies (e.g., green bonds/ loans, and climate-related investments)
- Explain government financial incentives, such as tax credits, grants, and subsidies



Emerging technologies and innovations

- Educate stakeholders on the latest research, innovations, and technologies enabling decarbonization (e.g., CCUS, recycled materials)
- Provide information on the practical application and market readiness of lowcarbon solutions



Global best practices

- Showcase case studies and success stories from industry leaders, especially companies implementing low-carbon technologies
- Foster industry collaboration through successful partnerships and joint initiatives



Each key message is communicated by various stakeholders in the cement and concrete industry to drive decarbonization in a holistic approach

Source: Roland Berger



Different lead communicators, each with unique objectives, require diverse communication channels to effectively engage their target audiences

Type of main communicators and tailored communication channels

Lead communicator		Objective				
俞	Government bodies	 Build partnerships to drive supportive policies for decarbonization Publicize new policies to encourage private sector engagement Raises general awareness on importance of climate change and prioritizing decarbonization in the cement and concrete industry 				
	Private sector/ businesses	 Raise awareness across supply chain Promote low-carbon cement and related products in the market Provide inputs and feedback to policies, explore private funding 				
	Investors and financial institutions	 Promote green financing opportunities to support sustainable investment Provide inputs and feedback to policies 				
	Academics/ researchers	 Share research to advance innovation Educate industry leaders on application of emerging low-carbon innovations Provide inputs and feedback to policies 				
	NGOs and civil society	 Increase awareness of decarbonization's importance in the cement and construction industry across demographics Provide inputs and feedback to policies 				
	Communications professionals	 Raise public awareness on the importance of green construction Communicate new regulations and policies 				

Communication channels based on market observations



Digital Platforms - LinkedIn, Instagram, Facebook, YouTube, government official portals/websites, blogs, and e-newsletters



Publications - Industry white papers, academic journals, case studies, brochures, reports, and policy briefs



Industry Events/ Forum - Trade fairs, expos, conferences, workshops, roundtables, webinars, and panel discussions



Corporate Platforms - Company annual reports, investor presentations, sustainability reports, and press releases



Traditional Media – TV programs, radio broadcasts, newspapers, magazines, and printed advertisements

For each communication campaign, it is important to clearly define the objectives and target audiences to ensure effective use of appropriate channels

Selected examples of communication campaigns in benchmarked countries





US



Canada



China



Campaigns:

Objectives:

Lead communicator:

Target audience:

Communication channels:





EU ETS

Increase understanding and acceptance of the EU ETS among stakeholders and the general public

Authorities of all EU

Member States



LEED Certification¹⁾

Promotes green building practices through the use of sustainable materials and technologies





Roadmap to Net-Zero Carbon Concrete by 2050

Guides the industry to align practices by adopting lowcarbon solutions and technologies



Green Credit Guidelines

Encourages Chinese banks to offer green financing for sustainable construction

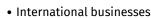


Mexico



CIMESA's EXEGY® Low-Carbon Concrete

Promotes the adoption of lowcarbon concrete solutions to reduce emissions in construction projects



- Industry leaders
- General public

- Construction leaders
- · Property owners & tenants
- Financial institutions



Policymakers

Association of Canada

- Industry Stakeholders
- General public



- Chinese banks & financial institutions
- Construction leaders



- Construction leaders
- · Architects and design firms

- EU Websites (e.g., EC Climate Portal)
- EU publications and events
- Public consultations and stakeholder meetings
- Social media

Deep-dive available

- USGBC Platforms
- Webinars (e.g., Greenbuild International Conference and Expo)
- Publications and Media (e.g., Construction Dive)
- Social media

- Canadian government websites
- Industry conferences
- CAC Publications
- Social media

- CBRC official websites
- Training programs
- CBRC guidelines
- Banking Networks, Industry Forums
- CIMESA website
- Industry events (e.g., Collaboration with CANACEM to promote EXEGY®)
- Local construction conferences
- Social media

¹⁾ Leadership in Energy and Environmental Design



Case study: To promote the EU ETS, diverse communication channels were used to enhance understanding and acceptance among industry stakeholders

EU ETS communication campaign



To enhance understanding and acceptance of the EU ETS among industry stakeholders, the EU communicates through 3 primary channels under the EU ETS framework:

- **Digital channels:** The EC Climate Portal and strategic social media campaigns (e.g., YouTube, Facebook) serve as key tools to provide updates on emissions trading and enhance stakeholder awareness
- Industry engagement: Workshops, seminars, and conferences organized by the European Commission and industry associations such as CEMBUREAU foster collaboration and promote compliance with ETS requirements
- Publications and reports: Regulatory updates and reports convey emissions targets and decarbonization priorities







Key takeaways

- Communications from regulatory bodies enhance credibility and effectively drive traffic to official platforms
- The collaboration between regulatory bodies and private sector associations (e.g. the EU and CEMBUREAU) plays a crucial role in enhancing credibility, building awareness, and driving industry change
- The use of online channels enables quick and easy access to information for both public and private sectors
- Tailor language and messaging to meet the needs of target audiences (e.g., the EU workshop was hosted in multiple languages across different member states)



To build a resilient workforce for sustainability in cement and concrete industry, the government can help bridge skill gaps and promote diversity & inclusion

Strategic government actions to enhance workforce resilience in the cement and concrete industry

To enable a **Just Energy Transition**

A Just Energy Transition Plan (JETP) is a framework that ensures the shift from fossil fuels to renewable energy is fair, inclusive, and equitable. It focuses on economic development, job creation, social inclusion, and environmental protection while minimizing the negative impacts on communities that rely on fossil fuel-based industries.





Bridging skill gaps to enhance competitiveness

Discrepancy in existing skills of workforce and required skills for the cement and concrete industry could result in a shortfall of qualified workers – skill gaps must be addressed promptly to ensure workforce resilience and industry sustainability

Enhancing workforce diversity & inclusion

Jobs in cement and concrete industry are typically male dominated with limited women's participation – increasing diversity can enhance productivity and innovation



To prepare the workforce, training initiatives focused on upskilling and reskilling soft skills and technical skills are crucial for the cement and concrete industry

Overview of social and workforce development

Training Models



Private-sector-led training programs (e.g. cement associations)



Government-driven training programs



University and/ or academic training courses with certification



Cross-sector integration: Collaboration between public, private, NGO, and academic institutions

Key Skills to Prioritize for Development

Soft skills

Required across the labor force

- Environmental awareness and attitude
- Adaptability and transferability skills
- Teamwork skills
- Communication and negotiation skills
- Entrepreneurial skills
- Occupational safety and health (OSH)
- Gender equality awareness and practice skills

Technical skills

- Basic construction technology skills (e.g., low-carbon materials usage)
- Understanding of **regulatory compliance** (e.g., knowledge of local and international green building standards)
- Advocacy and marketing skills

Required in medium to high-skilled occupations

- Environmental awareness and attitude
- Strategic and inclusive leadership skills
- Coordination, management and business skills
- Analytical thinking (incl. risk and systems analysis)
- Adaptability skills
- Consulting skills to advise consumers
- Networking, ICT, and language skills
- Stakeholder connection skills
- Gender equality awareness and practice skills

- **Construction techniques** for reducing environmental impact (e.g., circular construction)
- New product technology knowledge (e.g., carbon-capture technology, energy-efficient systems, CCUS technologies)
- Understanding in policy and regulations (e.g., construction and environmental regulations for promoting the use of C&D waste)
- Understanding in green finance and carbon market knowledge (e.g., carbon credit, ETS)



Public and private entities typically offer trainings for various audiences, with diverse formats and content depth aimed at enhancing green skills

Selected examples of workforce development programs in benchmarked countries

	EU	US	🙌 Canada	China	Mexico	
Program:	Pact for Skills	ACI University	Training Course Partnership	Master's Program in Green Environmental Infrastructure	CEMEX University	
Organizing entity:	European Commission	American Concrete Institute Always advancing	SUSTAINABLE Cement Association of Canada Royal Roads UNIVERSITY	消華大学深圳国际研究生院 Tsinghua Shenzhen International Graduate School	// CEMEX	
Selected training courses:	 Green Skills for the Construction Sector Circular Economy for Workers in Manufacturing Sustainable Energy Solutions Pact for Skills Roundtable with Commissioners Schmit and Breton for the Construction Ecosystem 	 Certification - Cement Physical Tester Certification - Construction / Specialist Programs Concrete with Recycled Materials Sustainable Concrete: Practices and Pathways 	 Collaborative Leadership for Climate Action Climate Action & Transition Leadership Climate Action for Nonprofit Leaders Youth Environmental Leaders Learning Lab 	 Research on Internationalized Environmental Issues Green Building Strategies for Infrastructure Projects Energy-Efficient Urban Planning 	 Introduction to Sustainable Construction Sustainable Concrete Solutions Sustainable Finance for SMEs Impact Measurement and Reporting and many more	
Format:	Webinars , Online modules	Online modules, Webinars, Certificate programs, In- person seminars	Online workshops, Online modules, In-person training	Master's program (incl. Lectures, case study presentations)	Online modules	
Tuition fee:	Free of charge	USD 900 - 1,000	USD 120 – 520 ¹⁾	USD 8,015 per year ²⁾	USD 0 - 100	
Duration:	4-10 hours per workshop/module	2-4 days per course Deep-di	1 - 2 months per course ve available	Generally required to be completed in 2-3 years	4-10 hours per workshop/module	

¹⁾ CADUSD = 0.69 USD; 2) CNYUSD = 0.14 USD



Case study: Certified training courses attract professionals, while leadership programs can also create a broader impact on workforce development

Selected workforce development programs: ACI and ASI case studies







Designed to upskill technicians for cement industry









Key Programs and Offerings

- On-demand courses and webinars for flexible learning
- **Certification programs and training** for various roles within the concrete industry
- An All-Access 12-month subscription, offering unlimited access to 175+ webinars and 350+ on-demand courses
- It serves as a one-stop shop for education, catering to professionals who want to upskill in areas like mix design, quality control, sustainability, and more

Training Course Partnership





Designed to empower leadership in driving climate action



Selected partners:



















... and many more

Key Programs and Offerings

- Leadership Courses: Online and in-person courses, focusing on Transition Leadership competencies
- **Members Network:** A community of professionals committed to advancing climate action within their organizations
- Custom Engagements: Tailored support for organizations
- Research Projects: Research on Transition Leadership and climate action workforce development

Key takeaways

- Certified courses attract professionals seeking official recognition and credibility
- A variety of courses, from concrete mix design to sustainability, positions the platform as a one-stop service for professionals in the cement industry
- Leadership competencies in collaborative leadership, strategic futures, and inclusion equip leaders to drive sustainability
- Diverse sector partnerships expand the range of leadership courses available across multiple industries

Source: ACI, ASI, Roland Berger



Male dominance in employment within the cement and concrete industry is widespread globally and can be observed among leading companies

Percentage of female employees of major cement players in benchmarked countries, 2023 [%]



1) The share of women in senior management; 2) Percentage of female global employees



Promoting gender diversity in the cement and concrete industry requires social awareness, mentorship, STEM education, apprenticeship programs for women

Current challenges and way forward for enhancing gender equality in the cement and concrete industry

Current challenges

Proposed solutions

Examples

Cultural norms & mindsets

The cement and concrete industry is perceived as male-dominated, with strong stereotypes about women's roles



Social dialogues to raise awareness

Organize discussions to challenge gender stereotypes and promote women's participation across the industry



Panel discussion at the World Cement Association: Experts from Sinoma International, JK Cement, and others shared strategies to boost women's representation in the cement industry

Underrepresentation in leadership

Women are underrepresented in leadership roles in the industry especially at the C-level



Mentorship programs for women

Develop initiatives to prepare women for leadership by building skills and networks for C-level roles



Lafarge Canada mentorship program: Lafarge Canada supports women's leadership development, fostering confidence and driving lasting organizational change

Limited access to STEM¹⁾ education

Few women pursue STEM fields relevant to the cement industry, resulting in a lack of skilled female professionals



Funding for women's STEM1) education

Provide scholarships, financial support, and industry-specific training programs to encourage more women in STEM¹⁾



SWE²⁾ **Scholarship Program:** The Society of Women Engineers grants over USD 1 m annually to support women in STEM education and engineering careers

Limited recruitment strategies

Efforts to recruit and retain women, especially in technical roles, remain minimal in the cement and concrete sectors



Apprenticeship programs and conversions

Require companies to create apprenticeships and conversion opportunities, providing women with hands-on experience and pathways to permanent roles



Southern California Cement Masons Apprenticeship: This program offers women hands-on training, safety skills, wages, and career advancement in cement and concrete work

Mismatched working conditions

Women often bear greater household and childcare responsibilities, limiting workforce participation



Flexible work policies

Mandate flexible work policies, such as remote work and adjustable hours, to help women balance household and childcare duties with professional responsibilities



Family and Medical Leave Act (FMLA): The act offers up to 12 weeks of unpaid leave for maternity, caregiving, or personal health reasons for women and applies broadly to all sectors, including the cement and concrete industry

¹⁾ science, technology, engineering, and mathematics; 2) Society of Women Engineers

Summary of key findings (1/3):

Enablers for a comprehensive policy framework in cement & concrete decarbonization

Overview of key enablers

What are the key enablers and why are they important?

- Infrastructure development Enables economy of scale, reduces costs, and accelerates implementation through shared and optimized infrastructure solutions
- Institutional structure Ensures clarity in roles, responsibilities, and coordination for seamless policy implementation
- Monitoring, reporting, and verification (MRV) Facilitates evidence-based policymaking, enhances transparency, and builds stakeholder trust
- Multi-stakeholder collaboration Leverages resources, addresses policy complexity, and accelerates sustainable practice adoption
- Promotion of sector & market awareness Increases demand for low-carbon alternatives and builds public and industry support
- Social and workforce development Supports the transition through reskilling, upskilling, and promoting public acceptance of the benefits

Infrastructure development

What types of infrastructure investments are required from governments to support emissions reduction in the cement and concrete industry?

Government investment is required in high-CapEx infrastructure including:

- Carbon Capture, Utilization and Storage (CCUS): Shared CO2 hubs, terminals, and CO2 transport and storage networks
- Renewable energy: Utility-scale renewable generation and grid modernization to power low-carbon operations
- Circular economy infrastructure: Facilities like Waste-to-Energy (WtE) plants to enable alternative fuels and materials

Which entities or sectors are responsible for investing in and managing green infrastructure?

Green infrastructure is often managed through **public-private joint ventures**, with government and industry co-investing. Governments provide regulatory support, while private operators manage operations under a tariff-based, consumption-driven model

Institutional structure

What are the key roles and responsibilities of the government in driving emissions reduction within the cement and concrete industry?

- Setting strategic direction Establish overarching national decarbonization goals and strategic frameworks
- Regulatory framework & policy development Develop and enact legislation, including emission standards, carbon pricing, and low-carbon mandates
- Policy implementation & enforcement Oversee policy execution, ensure effective implementation, and track progress through monitoring and verification
- Financial instruments & investment facilitation Facilitate funding, incentives, and green bonds to drive investment in sustainable technologies
- Research & innovation development Research, develop, and scale innovative technologies
- Workforce & social development Implement initiatives to reskill and upskill the workforce, preparing for green jobs in the decarbonized sector

What type of government bodies undertake the key roles & responsibilities?

The type of government bodies are ministries, regulatory agencies, financial institutions, and research bodies

Source: Roland Berger

Summary of key findings (2/3):

Enablers for a comprehensive policy framework in cement & concrete decarbonization

Monitoring, reporting, and verification

What is MRV, and why is it crucial for supporting emissions reduction in the cement and concrete industry?

MRV is a system for tracking, reporting, and verifying emissions data to ensure transparency, accountability, and compliance with climate commitments, enabling informed decision-making and progress monitoring

What are the key dimensions to consider in designing and implementing an effective MRV system?

Key dimensions include disclosure frequency, entities required to disclose, measured data, reported content, and content to be verified

Which entities are responsible for overseeing and managing MRV system?

- National level: e.g., Government agencies and provincial/local government bodies
- Organizational level: e.g., Cement manufacturers
- Facility level: e.g., Environmental compliance units at individual facilities, undergoing verification by third-party accredited verifiers

Multistakeholder collaboration

Which key stakeholders are involved in emissions reduction efforts in the cement and concrete sector?

Key stakeholders incl. government, international organizations, academia/research institutes, financial institutions, and private-sector businesses/ industrial associations

What are the various ways stakeholders collaborate to drive emissions reduction in the cement and concrete industry?

Stakeholders collaborate through setting strategic direction, regulatory and policy development, policy implementation, financial and investment support, research and development, as well as workforce and social development

What are the roles and responsibilities of stakeholders in the context of collaboration for emissions reduction in the cement and concrete industry?

There are 3 main roles and responsibilities – stakeholders can serve as knowledge and strategy partners, implementation partners, and resource and support partners

Source: Roland Berger

Summary of key findings (3/3):

Enablers for a comprehensive policy framework in cement & concrete decarbonization

Promotion of sector & market awareness

Why is raising awareness important, and what are the key messages that need to be communicated and promoted?

Raising awareness is crucial for driving sustainability and encouraging action. The key messages that need to be communicated and promoted are decarbonization national strategies and regulations, benefits of low-carbon alternatives, green financing opportunities, emerging technologies and innovations, and global best practices

What communication channels are available and most effective for raising awareness of low-carbon alternatives in the cement and concrete sector?

The most effective communication are government platforms, industry events and conferences, digital platforms, and publications and reports

What are the specific objectives of various communication efforts, and which entities are involved?

- **Objectives**: Build partnerships, raise awareness, promote green financing and technologies, educate industry leaders and the public
- Entities: Government, private Sector, financial Institutions, academia, NGOs

Social and workforce development

What are different ways the government can help drive social and workforce development to enable a Just Energy Transition?

The government can help **bridge skill gaps** and **promote diversity and inclusion** to build a resilient workforce for sustainability in the cement and concrete industry to enable a Just Energy Transition

What key workforce skills are essential for driving emissions reductions in the cement and concrete industry?

- Soft Skills: Environmental awareness, adaptability, teamwork, communication, leadership, coordination, and analytical thinking
- Technical Skills: Construction tech, regulatory compliance, advocacy, circular construction, green finance, and CCUS

How can the government facilitate the development of these skills?

The government can facilitate the development of these skills by developing training programs, promoting certification, providing financial support, collaborating with the private sector, and raising awareness

What is the current status of gender equality in the cement and concrete industry?

The cement and concrete industry remains **predominantly male-dominated worldwide**, with women constituting approximately 10% to 20% of the total workforce, highlighting the significant gender disparity in the cement and concrete workforce

How can the government help promote gender equality in the workforce?

To promote gender diversity in the cement industry, the government can drive initiatives that raise social awareness, implement mentorship programs, support STEM education for women, and encourage apprenticeship programs. These efforts empower women, foster career development, and create pathways for leadership roles in the industry

Source: Roland Berger | 173

Key learnings and success factors:

Enablers for a comprehensive policy framework in cement & concrete decarbonization



- Targeted, phased investment approach: Prioritize high-emission clusters with strong capture potential to maximize early impact and cost-efficiency
- Integrated infrastructure planning: Map capture, transport, and storage sites to reduce CO2 transport distances and unlock synergies
- Cluster-based development model: Enable shared infrastructure across sectors (e.g., cement and petrochemical) to reduce unit costs and leverage economies of scale
- Public-private joint financing: Mobilize capital through PPPs or joint ventures, with government participation de-risking private investment and accelerating implementation



- Clear roles and responsibilities and mutual understanding: Prevents overlap and alignment on objectives to reduce conflicts
- Strong regulatory framework: Enacts clear, comprehensive legislation to empower agencies and ensure a level playing field
- National vs. local alignment: Ensures collaboration between national strategies and local-level execution to prevent overlapping efforts and gaps
- Independent oversight: Establishes independent regulatory bodies to oversee compliance, strengthening governance



- Consistent methodologies and realtime integration: Standardize MRV systems across sectors and integrate real-time data for accuracy
- 3-level stakeholder coordination: Coordinate across facility, organizational, and national levels to ensure comprehensive data
- Targeting large emitters: Focus on mandatory compliance for major emitters under the 80/20 principle
- Mandatory independent verification: Ensure transparency with verification by independent or accredited thirdparty verifiers
- Robust data management systems:
 Ensure data accessibility for others to leverage in identifying reduction opportunities and guiding policy decisions



- Government as a central coordinator: Serve as the key point to align sectors and drive carbon emissions reduction
- Clear collaboration structure: Define a shared and realistic structure to guide multi-sector cooperation
- Joint roadmaps and milestones:
 Develop coordinated timelines and goals to unify efforts across stakeholders
- Efficient communication and data sharing: Foster frequent communication to ensure accurate data exchange and alignment on key elements



- Clear objectives for communication: Set clear communication goals to determine key messages and select the appropriate methods and channels
- Credible regulatory communications:
 Have regulatory bodies communicate directly to increase trust and credibility
- Online channels for quick access: Leverage digital platforms for easy, upto-date access to information
- Collaboration with industrial associations: Partner to improve access and enhance credibility with the private sector
- Tailored communication: Adjust language to suit the target audience, such as foreign investors



- Identify labor market skill needs:
 Pinpoint the skills required to develop both soft and technical skills effectively
- Accredited programs: Offer certified or accredited programs to attract more professionals
- Leadership competencies training: Train leaders at all levels, focusing on collaborative leadership and strategic leadership for sustainability
- Collaboration with educational institutions: Work with universities to develop advanced courses for technicians and professionals
- Enhancing workforce diversity & inclusion: Increasing female participation in the industry can improve productivity and foster innovation

Source: Roland Berger



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www.DecarbonizeThaiCementConcrete.org



Decarbonizing Thailand's Cement and Concrete Sectors